Research on Teaching Innovation of Immersive Design Courses Based on Virtual Reality Technology

Suning Gong

School of Civil Engineering, Nantong Institute of Technology, Nantong, 226002, China

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Abstract: At Present, Virtual Reality Technology is Booming and Has Been Applied in the Field of Education.on the Basis of the Research on the Development of Virtual Technology, the Relevant Theories of Immersion Teaching and the Problems in Current Design Courses Teaching, the Application of Virtual Reality Technology in Immersion Design Courses Teaching is Explored and Analyzed through Cases, So as to Break the Limitations of Traditional Classes and Inject Fresh Blood into Design Courses Teaching by Using Virtual Reality Technology.

1. Introduction

Virtual reality technology is a hot topic in current academic and design fields. Users can experience and immerse themselves in the virtual world by wearing virtual reality devices such as glasses, helmets and other carriers. With the emergence of several technological waves since the 1990s, commercial products and related theories based on virtual reality are maturing day by day. Virtual reality technology and its equipment have entered people's lives. At the same time, many countries have tried to introduce virtual reality technology into the teaching of design courses. Due to the innovative and aesthetic features of design, the immersion and expansion features of virtual reality can be combined in the design class teaching under the new environment, so that students can come into contact with sensory cognition that cannot be realized in the traditional class, thus achieving better learning experience and effect. Therefore, the construction of virtual information teaching mode based on VR and AR technology can improve the efficiency of classroom teaching, return to the essence of education by reshaping learning methods, and provide strong support for cultivating innovative design talents.

2. Overview of Virtual Reality Technology

As an important direction of simulation technology, virtual reality is a comprehensive technology that integrates computer graphics, human-computer interaction, sensors, psychology and even artificial intelligence. It takes the electronic computer host as the main body and creates a virtual environment in virtual reality equipment, thus making people feel as if they were there. These feelings are not limited to vision, hearing and touch. For the current stage of virtual reality experience, it is mainly completed by users wearing wearable displays. At present, many mature virtual reality displays have appeared in the market, such as Oculus Rift, HTC Vive and Sony VR, and many hand-held tactile handles for adapting visual experience. Through these devices, users can immerse themselves in the virtual environment for interaction. By collecting the user's interaction information, they can transmit it to the computer host for environment change and real-time interaction. Due to the interdisciplinary, the research on virtual reality technology itself has a high complexity. However, due to its revolutionary experience changes, in recent years, the research on virtual reality technology involves various fields, such as new tactile devices, environmental simulation, human-computer interaction, and other aspects, and important new achievements appear every year.

2.1 Vr Technology

Virtual Reality, or VR for short, was first proposed by Lanier, founder of VPL Company in the

United States. Virtual reality technology effectively combines computer system and various control equipment, creating computer simulation technology, 3D experience technology and sensing technology, etc. It realizes the mutual combination of hearing, vision, feeling and other senses in the mode of information interaction, and creates the perfect experience of virtual reality technology. Virtual reality technology has the characteristics of strong perception and autonomy, as well as the advantages of low cost and high efficiency. It meets the development of social production and life, and also provides convenience for classroom teaching of design majors in colleges and universities.

2.2 Ar Technology

Augmented Reality, or AR for short, applies virtual information to the real world through computer technology. The real environment and virtual objects are superimposed on the same picture or space in real time. A typical AR scene is to see virtual objects in the real world through a display device. Specifically, it is divided into three parts. The camera is responsible for capturing real-time scene images, the background program is responsible for environment identification and camera positioning, and the display device renders the virtual and displayed images together.

2.3 Characteristics of Virtual Reality Technology

2.3.1 Immersion

Immersion refers to the fact that users feel the immersive effect in the current virtual reality technology. In an immersive environment, users will feel fuzzy about the boundary between the real world and the virtual world. The ideal virtual reality environment hopes to achieve the goal of building an environment that can simulate the real world and combine the content characteristics under the virtual reality technology to generate a special effect that allows users to immerse themselves in it.

