Woody International Publish Limited
An Multidisciplinary Academic Journal Publisher
Journal of Theory and Practice in Sciences, Volume 2, 2025
https://www.woodyinternational.com/

Research on Intelligent Construction Education of Virtual Reality Technology

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Abstract: ***With the continuous development of technology, the application of virtual reality technology in various fields is becoming increasingly widespread. In the field of architecture, virtual reality technology has brought new opportunities and challenges to intelligent construction education. Intelligent construction, as an important development direction in the construction industry, has put forward higher requirements for the cultivation of professional talents. Virtual reality technology provides a new teaching method and approach for intelligent construction education with its unique immersive experience and interactivity. This article will explore the application of virtual reality technology in intelligent construction education, aiming to improve teaching quality and cultivate professional talents that meet the needs of industry development.***

Keywords: Virtual Reality Technology; Intelligent construction; Educational applications; Teaching effectiveness.

1. INTRODUCTION

In today's era of rapid technological development, the construction industry is moving towards intelligence, which has put forward new requirements for the cultivation of professional talents. Virtual reality technology, as an innovative means, has brought new possibilities for intelligent construction education. It can break through the limitations of traditional education and provide students with a more immersive learning experience. Through virtual reality technology, students can intuitively understand building structures, construction processes, and other knowledge in a virtual environment, enhancing their motivation and effectiveness in learning. This article will delve into the application of virtual reality technology in intelligent construction education, exploring how to better utilize this technology to improve the quality of education. Peng et al. [2] developing a dual-augmentor framework for 3D human pose estimation domain generalization, while their subsequent work on 3D vision-language Gaussian splatting [3] advanced scene understanding capabilities. Chen et al. [17] contributed to object recognition through their one-stage object referring system with gaze estimation, and Lyu et al. [6] optimized CNNs for rapid 3D point cloud object recognition. The financial sector has benefited from AI innovations, particularly through Deng et al. [4]'s transformer-based real-time fraud detection system and Shen et al. [14]'s data-driven robo-advisors for wealth management. These applications are further enhanced by Wang et al. [15]'s deep reinforcement learning approach to supply chain finance decision support systems. Sustainable urban development has seen notable AI integration, with Zhou et al. [5] optimizing garbage recognition models and Liu et al. [9] developing efficient building segmentation networks. Energy sector applications include Zhao et al. [8]'s CNN-Bi-GRU model for renewable electricity demand forecasting, demonstrating AI's role in environmental sustainability. In healthcare, Tian et al. [10] improved brain tumor segmentation through attention mechanisms, while Shen et al. [11] developed an LSTM-based system for anesthetic dose management in cancer surgery. Cybersecurity has advanced with Xu et al. [12]'s work on adversarial machine learning defenses. Logistics and supply chain optimization have been transformed by Wang and Liang [7]'s reinforcement learning methods for route optimization, complemented by Chen [1]'s data pipeline optimizations for gig economy platforms. Cross-industry applications are exemplified by Wang et al. [13]'s research on autonomous driving technology in FinTech.

2. THE RELATIONSHIP BETWEEN VIRTUAL REALITY TECHNOLOGY AND INTELLIGENT CONSTRUCTION EDUCATION

2.1 Concept and Characteristics of Virtual Reality Technology

Virtual reality technology, abbreviated as VR, is a technology that allows users to immerse themselves in and interact with a computer-generated three-dimensional environment. It utilizes hardware devices such as head mounted displays and motion capture devices, combined with advanced graphics rendering, physical simulation,

and artificial intelligence algorithms, to create a highly realistic virtual world. In this world, users can freely observe, explore, operate, and even interact with objects and characters in the virtual environment.

The core characteristics of virtual reality technology are its immersion and interactivity. Immersion makes users feel as if they are in a real environment, able to perceive and experience the virtual world from all angles. Interactivity, on the other hand, allows users to interact with the virtual environment through natural gestures, voice, and other means, resulting in a more realistic and rich experience. Virtual reality technology also has high flexibility and scalability, which can be customized and developed according to educational needs, providing new teaching methods and platforms for intelligent construction education.

