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Application of Virtual Simulation in "Preliminary Architecture"

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Abstract

There are many limitations in the implementation of traditional courses for architectural design majors, such as students' lack of initiative and difficulty in expressing space concepts. It is imminent to integrate new technologies into teaching methods. Based on the characteristics of virtual reality experiential learning, taking "Architecture Preliminary" as an example, the teaching reform idea of integrating the D-Sketch three-dimensional information simulation platform is proposed. The students majoring in architectural design in a university were selected as the experimental group (40 people) and the ordinary group (37 people). The ordinary group used conventional teaching, and the experimental group used virtual simulation platform based on conventional teaching. The comprehensive assessment scores and teaching satisfaction of the two groups were compared. The results showed that the comprehensive scores and teaching satisfaction of the experimental group were significantly improved, and the difference was statistically significant (P<0.05). Virtual simulation platform teaching can improve the teaching effect and teaching satisfaction of architectural design courses.

Keywords

Preliminary Construction; Virtual Simulation; Experiential; Teaching Reform; D-Sketch.

1. Introduction

Efforts to cultivate technical and skilled personnel and high-quality workers is an inevitable requirement to promote my country's transformation into a manufacturing power. Improving professional skills, studying diligently, and exercising more can better meet the needs of architectural design positions, which are not only the basic requirements for the professional quality and practical ability of architectural design talents, but also the fundamental requirements for the cultivation of architectural talents in higher vocational colleges. In the process of higher vocational teaching, attention should be paid to cultivating the habit of students' independent learning. Obviously, a single classroom teaching mode can hardly meet the diverse learning needs of students. Effectively arrange various teaching activities and tasks in multiple spaces such as virtual network classrooms and virtual network classrooms, so that teaching can truly and effectively promote the growth of students [1].

2. Preliminary Research on Teaching Reform

2.1. The Background of Teaching Reform

2.1.1. Learning Motivation of Higher Vocational Students

The lack of learning motivation of higher vocational students has become the focus of education. For some students, going to school is a helpless choice. common phenomenon. However, higher vocational education, which follows the old student training and education model, is increasingly feeling powerless in the face of students who lack motivation to learn [2]. Students' weak independent thinking ability and lack of independent innovation ability are largely attributable to the fact that the traditional teaching model is out of the real environment, does

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not stimulate the enthusiasm of students, and the participation of students is not high, which also leads to the criticism of the traditional teaching model.

2.1.2. Characteristics of Preliminary Course of Architectural Design

The "Preliminary Architecture" course is a compulsory basic course for architectural design majors in colleges and universities, and it is also a professional introductory course. It allows students to have an initial understanding of the content of architectural design majors and plays a key role in guiding students' professional interests. The first half of the course enables students to understand the historical development of Chinese and foreign architecture, understand the relationship between architectural development and social, economic and cultural development, and promote the improvement of architectural design ability through the study of architectural history, master the general situation of modern architectural design, contemporary design The development of ideas and technology has a huge impact on the development of architecture; the second half builds a curriculum system based on the skills and knowledge required for the preliminary architectural design required by the architectural design major, and selects the curriculum content closely around the needs of completing the preliminary tasks of architectural design. To enable students to understand architecture and design, and to cultivate their basic ability of architectural design.

However, there are a lot of architectural cognition content, and under the condition of limited teaching hours, it is difficult for students to digest in a short time, which is easy to make students tired and cause students to lose interest in learning architectural design. The content of architectural space scale and structural overlap is highly abstract and complex. Some students lack three-dimensional imagination and cannot form three-dimensional feelings through two-dimensional pictures, so that space and structure become the bottleneck of learning this course, which seriously affects Students' enthusiasm for learning architectural design. For teachers, it is difficult and risky to organize students to visit the site. They can understand the difficulties of students but cannot help students to recognize buildings with empathy, resulting in the teaching effect not reaching the expected goals.

2.2. Experiential Learning

Experiential learning is the most basic and natural way of learning for human beings [3]. Experiential teaching means that in the course of course teaching, according to the cognitive characteristics and laws of the student group, teachers present professional teaching content by carefully designing and creating real situations and opportunities, so that students can gain more experience in the process of experiencing the environment. It is a teaching form that is intuitively aware of, and gradually recognizes, understands, and constructs teaching knowledge.

