Measures Discussion of Virtual Reality Technology Applied in Architectural Design Teaching

Chen Xi, Xiao Chen[(✉)], and Huaiye Xu

Jiangxi Science and Technology Normal University, Nanchang 330013, China
`413414840@qq.com`

Abstract. From the traditional teaching mode of architectural design, the teaching knowledge is relatively abstract, which requires students to have higher abstract thinking ability, and the whole teaching mode is not intuitive enough, which makes it relatively difficult for students to understand, resulting in the overall teaching effect is not ideal. The application of virtual reality technology can effectively solve the above problems, through the creation of targeted three-dimensional space, in the teaching process to create a simulation scene, to help students better understand and learn. In view of the above problems, this study puts forward some suggestions on the application of virtual reality technology in architectural design teaching, hoping to provide support for architectural design teaching research, for reference and reference only.

Keywords: architectural design teaching · Virtual reality technology · Informatization

1   Introduction

The full arrival of the 5G era and the continuous popularization and application of various emerging technologies have promoted the transformation and development of all walks of life, and the education industry is no exception. From the perspective of the development trend of the education industry, the application of more and more emerging technologies has effectively promoted the development of the education industry and created a diversified new teaching mode [1]. Virtual Reality technology (Virtual Reality VR), as one of the current popular technologies, can create new opportunities for the development of architectural design teaching, enable students to feel and experience architecture more truly in the design process, and promote students to better understand some of the original very abstract knowledge content, whether for theoretical teaching or not. For practical teaching, virtual reality technology can solve the pain points of traditional teaching mode and provide effective technical support for the reform of architectural design teaching [2].

In the virtual reality interactive teaching practice of Jiangxi Normal University of Science and Technology, through data analysis, the results show that VR has indeed had
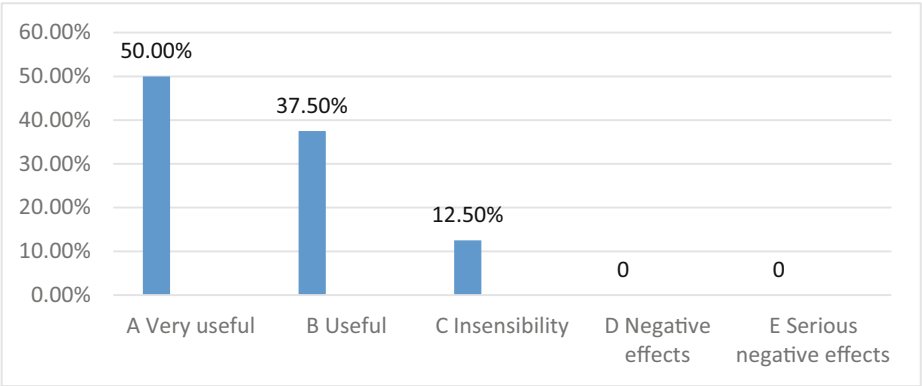
Fig. 1. The Impact of VR on Design Teaching in Teachers' Questionnaire (owner-draw)
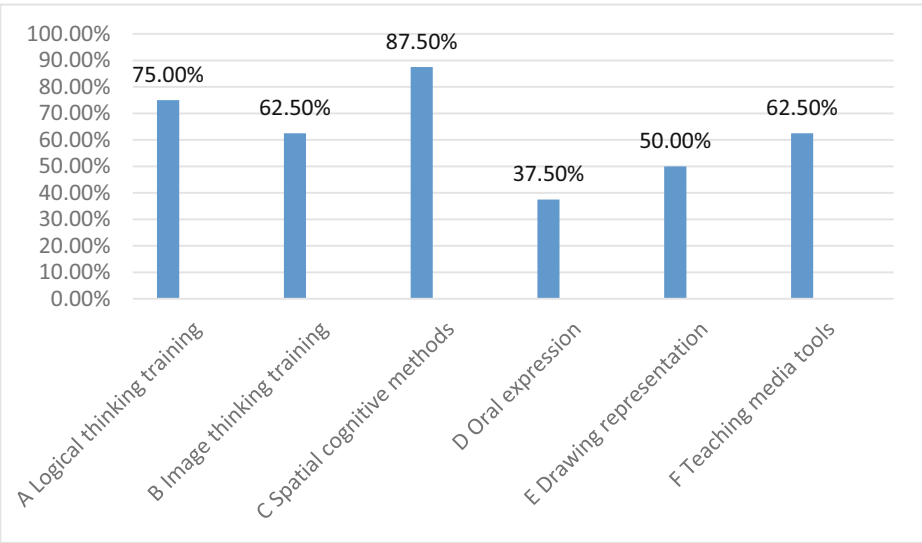

Fig. 2. Evaluation of Virtual Reality Teaching Effect (owner-draw)

a significant positive impact in the teaching process in terms of intuition and immersion, and its application in architectural design teaching has also been recognized by teachers and students (Figs. 1 and 2).

