

Application Research of Virtual Simulation Technology in Interior Design Teaching*

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Virtual simulation technology is the integration of virtual reality technology and augmented reality technology, with intuitionistic, practical and experiential, it can fully meet the needs of different scenes and operation needs of interior design course teaching, and provide students with a full sense of immersion, independent operation and exploration of open space. The fundamental purpose of this study on the application of virtual simulation technology in interior design course teaching is to promote the modernization of interior design course teaching and improve the efficiency of teaching. This paper briefly expounds the concept of virtual simulation technology and interior design course, analyzes the limitations and shortcomings of interior design course teaching and implementation, and discusses the advantages of its application in interior design course from the technical point of view. Finally, the paper puts forward three application steps of virtual simulation technology in interior design course teaching and puts forward the implementation strategy of applying technology to carry out teaching based on the perspective of students, in order to provide valuable reference for the modernization of interior design course teaching.

Keywords: virtual simulation technology, interior design, teaching application

With the gradual deepening of the development process of education modernization in our country, more and more advanced technology means are applied in curriculum teaching, which expands curriculum content resources, enriches curriculum teaching forms, and greatly improves the efficiency and quality of curriculum teaching. Virtual simulation technology is the mainstream technical means of modern development of interior design course teaching. Compared with simple information technology, this technology can transform interior design conditions and interior design projects into virtual reality scenes, allowing students to observe and design in virtual simulation scenes, fully exercise students' interior design skills, and develop students' professional literacy and aesthetic ability. In practical teaching application, it is suggested that teachers should organically combine virtual simulation technology with the three steps of interior design to form virtual reality program design, virtual simulation effect display, and virtual simulation interactive experience. At the same time, teachers should guide students to divergent thinking and design creation with technical advantages, encourage students to cooperate with each other and integrate knowledge and practice, and gradually deepen students' understanding of

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this course knowledge. Cultivate students' unique interior design concept and style and promote students' professional and high-quality development.

I. Overview of Virtual Simulation Technology and Interior Design Courses

Virtual simulation technology is a kind of technology that forms simulated three-dimensional space through computer processing. In three-dimensional space, various sensor configurations interact with each other, allowing users to interact with the environment as if they were in the real world. Virtual simulation technology focuses on the user's operation control and sensory cognition, has strong human-computer interaction characteristics, and can simulate the human audiovisual process and dynamic behavior in the case of high simulation.

Interior design courses mainly involve the basic theories, procedures, space design methods and style shaping of modern interior design courses, which belong to the decoration category of architectural design major. According to the book "Interior Design Course" published by China Architecture Industry Press in 1991, its main contents include: interior design principles, ergonomics, reference data of interior spatial scale, main materials of interior design and their application methods, interior color principles and expression, interior environmental psychology, interior plane composition, and expression techniques of interior design. At the same time, it needs to be combined with some software courses to ensure that students can use various kinds of software to complete modern interior design tasks, such as AutoCAD, SketchU, 3dsMax, VRay, Photoshop, Lumion, Enscape, etc.

The core of using virtual simulation technology in interior design course teaching is to synthesize high degree of simulation and strong operability of indoor environment by using technical advantages. In the synthetic environment, students can perceive various things, such as force response, moving back and forth, and visual Angle changes. Students observe, measure, design decoration, simulate the implementation of design scheme, display the effect of design scheme and interactive experience in the virtual simulation indoor environment.

2. Limitations and Deficiencies of Interior Design Course Teaching and Implementation

In recent years, with the rapid development of modern educational technology, teachers have successively applied information technology, Internet technology and other means in interior design courses, which has changed the presentation form of curriculum knowledge to a certain extent and increased the interest, intuitiveness and operability of course teaching (Liu & Tang, 2024, pp. 136-139). However, with the development of new quality productivity, people's living standards have gradually improved, and the requirements for interior decoration, interior space layout and environmental use have gradually increased, and the tasks of interior design have become more complex. The original teaching mode of interior design course has been unable to meet the learning needs of students, and it is difficult to provide students with an interior design environment that truly meets the needs of society, and it is difficult to effectively exercise students' professional skills and promote the development of students' professional comprehensive literacy. At present, the limitations and shortcomings of interior design teaching and implementation can be summarized as follows:

First, the Original Modern Educational Technology Means Lag Behind, the Classroom Teaching Form is Mainly “Seen”, Lack of Interaction, Experience and Practice.