2.3.2 Multi-Perception

The default sensory experience in computer technology under traditional technology is vision and hearing, but in addition to these two items, multi-perception under virtual reality also includes and is not limited to tactile perception, olfactory perception or motion perception. The ideal virtual reality technology should be able to restore human sensory experience in the real world. Under the current circumstances. People can feel the reality of virtual reality through vision, hands and feet touching, movement, olfactory and gustatory reactions. At present, virtual reality technology has not been developed to meet all human needs for the future world. Therefore, the existing conditions can only meet the needs from the visual, tactile, sensory, olfactory and gustatory sensory systems.

2.3.3 Interaction

When a user interacts with any object in the virtual environment, the natural degree and real-time nature of feedback from the object to the user in the virtual environment also includes the operability of the object in the virtual environment. When a user touches an object in a virtual environment, the user can feel the shape and hardness of the object; When a user picks up an object in a virtual environment with his hand, the user can feel the weight of the object, and when the user picks up the hand of the object and moves, the object in the virtual environment also moves along with the user's hand. Through glasses, you can feel the same real scene in virtual reality as in real life. Through touching or with the help of external tools, you can feel the authenticity of objects, and you can clearly experience the specific detailed features such as the weight, shape and color of objects, so as to strengthen the interaction between people and objects.

2.3.4 Imagination

The scene created by virtual reality technology has a wide imagination space, which can not only reproduce the environment in the real world, but also construct the environment that does not exist in the real world, even the environment that cannot exist in the real world. Virtual reality technology has brought huge space for people's imagination and creativity. In the virtual reality world, the imaginary objects and things in the future are displayed to the fullest extent, and various

solutions to things are imagined, thus avoiding the restrictions of various rules and regulations in reality and giving full play to the ability of self-innovation.

3. Problems in Teaching Design Courses

3.1 The Arrangement of Practical Teaching Hours is Unreasonable

The main purpose of the school's talent training program is to improve students' application skills. However, in the setting of practical teaching courses, the corresponding class hours will be continuously shortened, mainly focusing on the explanation of professional knowledge. The teaching time of theoretical content is long, and the class hours for students to participate in practical experience are few, resulting in uneven distribution of class hours. Under such circumstances, students have to accept a large number of professional courses and have very little time to participate in classroom activities independently, which leads to students' lack of practical ability and deviates from the leading goal of the training program for design talents.

3.2 Details Education is Not Deep Enough

Students must master the essence of design before they can design excellent works. Under the guidance of teachers, most students use drawing software to design the whole and details, use modeling software to make three-dimensional models, and use mapping and lighting settings to present three-dimensional effect maps. In the production process, a lot of time and energy are consumed, the overall design is quite difficult, the precise control of details is very difficult, and the construction situation cannot be predicted. Moreover, a teacher, facing dozens of students in each class, can only carry out simple design guidance in a very short period of time without specifying the specific materials and detailed structures, resulting in an unsatisfactory result.

3.3 Static Training Room Has High Cost and Single Content

Static training rooms are mostly displayed in the form of samples, with high cost, single content, lack of variability and students' lack of experience in color, materials, space, etc. The on-site practice of the project is greatly restricted by external conditions, and the safety cannot be guaranteed. The emphasis is mainly on completing the homework, thus the enthusiasm and enthusiasm of the students for learning are reduced. Students can experience it in the whole virtual environment. They can browse famous works and expand their knowledge without leaving home. With the help of VR and AR learning environment, the construction of a new teaching mode supported by technology platform can effectively solve the monotonicity of traditional teaching methods, cultivate students' autonomous observation ability and the ability to analyze and solve problems. Let students watch and experience their own design effects directly in the virtual space, thus improving students' interest in learning. Students can better immerse themselves in learning, interact in real time and feedback quickly.

