

Integration of Digital Virtual Reality Technology and Architecture Course in College

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Received: 27 July 2023; Accepted: 18 August 2023; Published: 17 October 2023

Abstract:

The teaching method of the traditional building construction courses are limited by many factors such as time, space and safety, which affect the teaching effect of the course. With the rapid development of VR technology, its immersive and virtual operation characteristics provide new teaching ideas for building construction courses, and the introduction of virtual reality technology can greatly solve related problems, enrich teaching resources, and create an interactive learning environment. This new teaching method can effectively improve students' interest and learning efficiency, and improve the teaching effect of teachers.

Keywords:

VR Technology, System Architecture, Interactive Advantages

1. Introduction

Virtual reality technology (VR) is a comprehensive use of digital technology, through interactive devices can allow people to get an immersive experience in the virtual environment, and allow users to interact in the virtual environment. Professional teaching in colleges highlights comprehensive knowledge application and ability training. The practical teaching emphasizes the application scenarios that can reflect the complex dimensions, and it is difficult for conventional internships and practical conditions to meet the talent training needs in this regard. [1] Through VR technology, creating suitable internship practice conditions in a virtual environment is a reasonable solution.

Architecture is a profession that emphasizes practicality, but the construction of an architectural project from blueprint to practical work is a complex process of building. [2] Under normal conditions, it is impossible for colleges to find a suitable practice environment at the time, economic, social and other dimension. In the current teaching, the internship and practical courses of the architecture major are mainly based on on-site surveying and drawing practice, and there is almost no real internship involved in the construction process of the building. Therefore, virtual simulation practice through VR technology can solve this problem well. In particular, under the

relatively mature and cheap conditions of virtual founder technology and its hardware products, it is possible to apply virtual simulation technology in the teaching of architecture.

2. Advantages of VR Technology in Practical Courses

2.1. Breaking the limitations of time and place

Time and space were unfavorable factors that limited construction training, and traditional training could only divide the building into several components. The parts are isolated from each other, and it was difficult for students to form a holistic cognition. In addition, building construction was a time-consuming process, and students could learn about the construction methods, techniques and management of the entire building in the construction site internship, which cannot match the traditional professional teaching. Using VR technology, it was possible to teach theory while showing students the relationship between the parts and making them feel the process of building construction. Moreover, the VR equipment was moderate in size and easy to operate, so even after class, students could easily experience it, deepened their impression of the building structure, and improved learning efficiency. The use of information technology could also record the records generated in teaching and training, helping teachers and students found the effectiveness of teaching to improve the quality of teaching.

2.2. Combination of theory and practice

The purpose of building construction training was to help students better understand the relevant detailed construction knowledge so that they can be proficient in future studies and even work. However, due to constraints such as venue, time, funding and safety issues, most institutions only be arranged students for theoretical study. This kind of internship was often arranged in the short semester of teaching in the summer, and students were guided by instructors to conduct a superficial visit to the construction site. It was difficult to impress students in this way, which was contrary to the purpose of the course. VR technology could make it possible to fully simulate engineering practice, and only a very small cost can realize the connection between theoretical experiments and actual engineering practice.

2.3. The teaching content follows the times

According to the characteristics of the building construction course, the advantages of VR technology, combined with the Internet, enabled teachers to display the latest materials and structural nodes in the current society in front of students through VR technology, and improve students' professional quality and enthusiasm for learning. By this method, teachers could keep abreast of students' learning situation, difficulties of leaning and shortcomings, and carry out targeted teaching and training in combination with teaching priorities. At the same time, the content of teaching could be adjusted according to the status of the students.

The virtual simulation system could also be connected to the Internet, allowing students to practice on their own during or after class. In this way, "self-study - in-class guidance - after-class review" could be integrated into one system at the same time. Student learning and training were mainly completed outside the classroom, achieving the effect of "flipped classroom". The Internet access system could also provide a virtual place for students from other majors or other schools to learn and

train, realizing the unity of open online teaching and exclusive teaching. In a sense, this could be used as a technical means to implement the Massive Open Online Course(MOOC) and Small Private Online Course(SPOC).

3. Advantages of VR Technology in Practical Courses

3.1. Not limited by time and place

Time and space are unfavorable factors that limited construction training, and traditional training could only divide the building into several components. The parts were isolated from each other, and it was difficult for students to form a holistic cognition. Using VR technology, it was possible to teach theory while showing students the relationship between the parts and making them feel the process of building construction. Moreover, the VR equipment was moderate in size and easy to operate, so even after class, students could easily experience it, deepened their impression of the building structure, and improved learning efficiency.