Under the background of modern education, the application of technology in teaching will directly affect the teaching effect of courses and students’ learning style and results. At present, in the teaching of interior design courses, teachers mainly use Internet technology and information technology to play many interior designs case pictures and videos, or directly show students the 3D rendering of interior design schemes, so as to create situations and introduce the main content of the course. Although this way can intuitively display different interior design works and stimulate students’ interest, blindly “looking” can only deepen students’ perception and understanding, but cannot temper students’ skills. Compared with the teaching means of virtual simulation, the current classroom teaching technology is relatively backward, and the form is single, ignoring the main needs of students, and limiting the development of students’ spatial concept and design thinking.

Second, the Course Teaching Deviates from the Frontier Trend of Market Demand.

The fundamental purpose of interior course teaching is to train talents with strong interior design literacy and professional skills, to meet the market demand. However, at present, the teaching of interior design in most schools focuses on theory and neglects practice. At the same time, when the interior design market is moving toward 3D effects, five-dimensional space display, and VR dynamic renderings, many interior design courses in schools still focus on theoretical explanation and floor plan drawing. The teaching content and form of interior design courses are deviated and disengaged to varying degrees, and they do not keep up with the development trend of *The Times*, which makes it difficult for students to master interior design tools and technical means that meet the cutting-edge trend of *The Times*. Students’ professional knowledge reserve and basic skills are detached from the market demand, which affects their future employment and professional development.

Third, the Significant Advantages of Virtual Simulation Technology in the Teaching of Interior Design Courses

As mentioned above, virtual simulation technology can create an open, immersive and interactive scene for learners to meet their observation, interaction and exploration needs. In terms of technical characteristics, the application of virtual simulation technology in interior design teaching has significant advantages.

(1) Break through teaching limitations

In the past, the teaching of interior design courses was limited by educational means and the function of information technology. Students could only imagine the corresponding interior space in their minds according to the case materials provided by teachers and draw plans and renderings on the plain. This kind of teaching method has high requirements for students’ spatial construction ability, imagination ability and intuitive description ability, resulting in many students cannot really achieving the expected learning effect. After the application of virtual simulation technology, it can break through the limitations of time and space and create a virtual real environment by means of technical means. Students wear devices to enter this environment, not only do not need students to imagine space in their minds, but also provide students with the details of indoor space and display specific things, so that students can flexibly apply the learned knowledge to design practice. Completely meet students’ design operations and design implementation requirements. The application of virtual simulation technology can effectively break through the limitations of previous teaching (Gao, 2024, pp. 132-135).

(2). Enhance students' learning experience

With the application of virtual simulation technology in interior design teaching, teachers can create real virtual reality space for students according to the actual situation of students in different grades and combined with different course contents. Relying on technology to simulate a variety of complex indoor environments, or dynamically display the process of design realization in the indoor environment, so that students can see the specific details of various design schemes being operated, constructed and realized, deepen students' understanding of different design techniques and design methods, and thus enhance students' main experience.

(3) Help to achieve interdisciplinary integration

The interior design course is comprehensive. Students studying this course should not only learn interior design theory, but also learn color principle, ergonomics, interior environment psychology, interior plane composition, interior design performance techniques and so on. With the application of virtual simulation technology in interior design teaching, teachers can make use of technological advantages to integrate various disciplines such as art, nature, geography, psychology, artificial engineering, optics and humanities to achieve cross-disciplinary integration and provide opportunities for students to comprehensively apply knowledge of different disciplines to carry out interior design practice. The application of such teaching technology can not only expand students' thinking, but also improve their comprehensive quality and ability.

(4) Adapt to the needs of industry development

In recent years, virtual reality technology has entered the building decoration industry, becoming an important means for the main body of the industry to display the finished product effect and provide customers with interactive experience opportunities. The development of the industry determines the development trend of course teaching. The application of virtual simulation technology in interior design teaching by teachers can not only improve the modernization level of course teaching, but also adapt to the development trend of the industry.

(5) Meet the needs of individualized and diversified teaching

By applying virtual simulation technology in interior design teaching, teachers can create an open virtual reality scene for students. In this scene, students can give full play to their subjectivity, design according to their own ideas, and create works with personal style. At the same time, teachers can also create personalized virtual reality scenes for students in different situations according to their personality characteristics and future development wishes and teach students in accordance with their aptitude to fully meet the personalized and diversified development of students.