4. Immersion Teaching and Immersion Theory

4.1 Immersive Teaching

Immersion Instruction originated in Canada in the 1960s and is a teaching mode based on subject content and the target language as the teaching language [1]. Immersive French teaching mainly includes three forms: basic class, long-term class and immersion class [2] (as shown in Table 1). Bilingual teaching was born, which was also the earliest immersion teaching form. Immersive French teaching has brought about educational reform in primary and secondary schools in Canada, and has also had a strong impact on Canadian education. In 1986, Dr. Mohan [3] proposed that immersion teaching realized the change from isolated and simple language teaching to teaching combining language with different subjects, providing a broad and rich language environment for students to learn and use a new target language. Immersive teaching class is not only a place where students learn languages, but also a place where they receive education, aiming at developing their

subject knowledge, language level and thinking ability. Facts have proved that "immersion teaching" has incomparable advantages over other teaching modes in second language learning. From a global perspective, the immersion teaching mode pioneered by Canada in the past few decades is the most effective and meaningful second language teaching reform, and it is the contribution of Canadian educational circles to the world education reform.

Table 1 Three Forms Of Immersion French Teaching

Three immersion French teaching forms			
Stage	Basic course	Long-term course	Immersion course
starting point	Grade 4 (after having a mother tongue Foundation)	Grade 7 (after having French Foundation)	Grade 1(Early immersion)
			Grade 4(Late immersion)
strength	1 hours/days	no more than 50% of total class hours	Grade 1-3 accounts for 100% of the total class hours
			Grade 4-6 accounts for 70% of the total class hours
			Grade 7-8 accounts for 50% of the total class hours
			Grade 9-12 accounts for 40% of the total class hours

4.2 Flow Theory

Flow Theory was first proposed by Mihalyi Csikszentmihalyi, professor of psychology at the university of Chicago in 1975 on the basis of immersion teaching practice. He believes that people are completely attracted to the activity and put into the situation, filtering out all irrelevant perceptions and entering a state of immersion. When the challenge is higher than the skill, the participants will feel that they are insufficient and lose confidence in the challenge. When the challenge is lower than the skill, the participants will feel that the task is much lower than their ability and disdain the challenge. Neither of these two states is the best state and cannot enter the immersion state. Csikszentmihalyi pointed out that "Flow" is an "Optimal Experience" when studying and working. the inner satisfaction it brings can make people full of interest, forget fatigue, keep exploring and reach new goals. Immersion theory places special emphasis on students' subjective experience. In 1985, Massimini and Carli of the university of Milan supplemented the immersion theory and constructed an immersion model containing eight combinations of challenges and skills, as shown in Figure 1. The challenges and skills are divided into three levels: high, medium and low, which are combined into eight relationships. Only when the challenges and skills are high can "Flow" be generated, i.e. flow of heart, which enables people to enter a state of immersion. The model shows that only when high challenges are accompanied by high skills can people enter and maintain an immersion state, which they call "flow" [4]. 1In 1996, Novak and Hoffman emphasized from the perspective of human-computer interaction that in order to achieve immersion, besides reaching a certain level of skills and challenges, participants also need a certain degree of concentration. They made relevant immersion mode tests for different network information behaviors such as online games, online shopping, E-mail, etc., and found that in network usage behaviors, information seeking is the easiest way to make customers enter an immersion state, and different network information behaviors will bring different immersion experiences [5].

Therefore, in the teaching process, especially for the current classroom teaching in our country, if the immersion theory can be effectively applied and the immersion teaching mode can be implemented, it is of great benefit to improve the teaching effect and the practical application ability of the students. It can more effectively transform the course content into the cognitive structure, personality quality and social behavior of the students, so that the students can better meet the challenges and serve the society. As the introduction of virtual reality technology into immersion teaching is still in the exploratory stage, the development of subject teaching applicable to it is a major revolution. Immersive teaching based on virtual reality technology provides students with