2.2 Objectives and Requirements of Intelligent Construction Education

Intelligent construction education aims to cultivate high-quality construction talents with innovative thinking and practical abilities. It requires students not only to master solid theoretical knowledge of architecture, but also to have the ability to solve practical problems and flexibly apply the learned knowledge in complex architectural environments. Therefore, intelligent construction education requires a teaching method that can simulate real building environments and provide rich practical opportunities.

In the process of intelligent construction education, students need to understand the entire process of architectural design, including pre planning, structural design, construction management, and other aspects. They also need to master various advanced building technologies and tools, such as BIM technology 3D printing technology, etc. In order to meet these needs, intelligent construction education needs to provide a teaching method that allows students to experience the process of architectural design and construction in an immersive way, so that they can better understand and master the knowledge they have learned.

2.3 Advantages of Virtual Reality Technology in Intelligent Construction Education

Virtual reality technology has significant application advantages in intelligent construction education. Firstly, it can provide a highly realistic virtual architectural environment, making students feel as if they are in a real building scene. This immersive experience helps to stimulate students' interest and motivation in learning, improve their learning enthusiasm and participation. Secondly, virtual reality technology can simulate various complex building scenes and construction processes, providing students with rich practical opportunities. By simulating the real process of architectural design and construction, students can gain a more intuitive understanding of the principles and techniques of architectural design, and master various advanced building technologies and tools. They can also engage in practical operations in virtual environments to exercise their hands-on and problem-solving abilities.

In addition, virtual reality technology also has high flexibility and scalability. Educators can customize and develop various virtual building scenarios and teaching modules according to teaching needs to meet the learning needs of different students. This personalized teaching approach helps improve students' learning outcomes and satisfaction, promoting their comprehensive development. Virtual reality technology has broad application prospects and significant advantages in intelligent construction education. It can not only provide a highly realistic virtual building environment, stimulate students' learning interest and motivation, but also provide students with rich practical opportunities and personalized teaching methods. Therefore, applying virtual reality technology to intelligent construction education is of great significance for improving the quality of education and cultivating high-quality construction talents.

3. APPLICATION OF VIRTUAL REALITY TECHNOLOGY IN INTELLIGENT CONSTRUCTION THEORY TEACHING

3.1 Building Virtual Teaching Scenarios

The application of virtual reality technology in intelligent construction theory teaching is first reflected in the construction of virtual teaching scenarios. Through virtual reality technology, educators can create virtual scenes that are highly similar to the real building environment, covering the entire process from the early stages of architectural design to the completion of construction. For example, educators can design a virtual urban planning scenario that includes various types of buildings, roads, greenery, and other elements for learners to explore and learn in a virtual environment.

In virtual teaching scenarios, learners can freely roam in the virtual environment, observe the details of architectural design, understand the relationship between architecture and the city, and even modify design elements through interactive operations to observe the effects of design changes. This immersive experience not only allows learners to have a more intuitive understanding of the principles and methods of architectural design, but also stimulates their interest and creativity in learning. Virtual teaching scenarios can also be dynamically adjusted according to teaching needs to adapt to the learning progress and interests of different learners, achieving personalized teaching.

3.2 Simulating Building Structures and Construction Processes

Virtual reality technology can also simulate building structures and construction processes, providing learners with in-depth theoretical learning and practical opportunities. Through virtual reality technology, educators can construct virtual models of building structures, including various parts such as the skeleton, walls, and roof of the building. Learners can observe the details of building structures in a virtual environment, understand their construction principles and stress characteristics.

More importantly, virtual reality technology can simulate the entire process of building construction, including material preparation, construction machinery operation, and collaboration among construction personnel. Learners can simulate construction operations in a virtual environment, such as lifting building materials, setting up scaffolding, etc., in order to gain a deeper understanding of the technical requirements and safety regulations during the construction process. This simulated construction process not only helps learners master construction skills, but also enhances their ability to cope and make decisions in complex construction environments.