Fourth, the Application Steps of Virtual Simulation Technology in Interior Design Course Teaching

The key to applying virtual simulation technology in interior design teaching is to make technology serve around interior design practice. Therefore, in the actual application, the teaching steps of technology application should be set according to the interior design process, which are respectively: using technological advantages to support scheme design, using technological advantages to achieve effect display, and using technological advantages to support interactive experience of interior design results.

(1) Scheme design

Scheme design is an important part of interior design and a key step of interior design teaching. In the application of virtual simulation technology in interior design courses, scheme design should be taken as one of

the main application steps, requiring students to complete interior design schemes in the virtual simulation space, while using technical functions to carry out three-dimensional modeling and visual design, converting plane lines into advanced, intuitive, specific and vivid three-dimensional models to obtain realistic visual effects. In the process of scheme design, the application of virtual simulation technology can improve the accuracy of design details, including accurate adjustment of indoor light Angle, accurate correction of indoor floor and wall flatness, etc. It can also enrich the expression of interior design schemes, such as using modeling software to build fine wall structures and design lifelike floor textures. Compared with traditional CAD drawings, interior design schemes relying on virtual simulation technology can express students' design concepts more intuitively and concretely, convey design intentions, and communicate better with teachers and students. With the application of virtual simulation technology in this step, students can make use of technical advantages to conduct collision detection on the constructed indoor three-dimensional model, such as: collision detection between the bathroom door area and the living room, to determine whether there is a dead corner between the two areas, whether the connection between the two is good, whether there is a non-removable load-bearing wall and so on. Students can also use technical means to obtain feedback information on the interior space structure design and the design of each space area, continuously optimize the interior space design scheme, and consider the actual situation as much as possible to ensure that the final design product can be effectively transformed into a real interior decoration project. It can be seen that the application of virtual simulation technology in this step can adjust the interior space layout more flexibly, rationally plan the functions of each area of the interior space and achieve interior design innovation.

(2) Effect display

Effect display is an important part of interior design, mainly designers to customers, partners to show their overall effect of design, transfer their own design concept, presets the interior design works into the reality of the decoration after the expected. In the teaching of interior design, the effect display is mainly the display and communication of the interior design works designed by the students. By applying virtual simulation technology in this process, teachers can expand the form of students' display of design works and form a more three-dimensional and immersive display of works by using virtual reality technology and augmented reality technology (Qin, 2024, pp. 52-54). In this step, the application of virtual simulation technology can be started from two aspects: (1) The use of VR equipment to display the finished interior design work, so that students and teachers can experience the effect after the realization of the work. Students and teachers can enter the virtual simulation environment by wearing VR glasses. Teachers can review students' works, and students can also understand teachers' reviews according to the specific details of interior design works in the virtual simulation environment, and jointly optimize and adjust the design works, so as to exercise students' design skills and improve students' interior design level. At the same time, students in the same group can enter the virtual simulation effect scene of their own design works and comment and communicate with each other, which can not only share their own design concepts, but also give students more satisfaction and improve their design self-confidence (Zhang, 2024, pp. 75-78). (2) Use AR to demonstrate the enhanced effect. In interior design teaching, teachers use the AR function of virtual simulation technology to enhance the transformation of students' works, support students to superimpose more virtual elements into the real environment, and promote interior design works to be more personal. For example, teachers can record the scanning of the environment of a

classic residential building in a city into the virtual simulation system, build a real virtual scene, and require students to optimize the design of the positions and specifications of doors and Windows and optimize the configuration of interior decoration colors in the virtual environment, to achieve the coordination of colors and light and shadow. In this teaching, students can realize their imagination by enhancing technology, boldly adjust the interior decoration color, verify their design ideas, feel the design effect, so as to allow students to accumulate experience and promote the development of students' professional comprehensive quality.