"immersive" experience, thus allowing students to immerse themselves in the learning environment, learning knowledge better and faster and improving learning effect.
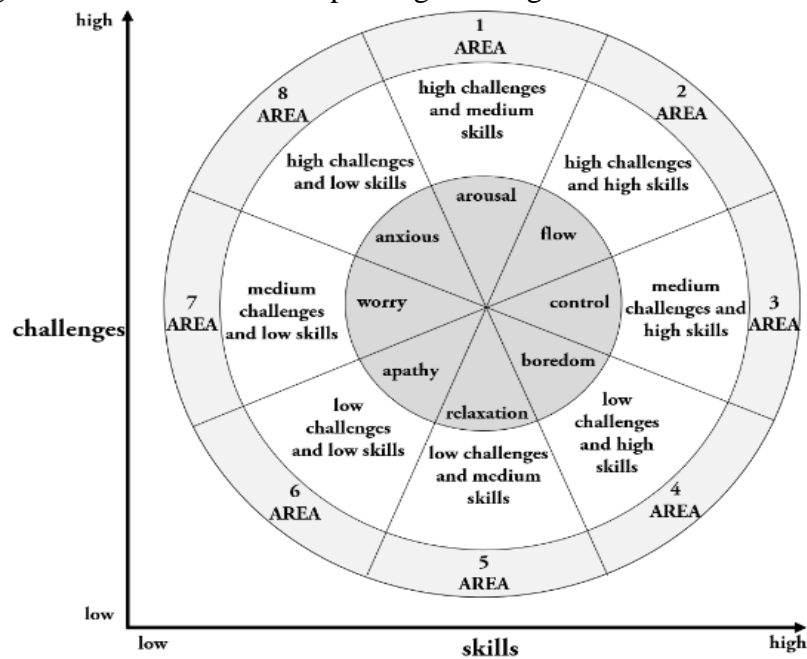

Fig.1 The Eight Combinations of Immersion Models

5. Application of Virtual Reality Technology in Immersive Design Teaching

Make full use of VR, AR technology and other teaching media as well as information technology and digital resources, pay attention to the application of VR, AR technology in class and after class, so as to create a learning environment with high challenges and high technology, in order to enhance students' sense of experience, perfect the scheme, find the deficiencies and gaps, and build an integrated immersion teaching mode by way of tasks and activities. After the emergence of virtual reality technology, carriers have been dominated by smart handheld devices, including smart phones and tablets. In the field of design teaching, through the combination of intelligent handheld devices and two-dimensional graphics, the original two-dimensional graphics can be combined with three-dimensional models, three-dimensional animations, images and sounds, so that students' learning is no longer boring and they can accept knowledge faster.

5.1 Immersive Design Teaching Process under Virtual Reality Technology

Before class, teachers send task book, data package and knowledge points related to the course through the teaching resource platform. Students are required to download and complete the task using mobile phone APP. In class, the teacher gives feedback on the tasks before class, and lets the students use the network simulation software to check the standardization of the layout. Rich and substantial multimedia courseware materials can be made in advance, pictures, videos or explanation videos related to design knowledge can be searched by using Internet technology, and VR resources with unique design specialties can be inserted. At the same time, students can use the teaching resource platform to download materials of corresponding styles from the "model base" and enrich the design scenes. The practice process takes the form of an operation competition and is a cooperative inquiry process of autonomous learning. To truly realize "learning by doing, practicing by doing". In the process of perfecting the works, teachers use VR technology to transform students' roles in groups. On the one hand, the role of students is transformed into customers, so that students can feel the models they have designed and enter into the schemes they have designed. VR and AR technologies enable students to transform from traditional drawing media to 3D virtual reality space. Students are exposed to 3D dynamic visual scene and interact with entity design behaviors to experience the surprises of customers. On the other hand, as a

designer, I use VR technology to check the existing problems in my design. For example, through VR virtual experience of three-dimensional indoor space, students realized that the bedroom space they designed was too crowded and there was no room for curtain boxes. Perceive problems, solve problems, and strengthen students' people-oriented design concept. After modifying and perfecting the model, AR platform is used to demonstrate and explain the bedroom model works. AR, as an augmented reality technology, can give customers more intuitive and immersive experience of various schemes. The use of mutual evaluation, scoring and other forms, to the greatest extent to stimulate students' awareness of team learning and cooperation. In order to strengthen the students' sense of space and stereoscopic impression, the teacher handed out teaching aids to each group of students, and the students built a physical bedroom model with functional layout in proportion. In the process of construction, team cooperation is needed to convert the virtual into reality again. In the production process, the teacher uses the mobile phone to shoot, and uses the software to generate frame-by-frame animation, which once again shows the spatial composition process from plane to solid, laying the foundation for further modeling. After class, through the establishment of interest groups, VR and AR societies and regular thematic activities, students can make full use of VR and AR laboratories to improve their design ability. In short, with the help of VR and AR learning environment and the construction of a new teaching mode supported by technology platform, students can better immerse themselves in learning, interact in real time and feedback quickly.

