

Application of BIM and AR technology in teaching reform of building construction technology course

Chuxuan Ren ^{1, a}, Zihong Wan ², Mengting Yuan ¹

¹School of Management, Sichuan University of Science & Engineering, Zigong 643000, China.

²School of Civil Engineering and Architecture, Southwest Petroleum University, Chengdu 610500, China.

^a407881293@qq.com

Abstract

The application of Building Information Modeling (BIM) Technology in the design, construction, operation and maintenance phases of construction engineering is becoming more and more extensive. The combination of BIM and Augmented Reality (AR) Technology is not only a major innovation in the construction industry, but also a new challenge to the undergraduate teaching model of civil engineering. Institutions of higher learning have made BIM and AR Technology a teaching task, which has become an irreversible trend. On the basis of summarizing the problems faced by the current teaching mode, this paper constructs a simulation teaching system based on BIM and AR Technology, and explores and practices the teaching reform methods of construction technology course.

Keywords

Application, BIM and AR technology.

1. Introduction

At present, BIM Technology, as an inevitable trend of construction 'information-based development ^[1], poses a severe challenge to the undergraduate teaching tasks of civil engineering. In order to adapt to the development of the construction industry, students majoring in civil engineering should not only master the application of traditional computer software (such as CAD, Thsware software, etc.), but also master the three-dimensional visualization of BIM Technology and virtual environment technology. The introduction of BIM and AR Technology in the teaching of construction technology course can convey the most cutting-edge knowledge and improve students ' interest in learning. At present, many scholars have explored and practiced the combination of BIM technology and professional courses of civil engineering ^[2-5]. However, no one has combined BIM and AR Technology to apply research on the teaching of construction technology courses. This paper will summarize the problems existing in the teaching of construction technology course, and on this basis, explore and practice a new teaching mode combining BIM and AR technology.

2. BIM and AR Technology

The application of BIM in engineering construction is as follows: building three-dimensional model and expressing detailed information of actual project with digital parameters. Among them, the model is the carrier, the information is the soul, and the parameterization is the means. The three-dimensional visualization function of BIM technology greatly facilitates the design, construction, operation and maintenance management, and truly achieves "what you see is what you get". BIM Technology is a subversive technological revolution in the construction industry. Every country in the world promotes BIM Technology in the construction industry ^[6]. Universities and colleges are making great efforts to strengthen the training of BIM Technicians.

At present, the development of cloud platform, Internet of Things, GIS and virtual reality technology has increased and more possibilities for the application of BIM technology. AR Technology is a new

human-computer interaction technology, which can simulate the real scene landscape. In the application of BIM technology combined with AR technology, BIM technology emphasizes the integration of three-dimensional model building, visualization and digitization of building information, and AR technology emphasizes virtual human-computer interaction experience. Therefore, BIM technology can provide necessary scenario resources and data information for AR technology, and AR technology provides a visual interactive application platform for the promotion and application of BIM.

3. Traditional teaching mode of building construction technology course

The course of construction technology is a very important professional course in the learning task of this science. It has a strong theoretical and practical nature and involves complicated knowledge. At present, the traditional teaching mode mainly uses PPT courseware, video and animation to stimulate students' cognitive ability, and then cooperate with curriculum design and construction practice to strengthen and consolidate the study of theoretical courses, which is not effective. This three-stage teaching mode of theoretical study, curriculum design and construction practice is disconnected from each other. There are some problems as follows:

- (1) Students in China lack initiative and autonomy in professional class. Because of the boring theoretical knowledge, students lack interest in learning in the classroom. In the curriculum design of the construction technology course, students have no practical experience and corresponding technical ability, can only mechanically imitate the previous curriculum design works, and do not give full play to the role of the course design.
- (2) Schools did not build training bases for construction technology training. At present, most university and colleges offer training venues to students in the form of renting training bases. This strategy is costly and ineffective. Even some colleges and universities directly cancel the construction training links, resulting in students not having sufficient practice ability.
- (3) Textbook knowledge lags behind the actual construction technology. At present, the textbook of construction technology mainly teaches the basic construction technology, which is mostly out of touch with the actual construction technology. As a result, students need to re-learn the latest construction technology after participating in the work, which wastes a lot of time and energy.

4. BIM and AR technology simulation teaching system

At present, most colleges and universities have established BIM centers, BIM laboratories, etc. for some students to learn BIM technology, but it only serves a small number of students. The BIM technology-related software purchased by the school does not really benefit all the students majoring in civil engineering. Therefore, it is imperative to increase the BIM technology-related courses in colleges and universities, and to use the visualization of BIM technology and the immersion and realism of AR technology to increase the enthusiasm and interest of students.