(3) Interactive experience

Interactive experience is one of the key steps of interior design courses based on virtual reality technology. The key to this step is human-computer interaction and multi-person collaboration, which is an important opportunity to fully exercise students' design skills and hone students' professional ability. Specifically, it can be started from two aspects: (1) Human-computer interaction between students and virtual simulation devices to meet students' learning and exploration needs. The application of virtual simulation technology in the interactive experience steps can give full play to students' subjectivity, let students feel the different angles between designers and users, and use software functions to constantly perceive the indoor space in virtual simulation scenes, insight into the real needs and behavioral logic of users in different scenes, so as to consider how to optimize the interior design to meet the needs of users. Take the interior design of aging housing as an example, this design is a popular design theme in recent years. The main idea is to provide more convenience for the elderly by adjusting the ancillary facilities of the interior space, and to improve the safety of the elderly's indoor life by weakening the edges and corners of all parts of the space (Wu, 2024, pp. 214-216). Teachers can take the bathroom of the elderly residence as a design object and ask students to feel in the virtual simulation space. "Classic elderly residential space bathroom case", feel the designer in this case to add handrails in the bathroom, increase the concept of gentle slope at the door of the bathroom, imagine yourself as an elderly person in such a bathroom can feel convenient and comfortable. Students can carefully observe the details and understand the impact of these design elements on the overall home environment. With the support of virtual reality technology, students can start more from the user's perspective, operate and feel carefully in the simulated environment of interior design works, to internalize the people-oriented design concept and develop the user-oriented design thinking. (2) Multiple students rely on virtual simulation technology to collaborate and interact. Virtual simulation technology can support multiple students to carry out interactive design, cooperative design and cooperation online at the same time, expand the form of effective interaction of students, and provide support for cultivating students' communication ability, cooperation ability and collaborative design ability. The teacher applies virtual simulation technology to require students to participate in the same interior design task in small groups, each responsible for a region, and coordinate and cooperate with each other.

Fifth, the Application Strategy of Virtual Simulation Technology in Interior Design Course Teaching

With the application of virtual simulation technology in interior design courses, teachers can gradually promote the teaching steps of interior design courses according to the above ideas, so that the technology runs through the teaching and serves the students' interior design learning and practice activities. So, how to integrate virtual simulation technology into curriculum teaching more flexibly, mobilize students to participate in subjectivity to the greatest extent, and provide support for students' independent exploration and cooperative

learning? This paper argues that we should start from the design of teaching objectives and include the related elements of virtual simulation technology as teaching guidance; Then, according to the technical characteristics of virtual simulation, a virtual simulation platform is built, and interior design experiments and implementation activities of virtual simulation are organized to create a scaffold for students to gradually and deeply participate in learning.

(1) Set teaching goals and integrate virtual simulation

Clear and specific goals are the key elements for teachers to carry out high-quality classroom teaching and the basis for guiding students to participate in learning independently. In the application of virtual simulation technology in interior design teaching, whether teachers want to organize virtual simulation scheme design, effect realization, or interactive experience activities, they need to let students first clear the learning objectives of this class, establish students' learning objectives, and let students participate in learning with goals, so as to improve learning efficiency. Therefore, it is suggested that teachers incorporate virtual simulation-related elements in the design of teaching objectives (Yao, 2023, pp. 199-201). In the goal, teachers can put forward requirements for students to understand the principle of virtual simulation technology and students to proficiently use virtual simulation technology to complete design tasks, to ensure that the teaching goal of interior design course has a clear "modernization" orientation. Taking the lesson of "Interior Plane Composition" as an example, according to the students' professional knowledge reserve and thinking level, combined with the main knowledge points of this lesson, the teacher starts with the design objectives from two aspects: theoretical knowledge and design practice, specifically: (1) Correctly understand the theoretical knowledge of interior plane composition, and understand the functions and effects of each component; (2) Understand the operation principle of virtual simulation software, can flexibly use the software function to draw indoor plan, can use the software function to generate three-dimensional plan; (3) Can adjust the indoor plane structure distribution table according to actual needs; (4) Use tablet and freehand pen to draw plan correctly on the software interface, and have good composition ability.