We created a simulation system of building construction that allowed students to learn the basic building construction process in a virtual environment. In the program, students could choose different basic materials according to the content of the training, such as walls, floors, doors, windows and roofs. Then, according to the building construction requirements and specifications, more building construction requirements and specifications was chosen by different envelope materials, waterproof materials, protective materials, thermal insulation materials and decorative materials. The program could determine whether the student's choice meets the requirements of the specification, such as whether the type of material, whether the thickness of the material, and what order of the material was correct. In addition, the program also could require students to use different construction gestures according to the properties of the material to simulate the construction process.

3.2. Combination of theory and practice

The purpose of building construction training was to help students better understand the relevant detailed construction knowledge so that they can be proficient in future studies and even work. However, due to constraints such as venue, time, funding and safety issues, most institutions only arranged students for theoretical study. This was contrary to the purpose of the course. VR technology made it possible to fully simulate engineering practice, and only a very small cost can realize the connection between theoretical experiments and actual engineering practice.

Through our virtual simulation system, 20 students could learn and simulate building construction in the classroom at the same time. During the training process, the program could assist the teacher in pointing out the student's mistakes and correcting them. Without this virtual simulation program, it would be difficult to find a place for practical training in reality, and it would be impossible to correct students' mistakes at any time.

3.3. The teaching content follows the times

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The virtual simulation system has an open architecture, which can add new technologies and materials to the database according to market changes and technological developments, and delete outdated technologies and materials, ensuring that students can understand the latest industry information and professional knowledge. In the period of rapid development of energy-saving technology and new materials, the materials and practices in teaching materials could no longer keep up with technological changes. Through the development and use of the corresponding system, students could keep abreast of the construction technology and building materials currently in use.

4. Feasibility of VR Technology Application

In view of the dilemma of building construction courses, it was aimed to the key points and difficulties of teaching practice, build a construction and materials database based on students' learning behavior patterns through technology development, and used Unity 3D engine's interface to read database data as virtual reality resources, which will be in line with the practical way to virtually practice the building or building part construction process of interactive experimental platform. To meet the teaching needs of the theory and practice of building construction courses.

Supported by the Zhejiang Province College Students Science and Technology Innovation Activity Plan (Xing Miao) and the project of Zhejiang Province Association of Higher Education, we developed a virtual simulation system for building structure training. The system was used the Unity 3D engine, which allowed students to actively select different building materials and construction practices according to different construction nodes, and used the joystick to choose the construction in the virtual environment. At the same time, the system was provided error prompt function according to the needs of teaching, helping students understand whether the simulation results are correct in real time.

4.1. Overall architecture of system development

The work content was included system process formulation and UI design, database design and entry. The database was included key information such as the relationship between building materials and construction, the characteristics of materials, engineering requirements, etc., and had high scalability, which could provide an open architecture for the future development of new construction practices and materials, and finally realize a virtual experimental platform for building structure and materials that reflected immersion, interaction and scalability, and was applied to classroom teaching, through the analysis and research of classroom teaching data, improved the quality of teaching, and provided a new framework and choice for future architectural theory courses.

The schema of the database was adopt a conditional data structure, and the main table contains the following fields, material type, material name, material thermal performance, material waterproof performance, waterproof material, thermal insulation material, decorative material, material compatibility, material thickness, and mounting accessories. The attached table was contained material compatibility, material hierarchy, interior and exterior wall materials, interior and exterior wall order. The software was designed to compare each material when the user performed virtual simulation operation, whether it met the built-in logic, and if an error was found, it could be automatically reminded through the virtual warning sign. At the same time,

the system could record the data of each user's operation on the server, identified the errors that occurred and made reports. Administrators could check the data for each user or for all users of the same simulation. Teachers could retrieve the operation data of each student and the overall data of each experiment through the administrator account, and analyzed the mastery of students at each knowledge point, which could help teachers adjusted the focus and content of the class in time, and improved the pertinence and timeliness of the teaching process.

The development process of the system was paid attention to and was focused on the following points: a) it was provided different simulation scenarios according to different construction nodes; b) Students could actively select different building materials in the system and are able to select different material thicknesses through gestures; c) the system could indicate the correctness of different building structures; d) Server-client system, which was allowed multiple students to conduct simulation training in the system at the same time.