BIM and AR technology simulation teaching system mainly consists of 2 parts: BIM modeling operation and AR making. Firstly, the CAD drawings are transformed into three-dimensional building model (BIM model), then the BIM model in FBX format, which is imported into the related software of AR technologies, and the virtual scenes of the corresponding sub-modules are built in AR software. BIM and AR simulation teaching system aims at imparting the integrated application mode of BIM and AR technology to students, so that students can experience different teaching modes and learn the most advanced knowledge. On the basis of the traditional teaching system, the teaching system includes three-dimensional building construction model modeling, virtual construction scene construction, interactive scene roaming and other related teaching contents. Accordingly, students can better apply BIM technology to the construction stage of construction projects by establishing BIM information base and combining AR technology. The specific operation steps are shown in Figure 1.

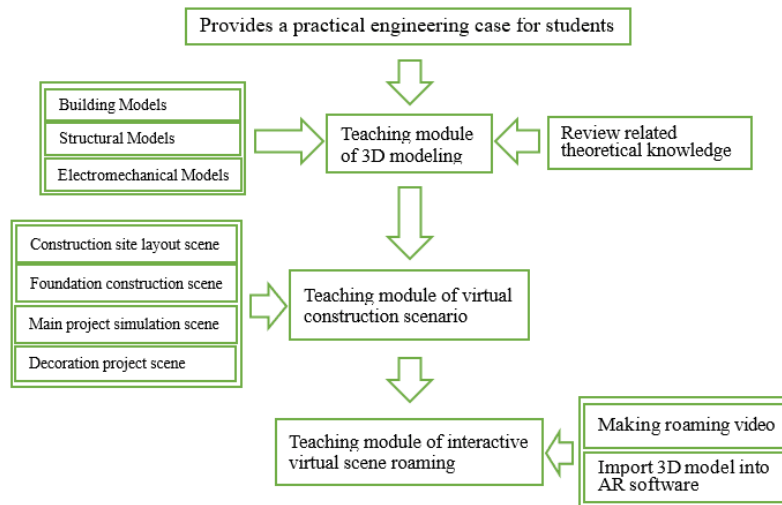


Fig.1. Practical application steps of BIM and AR technology simulation teaching system

5. Practical application

Based on the above analysis, the BIM and AR technology simulation teaching system is introduced into the teaching of construction technology course, and three teaching modules are set up:

(1) Teaching module of 3D modeling. Firstly, teachers provide students with specific engineering cases, and use Revit software to convert drawings into three-dimensional building models, including building models, structural models, electromechanical models. In this way, students can learn the relevant knowledge of building technology courses while learning BIM software. 3D modeling results of some students are shown in Figure 2.



Fig.2. 3D modeling of student course results

(2) Teaching module of virtual construction scenario. According to the specific characteristics of construction, it can be divided into construction site layout scene, foundation construction scene, main project simulation scene and decoration project scene. In the course, these scenarios are explained with theoretical knowledge, and detailed implementation plans and scoring standards are worked out. The teaching module abandons the traditional two-dimensional layout drawings of the construction site. Students can use BIM software to show all the details of the construction site in three-dimensional mode, including the size of living quarters, toilets, canteens and other temporary buildings, and the dimensions of construction shed. The construction scene layout model can realize man-machine interactive operation by AR technology, so that students can experience the real

construction site in class. The results of some students' roaming video production are shown in Figure 3.



Fig.3. The results of some students' roaming video production

(3) Teaching module of interactive virtual scene roaming. Scene roaming video breaks students' limitations on the imagination of building space. Through the roaming video in the construction site and inside the building, students can check the rationality of the site layout through these functions, and can also grasp the real-time construction process arrangement, material allocation, mechanical equipment and personnel use. In the teaching, combined with the scene and the actual project situation, the students are divided into several groups. The members in the group can be divided into the roles of project leader, technical leader and foreman. Students can cooperate with their roles to complete the design of key virtual scenes. In the process of implementation, according to the teaching progress, BIM and AR simulation teaching system is used to complete cognitive learning in each stage. Through AR immersion experience, students can not only experience the scene in virtual reality, but also find the advantages and disadvantages of the construction scheme, which can't be obtained in the traditional teaching mode.

6. Conclusion

Practice has proved that BIM and AR technology are combined to establish a BIM and AR simulation teaching system with three teaching modules. The system enables students to understand and apply BIM and AR technology, while stimulating students' interest in learning and improving students' practical and innovative abilities. The application of BIM and AR technology in the theoretical and practical aspects of the construction course teaching is a new breakthrough in the teaching of construction technology courses. Students apply what they have learnt instantly, so that they can use what they have learnt instantly, improve their practical and innovative internal forces, and have a deeper understanding of BIM and AR technology. At the same time, the introduction of BIM and AR technology is the combination of new technology and traditional technology. This improves students' enthusiasm for learning, saves teaching resources, and solves the shortage of construction internship resources.

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