(2) Build a virtual simulation platform to lay the foundation for teaching application

Under the background of education modernization, the application of virtual simulation technology in course teaching is gradually deepening, and the teaching methods are increasingly diversified, which greatly changes the learning way of students. Considering the limitations and deficiencies of the current interior design course teaching, although the inherent multimedia classroom can meet the basic learning needs of students, the teaching form is relatively simple, ignoring the individual development needs of students (Li, 2022, pp. 44-46). Therefore, it is suggested that schools upgrade teaching tools according to their actual conditions, build a virtual simulation platform on the campus network, and develop corresponding sections and functions that meet the teaching needs of interior design courses, so as to break through the existing teaching limitations and consolidate the teaching foundation of modern interior design courses. In the process of platform construction and development, schools and teachers should deeply study the practical transformation needs of interior design courses and related courses. For example, the basic principles of interior design courses need to show students the real and restored furniture models, which requires the development of household system and material mapping. It is convenient for students to intuitively feel the influence of different materials of furniture on interior style when they participate in learning through the platform in the future.

(3) Carry out virtual simulation experiments to support students' independent exploration

The application of virtual simulation technology in interior design teaching should satisfy students' independent inquiry needs as much as possible and support students' personalized development. According to the "three steps" proposed above, teachers can rely on virtual simulation technology to implement interior design scheme design, effect display and interactive experience, so that students can feel the whole process of interior design works from design to realization. For students, whether they use software to draw pictures, or use software functions to generate simulation drawings and virtual simulation renderings, they need to gain experience in continuous exploration, to form their own views, truly develop interior design thinking, and shape their own design style. Therefore, teachers can use virtual simulation technology to carry out virtual simulation experiments in program design, effect display, interactive experience and other links. According to the course content, teachers assign experimental tasks for students, such as interior space optimization, interior color matching, interior soft decoration design, etc. Students are required to use virtual simulation software to carry out design scheme experiments. In the experiment, students constantly adjust the detailed parameters, observe and compare the effect differences under different parameters, and finally form their own views and understandings to obtain rich learning results (Guo, 2019, pp. 259-260).

(4) Create virtual simulation activities and organize students to interact and cooperate in learning

When applying virtual simulation technology in interior design course teaching, teachers should provide students with open activity space as much as possible and provide opportunities for students to develop cooperation ability and cooperation consciousness. Different from simulation experiments, the purpose of virtual simulation activities is to allow students to systematically experience various processes of interior design and promote students to form an overall cognition of interior design. For example, in the simulation activity of the theme of "indoor space optimization", the teacher asked the students to select a group of indoor environments as a unit to carry out environmental observation, demand analysis, preliminary scheme preparation, scheme design optimization, scheme diagram generation, virtual simulation design results generation, and interactive detection in the simulation environment. In this process, students discuss about specific needs, have a collision of ideas, and go through a series of design and implementation operations, which promotes students to form a complete experience and form a more comprehensive understanding of the occupation of interior design. At the same time, students gradually formed a good sense of communication and cooperation in the process of discussion, joint design, virtual simulation realization and collision detection.

(5) Set up virtual design practice to guide students to integrate knowledge and action

To give full play to the application advantages of virtual simulation technology, it is suggested that teachers organize comprehensive practical activities relying on virtual simulation platform based on interior design course content and students' practice and exploration needs, further expand the form of students' design practice using software and allow students to flexibly use interdisciplinary knowledge content to design and practice their own design concepts. Integration of knowledge and practice, development of comprehensive literacy in interior design. In the actual process, in addition to learning the basic principles of interior design, students will also learn ergonomics, color matching, regional psychology, natural science, regional history, mathematics and other subjects. If these subjects can be integrated into interior design, it will be conducive to the professional development of interior design for students (Guo, 2019, pp. 99-103). Therefore, teachers can regularly organize

and carry out practical activities relying on the virtual simulation platform, such as: “Campus Cup” interior design master competition, and another example: smart home design competition, urban cultural characteristics of residential interior design project-style activities.

Conclusion

In summary, interior design courses are highly practical, operational and experiential. Traditional information-based teaching mode can no longer fully meet the needs of course teaching and it is difficult to ensure students’ full participation, thus affecting the teaching effect. Virtual simulation technology can break through the limitations of course teaching and create a more immersive and experiential learning space for students. It has significant advantages. In the discussion of this paper, the application of virtual simulation technology in the three steps of interior design course design, effect display and interactive experience is proposed, forming a technical application support throughout the whole process of interior design. At the same time, teachers pay full attention to the main needs of students, rely on the three steps to carry out the design exploration activities of virtual simulation flexibly, and form a more scientific, effective and modern interior design course teaching model, which has significant promotion and application value.

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