2 Application of Virtual Reality Technology in Architectural Design Teaching

2.1 Creating Virtual Situations with Students as the Core

As we all know, the knowledge points of architectural design are relatively abstract, which require higher abstract thinking ability and spatial thinking ability. If students want to learn these knowledge points from the aspect of image thinking, they often face greater difficulties [3]. Through the application of virtual reality technology, more realistic, vivid and real teaching scenes can be created, and the changing process and natural phenomena of things that are difficult to intuitively perceive in real life can be displayed, so that students can better feel the architectural design, understand the charm of architecture, and strengthen students' professional identity [4]. In addition, virtual reality technology can also show some knowledge and abstract concepts that are difficult to express in language, such as transparency, light intensity and other professional terms. Traditional teaching can only explain abstract concepts repeatedly, while virtual reality technology can directly bring students into the corresponding scene for understanding, which can naturally help students learn better.

2.2 Enhance Students' Awareness of the Design Process

The application of virtual reality technology in the teaching of architectural design is mainly through the intuitive teaching method. Specifically, the commonly used intuitive teaching methods mainly include model intuitive teaching, object intuitive teaching, language intuitive teaching and other modes. Object visual teaching is to guide students to observe objects and verify theoretical knowledge based on objects, so as to further strengthen students' understanding of theoretical knowledge. However, because of the particularity of the course of architectural design, it is difficult to achieve the goal of object teaching in the conventional teaching process [5]. The application of virtual reality technology can completely change the visual teaching mode, further enrich the image visual teaching mode, and comprehensively expand the teaching scope of the image visual teaching.

3 Suggestions on the Application of Virtual Reality Technology in Architectural Design Teaching

3.1 Display Three-Dimensional Objects Based on Virtual Reality Technology

From the perspective of architectural design courses, there are a lot of abstract conceptual content. In the traditional teaching mode, the display of various three-dimensional objects mostly adopts computer modeling, physical display, picture projector, etc., which has great limitations in intuitive teaching, making it difficult for students to perceive these three-dimensional objects through image thinking. Through the application of virtual reality technology, it can directly create a three-dimensional object highly similar to the real object, effectively breaking the cognition of space, time, cost and other aspects.

Meanwhile, by wearing various virtual reality interactive devices, students can better perceive three-dimensional objects and help students understand and learn. For example, VR technology can be used to visualize the abstract knowledge points in the course of building energy conservation teaching. In the chapter of architectural shading, the teacher asked students to use SketchUp to first make different forms of shading components for a certain architectural model, and then observe the shading effects of the shading components in Mars software. Through the adjustment of Mars software in different time periods in specific regions, such as summer solstice and winter solstice, Observe the sunshade effect of different sunshade components to understand the sunshade effect of different forms of sunshade components, to understand the sun height Angle and sun azimuth Angle, will cause what kind of light impact on each room. In the whole teaching process, students understand the abstract knowledge points in the books through immersive experience, which will help students to make a more profound judgment on the future architectural design, no longer floating on the surface [6].

3.2   Space Design Based on Virtual Reality Technology

For the teaching of space design, the traditional teaching is mainly through the mode of model making to cultivate students' ability of internal and external space design. Students must apply the basic knowledge of space design and shape design explained in class to design training, but because the model itself is far from the real object, it is often difficult for students to really master the practical application method of space design through model making. Through the application of virtual reality technology, students can design directly from the user's point of view, which can effectively avoid the limitations of the traditional single bird's eye view, pay more attention to the details of space design, and master the space, shape, streamline and size more accurately. At the same time, through immersive VR technology, students can better immerse themselves in their own works, and control the details, scale and material of the works more effectively. When students complete the design of the works, they can also experience directly in the scene designed by themselves, which can undoubtedly further help students consolidate their knowledge and develop their abilities [7].