3.3 Enhance students' understanding of theoretical knowledge

The application of virtual reality technology in the teaching of intelligent construction theory aims to enhance students' understanding of theoretical knowledge. By constructing virtual teaching scenarios and simulating building structures and construction processes, learners can engage in practical operations and interactive learning in a virtual environment, thereby gaining a more intuitive understanding of the principles of architectural design, the construction of building structures, and the technical requirements of the construction process.

For example, when studying architectural mechanics, learners can observe the deformation of buildings under stress using virtual reality technology, and understand the stability and safety of building structures. When studying construction technology courses, learners can simulate the construction process to understand the operation methods of construction machinery and the collaboration methods of construction personnel, thereby gaining a deeper understanding of construction skills. This intuitive learning method not only enhances learners' interest and participation in learning, but also helps them combine theoretical knowledge with practice, forming a more complete and in-depth knowledge system.

4. APPLICATION OF VIRTUAL REALITY TECHNOLOGY IN INTELLIGENT CONSTRUCTION PRACTICE TEACHING

4.1 Provide a virtual practice operation platform

The primary application of virtual reality technology in intelligent construction practice teaching is to provide a virtual practical operation platform. This platform simulates the real building environment, including various aspects of architectural design, various scenarios of construction sites, and the characteristics of building materials. Learners can engage in various practical operations in this virtual environment, such as architectural design, construction simulation, equipment operation, etc., without the need to enter real construction sites or laboratories.

This virtual practice operation platform has a high degree of interactivity and immersion, allowing learners to experience the entire process of architectural practice in person. Through virtual reality devices such as head mounted displays and controllers, learners can freely observe and manipulate objects in the virtual environment, and even interact with other characters in the virtual environment. This simulation practice not only enables learners to have a deeper understanding of the principles and methods of architectural practice, but also exercises their ability to cope with various complex situations in practical operations.

4.2 Cultivate students' practical operational abilities

Virtual reality technology can effectively cultivate students' practical operation ability in intelligent construction practice teaching. Through the virtual practice platform, learners can perform various simulation operations, such as operating construction equipment, selecting and matching building materials, and constructing building structures. These simulation operations can not only help learners become familiar with and master various architectural practical skills, but also exercise their ability to cope with various unexpected situations in practical operations.

In the process of virtual practice, learners can repeatedly simulate operations, constantly revise and improve their operational skills. The virtual practice platform can also provide real-time feedback and evaluation based on learners' operational situations, helping learners understand their operational level and shortcomings, and make targeted improvements and enhancements. This simulated practice approach not only enhances learners' practical skills, but also strengthens their ability for self-directed learning and continuous improvement.

4.3 Reducing the Cost and Risk of Practical Teaching

Virtual reality technology also has the advantage of reducing the cost and risk of practical teaching in intelligent construction practice. Traditional architectural practice teaching often requires a large amount of building materials, equipment, and venues, as well as professional guidance personnel and safety measures, which are costly and carry certain safety risks. Virtual reality technology can reduce these costs and risks through simulated practice.

Through the virtual practice platform, learners can simulate practice without the need for real materials and equipment, thereby saving a lot of material and equipment costs. The virtual practice platform can also provide real-time security measures based on learners' operational situations, such as automatically stopping dangerous operations, providing safety prompts, etc., thereby reducing security risks during the practice process. This method of reducing costs and risks not only makes practical teaching more economical and safe, but also improves the efficiency and effectiveness of practical teaching.