5.2 Application of Virtual Reality Technology in Architectural Design Teaching

Virtual reality technology can be effectively applied to real-time scheme comparison, design element editing, three-dimensional space comprehensive information integration, decision-making assistance and multi-party participation in design schemes in the design field. Great achievements have been made in the complex field of computer vision recognition. Visual design is a design concept shared by designers. The key to collaborative design. A more intuitive visualization platform is even more essential for the design industry that needs to effectively process digital information today. Visual design is the key for designers to share design perspective and carry out collaborative design. A more intuitive visualization platform is even more essential for the architectural design industry which needs to effectively process digital information. Augmented reality, as an enhanced visualization means, will also occupy a place in architectural design. Seichter developed Sketch and+system in 2003: a system for loading 3D sketches by scribbling on a digital tablet. In order to prove AR in the early design, cooperation and communication process can play an important role. On this basis, Seichter2004 applied AR to city planning in 2004, which enables designers to understand the city's spatial parameters in three-dimensional space, thus adding more carriers and completing decisions more quickly [6]. Dunston P mainly discusses the contribution of ARCAD system, which uses augmented reality technology to improve the visualization of standard CAD drawings, in reducing identification costs and collaborative design. ARCAD system enables HVAC and water supply and drainage designers to observe pipelines from multiple angles in a virtual 3D environment through visual equipment (HMD) to deepen the design and check the design problems existing in CAD drawings. The British London Museum uses AR technology to push the smart phone application of "Time Machine" and superimposes historical pictures and information on the current street view through cameras to deepen future generations' understanding of history and culture.

5.3 Application of Virtual Reality Technology in Construction Drawing Design Teaching

It is more efficient to communicate and make decisions by combining AR+BIM technology with 2D drawings. In the process of construction teaching, the original extraction of construction design data from plane drawings requires highly specialized students to complete, and is prone to misreading. Loading virtual construction content through AR technology can reduce huge losses caused by misreading of drawings and distortion of information transmission, and reduce the time spent by construction drawing design students in reading and reading drawings repeatedly. Compared with traditional two-dimensional design, the combination of AR and BIM greatly

improves students' cognitive ability to design, enables huge data in BIM models to be accurately extracted and visualized through AR technology, and will certainly play a great role in promoting the development of BIM technology in the field of construction drawing design.

AR book developed by Amir[7] superimposes 3D images of virtual construction equipment on 2D markers of AR. Students can only use computers or specific equipment to scan these markers to observe construction machinery from various angles. By superimposing the video signal of the real dynamic construction process on the AR marker, students can also understand and learn the construction technology from multiple perspectives, facilitating the communication and understanding between students. Taking hydraulic engineering design as an example, a template is made based on two-dimensional design drawings, and hydropower plant and gravity dam are respectively superimposed on the template. Through testing, the system can accurately identify the two-dimensional drawings and superimpose the three-dimensional virtual model on the real two-dimensional drawings. The virtual reality display effect is ideal, and the real-time virtual-real superposition effect can be realized. When the moving template or camera moves, the virtual object will change with the change of the real world, realizing seamless combination of 3D model and 2D drawing.

6. Conclusion

Virtual reality technology can provide an immersive design teaching environment, create rich virtual simulation teaching situations, provide learners with a variety of perception and interaction methods, and achieve an immersive intelligent education environment. The application of immersive virtual reality technology in the field of education has triggered a series of educational reforms and innovations, but the core of educational innovations still lies in the group of teachers, not the technical products. Although immersive virtual reality technology has achieved good educational results in K12 education, engineering education, innovation and entrepreneurship education, it is still a long way to go before it is widely popularized and applied in the teaching field of design courses. How virtual reality technology can be compatible with immersion teaching mode, form education industry chain, promote the integration and development of products, resources and teaching, and construct a virtual intelligent learning environment has important social value, which is worth further research and exploration.

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