3.3   Teaching and Training Based on Virtual Reality Technology

For the traditional architectural design teaching, many experiments will suffer from the constraints of hardware resources, resulting in the actual operation will be greatly limited, coupled with many practical teaching facing various factors, resulting in the overall effect is not ideal. For the above problems, virtual reality technology can also be used to complete, through virtual reality technology on the computer to establish a completely virtual laboratory training system, while virtual reality technology to replace the traditional teaching equipment, students can also use intelligent wearable devices to interact with the virtual laboratory, can obtain feedback of experimental results. Based on the application of virtual training technology, students can directly carry out training operation in the virtual platform, test the theoretical knowledge learned in class, and find out the problems exposed in the process of architectural design in time, and correct them at the first time. In addition, based on Brilliant City Mars software, it can also provide

students with opportunities for training, exhibition, communication and sharing, so that students can cooperate with each other and establish a more diversified training mode, thus effectively improving the effect of training. [8].

4 Hardware Suggestions of Virtual Reality Technology in Teaching

At present, some scholars have built a set of VR-E^{3}Model based on VR technology for the teaching effectiveness of virtual reality technology, and selected Entropy method to measure VR objective data and compare hardware devices. The calculation of entropy method adopts three formulas: entropy value (e), dimensionless data set (Y_{ij}) and entropy weight (w_j). Among them, the smaller the entropy value of the factor, the larger the entropy weight, indicating the higher explanatory power of the factor.

$$e = \sum_{i=1}^{m} p_i \times lnp_i \tag{1}$$

$$Y_{ij} = \frac{R_{ij} - min_j R_{ij}}{max_j R_{ij} - min_j R_{ij}} \tag{2}$$

$$w_j = \frac{d_j}{\sum_{j=1}^{n} d_j} \tag{3}$$

Python was applied to realize the entropy calculation, and the results of entropy, entropy weight and comprehensive evaluation value of the six types of devices were obtained, as shown in Table 1. The entropy calculation results of VR equipment teaching utility data show that VR technology will bring different interactive experiences

Table 1. Teaching utility entropy and entropy weight data of 6 kinds of VR devices[a]

Device type	Hardware factor			w_j
	Hardware installation[b]	Price factor[c]	Stability[d]	
VAHD	1.00	1.00	1.00	29.05
HVD	0.65	0.77	0.75	32.89
PVD	0.69	0.71	0.68	28.56
VAID	0.69	0.60	0.62	27.86
PTD	0.60	0.69	0.60	27.68
MHD	0.69	0.60	0.66	30.07
Device entropy weight	0.1094			1.00

a. This table is organized according to the paper A Study on the Construction and Validation of a Virtual Reality Technology Teaching Effectiveness Model (VR-E3 Model)
b. Interactive hardware installation suitable for teaching degree
c. Price acceptance of interactive hardware
d. How stable the interactive hardware is

to users due to hardware differences. Users generally pay attention to how VR technology is applied to the classroom, and hardware installation, price factor, stability, resource support, development difficulty and other factors will directly affect the use behavior intention of teachers. Based on the comprehensive consideration of factors such as acquisition cost, development difficulty and abundant resource support in practical applications, the following teaching allocation schemes are provided for teachers and administrators' reference. For schools with low teaching demand and low investment, VR + AR simulation equipment can be purchased, which has low cost and good interactivity and can provide students with basic VR learning experience. For schools with high teaching demand and low investment, visual simulation devices supported by mobile phones can be considered to carry out teaching. VR devices can be combined with smart phones to achieve basic VR immersion experience. For schools with low teaching demand and high investment, motion-capture simulation equipment or audio-visual interactive simulation equipment with slightly higher cost can be considered. Such equipment is also open source to some extent, and can support the development of interactive resources and the expansion of classroom activities in the future. For schools with high teaching demand and high investment, head-mounted visual simulation equipment or integrated tactile simulation equipment can be considered. Although the cost of such equipment is high, the equipment itself has provided better teaching support resources or programs, which can effectively help teachers solve the important and difficult problems in subject teaching [9].

5   Conclusion

To sum up, 5G technology has further promoted the rapid development of information technology, and various emerging information technologies have been continuously developed and applied, which has promoted the transformation and development of all walks of life. For the teaching of architectural design, the application of virtual reality technology can fully break the limitations of traditional teaching, reduce the threshold of architectural design, and give full play to the immersion, interaction and imagination of virtual reality technology. As a teacher, we should take the initiative to learn virtual reality technology, and at the same time fully combine the subject characteristics and knowledge characteristics of architectural design, introduce virtual reality technology scientifically and reasonably, enrich classroom teaching content and teaching resources through virtual reality technology, so as to effectively improve the efficiency and quality of teaching.

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