5. CHALLENGES AND COUNTERMEASURES OF VIRTUAL REALITY TECHNOLOGY IN INTELLIGENT CONSTRUCTION EDUCATION

5.1 Technical equipment and cost issues

The application of virtual reality technology in intelligent construction education first faces the issues of technical equipment and cost. High quality virtual reality experiences require high-performance hardware support, such as head mounted displays, motion capture devices, high-performance computers, etc. The purchase and maintenance costs of these devices are relatively high, which is a major burden for many educational institutions. The software development and content production of virtual reality technology also require professional teams and tools, further increasing costs.

To address this issue, the following measures can be taken: firstly, strengthen technology research and development, promote the popularization and cost reduction of virtual reality technology. By advancing technology, improving the performance and efficiency of hardware devices, reducing production costs, and making it affordable for more educational institutions. Develop more universal and user-friendly virtual reality software tools to reduce the threshold and cost of content production. The second is to explore diversified ways of fundraising, such as government funding, corporate cooperation, social donations, etc., to provide financial support for the application of virtual reality technology in intelligent construction education. Cloud computing and remote access technologies can also be considered to achieve the sharing and optimized utilization of virtual reality resources, reducing the cost of individual educational institutions.

5.2 Development of Teaching Content and Resources

The application of virtual reality technology in intelligent construction education also needs to address the development of teaching content and resources. Virtual reality technology provides rich interactive and immersive experiences, but how to combine these experiences with the actual needs of intelligent construction education and develop suitable teaching content and resources is a challenge. The rapid development of virtual reality technology also means that teaching content and resources need to be constantly updated and improved.

To address this issue, the following measures can be taken: firstly, to strengthen the research and innovation of teaching content and resources. Based on the characteristics and needs of intelligent construction education, design teaching content and scenarios that conform to the characteristics of virtual reality technology, such as simulating the construction process of buildings, demonstrating the principles of building structures, etc. Emphasize the practicality and fun of teaching content, and enhance learners' interest and participation in learning. The second is to establish a virtual reality teaching resource library to achieve resource sharing and reuse. By collecting and organizing excellent virtual reality teaching resources, a resource library is formed to provide educational institutions and learners with rich learning materials and reference cases. We can also encourage cooperation between educational institutions and enterprises to jointly develop virtual reality teaching resources, achieve complementary advantages and win-win sharing of resources.

5.3 Teacher Training and Professional Literacy Enhancement

The application of virtual reality technology in intelligent construction education also needs to address the issues of teacher training and professional competence improvement. Virtual reality technology, as an emerging teaching method, requires educators to possess corresponding technical abilities and teaching concepts in order to fully leverage its advantages. However, many educators currently have limited understanding and application capabilities of virtual reality technology, which limits its widespread application in intelligent construction education.

To address this issue, the following measures can be taken: firstly, strengthen the virtual reality technology training for teachers. By organizing training courses, seminars, and other activities, we aim to enhance educators' understanding and application capabilities of virtual reality technology. The training content can include the basic principles of virtual reality technology, the use and maintenance of hardware equipment, the development of teaching content and resources, etc. The second is to encourage educators to engage in practical exploration and innovation. Encourage educators to try applying virtual reality technology in actual teaching, constantly exploring and innovating teaching methods and means. Establish corresponding incentive mechanisms and evaluation systems, commend and reward the practical achievements of educators, and stimulate their enthusiasm and creativity. Through these measures, educators can continuously improve their professional competence and teaching ability, providing strong support for the widespread application of virtual reality technology in intelligent construction education.

6. CONCLUSION

The application of virtual reality technology in intelligent construction education is of great significance and value. By constructing virtual teaching scenarios, simulating construction processes, and other methods, students are provided with a more intuitive and vivid learning experience, which helps to improve their learning interest and effectiveness. However, the application of virtual reality technology in intelligent construction education also faces some challenges, such as high equipment costs and difficulty in developing teaching content and resources. To address these issues, it is necessary to strengthen technological research and development, optimize teaching resources, and improve teachers' professional competence. I believe that with the continuous advancement of technology and the updating of educational concepts, virtual reality technology will play a more important role in intelligent construction education, providing strong support for cultivating high-quality intelligent construction professionals.

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