4.2. Data structure construction and process design

According to the teaching content and system of building structure, it is necessary to systematically sort out the key construction types of teaching. The design of building construction experiments takes the teaching focus and difficulties of building construction as the starting point, and then subdivides the structural form according to the roof, and then subdivides each surface layer and the required materials according to the structural form. The data structure needs to solve the data relationship between material properties and construction practices, and provide an appropriate framework for background logic judgment and the extension of new materials and practices.

For the conditional judgment of different construction layers, there are two modes: backgrounder logic processing and data structure. These two modes have their own advantages and disadvantages, the background program workload is small but poor scalability, and the database-specific field logic judgment workload is large but flexible. The architecture of the system needs to consider the scalability of the system and the comprehensive consideration of data volume according to the characteristics of the building construction project.

The project takes virtual practice as the construction goal, hoping to restore the engineering scene to the greatest extent, for different building parts, different structural measures and nodes, the point taking, selection and presentation methods should be presented in the corresponding form, and the virtual reality experiment should be designed accordingly in the operation design.

4.3. The impact of real-world technology on teaching

In recent years, due to the impact of the epidemic, many universities and colleges have adopted or adopted the mode of online teaching, and various online learning platforms have also emerged. After considering the above practical factors, this project was developed a system platform that allows network access, which was not only a practical way for students to provide practical activities, but also provided open teaching materials for online learning. In addition, the software of this project was combined with classroom teaching to vigorously explore new teaching modes, so as to achieve the purpose of improving students' interest and quality of learning, so that teachers and students could operate more conveniently.

The software system was developed and deployed on the BIM Lab server of the Department of Architecture and piloted in exercises in the professional course of the academic year. This system was not officially operated in classroom teaching, but it was carried out in small groups outside the classroom. Students who used this software system in the trial operation generally reflected that they could more intuitively experience the differences in building structure, and could more intuitively understand the composition of different structural levels through virtual means, and the system's prompts could help students better recognize the memory blind spot, which had a certain auxiliary effect on learning. Of course, during the trial operation, some students reported that the virtual simulation environment provided by the system was not realistic enough, and the students had a sense of freshness at the beginning, and their interest waned after a period of operation. Knowledge point error prompts could feedback students in a timely manner, but had limited help for long-term memory of knowledge points.

Considering the different situations of each institution, the software could be operated not only through virtual reality devices, but also only on the computer or mobile phone. Some colleges and universities had a large student base, under such a premise, it was unrealistic to ensure that every student's VR operation was unrealistic, and this project software could operate on multiple platforms and cross-platforms to ensure that every student could complete their studies. In addition, the software had the characteristics of flexible and small area of the required site, which greatly solves the problem of unsafe actual operation of building construction engineering and large site.

5. Conclusions

As a practical course, the building construction course can effectively integrate teaching resources by relying on virtual reality technology. In the process of optimizing teaching, reproducing the construction scene, simulating the construction site construction environment without the influence of time and space for knowledge point explanation, can effectively improve the interaction of the classroom. In the traditional teaching mode, it is only carried out through two-dimensional forms such as pictures and videos, which is difficult to impress students. VR technology can be displayed in three-dimensional space. At the same time, virtual reality technology clearly expresses the relevant structural details, which can accelerate students' impression of knowledge points. Combining virtual reality with the Internet can bring the latest knowledge to the classroom. The operation of VR equipment is simple and easy to use, and students can learn through virtual VR equipment at any time, effectively enhancing students' interest in learning. Similarly, teachers can also break the original traditional teaching mode and use the interactivity of virtual reality technology to diversify teaching forms and improve teaching quality.

Conflicts of Interest

The authors declare that there is no conflict of interest regarding the publication of this article.

Author Contributions

Conceptualization: Wei Zhu; Methodology: Dingshun Huang; Investigation: Dingshun Huang, Yao Tong, Lu Gao; Software: Dingshun Huang; Investigation: Yao

Tong, Lu Gao; Writing – original draft preparation: Dingshun Huang; Writing – review and editing: Yaping Lv, Wei Zhu; Project administration: Wei Zhu.; Funding acquisition: Wei Zhu.

Funding

This work was supported by the Project of Zhejiang Province Association of Higher Education, KT2023136; Project of Zhejiang Province College Students Science and Technology Innovation Activity Plan(Xing Miao), 2021R437004; Zhejiang Province First Class Curriculum Construction Project, Architecture and Digital Technology; Zhejiang Province Curriculum Ideological and Political Model Course Project, Green Architecture and Residential Environment.

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