As an important teaching method, experiential learning has been paid more and more attention, and many scholars have carried out teaching theoretical research and practice. The results of the subject search on CNKI for nearly 20 years with "experiential teaching" as the key word (Figure 1) can be seen that since 2001, the domestic research on experiential teaching has shown a gradual upward trend, indicating that experience More and more attention and attention have been paid to teaching in the form of teaching, and it will gradually become one of the research hotspots. The "China Education Modernization 2035" issued by the Central Committee of the Communist Party of China and the State Council in 2019 is an epoch-making and important programmatic document that points out the direction for the modernization of China's education [4]. In the field of architectural design teaching, AR [5], VR [6], BIM [7] and other technologies have been used to carry out experiential teaching, all of which require the use of high-configured computers and expensive experience equipment, which are not suitable for large-scale teaching in teaching. use.

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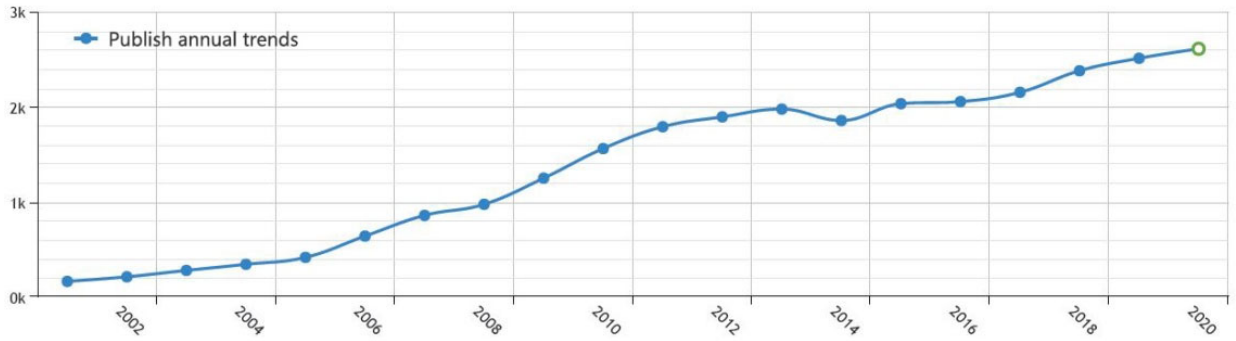

Figure 1. Literature retrieval on the theme of "experiential teaching" (2001-2020)

The use of the D-Sketch platform is not limited by equipment, prices and venues, allowing learners to experience anytime, anywhere and realize teacher-student interaction. D-Sketch introduces VR (Virtual Reality) technology into design, enabling designers to truly immerse themselves in three-dimensional space, experience the spatial effect of design, and effectively assist designers in deliberating the rationality of the space scale, so as to improve the Design results for effective feedback [8]. In the past, the use of VR required high-configured computers and professional VR equipment. Through the D-Sketch platform, only a mobile phone and a Cardboard box can be used for VR experience. This study uses the D-Sketch platform to create an experiential teaching experience and explores its impact on the teaching effect of "Architecture Preliminary". The report is as follows.

3. Teaching Reform Research Design

3.1. Research Objects

The participants were 77 freshmen of the 19th grade architectural design major in N colleges and universities. They were divided into the general group and the experimental group according to the administrative class, with 37 people in the general group and 40 people in the experimental group. The two groups of students are all general high school students. The general data are shown in Table 1. There is no statistical significance (P>0.05), and they are comparable (Table 1).

Table 1. Comparison of general data of two groups of students

Project		Normal Group (n=37) (%)	Test Group (n=40) (%)	χ^2/t	P
Gender	Male	21(56.8)	22(55.0)	0.024	0.877
	Female	16(43.2)	18(45.0)		
Age	≤18	11(29.7)	20(50.0)	3.346	0.188
	19	20(54.1)	16(40.0)		
	≥20	6(16.2)	4(10.0)		
Household Registration	Rural	27(73.0)	33(82.5)	1.014	0.314
	City	10(27.0)	7(17.5)		
Hometown	Within the Province	18(48.6)	18(45.0)	0.103	0.794
	Outside the Province	19(51.4)	22(55.0)		
Filed Results		412.43±74.51	407.85±73.94	-0.271	0.787

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3.2. Research Implementation

Based on D-Sketch as an auxiliary teaching method, the course "Preliminary Architecture" is carried out. Through the comparative analysis of the experimental group and the ordinary group, the conclusion is drawn.

3.2.1. The Normal Group

Using the traditional teaching mode, teachers mainly use pictures and two-dimensional vertical profile drawings to explain the introduction to architecture and cognition of architectural works. In the process of copying and drawing architectural works, traditional hand-painted expression techniques are used to let students copy and draw from plants, people, roads, mountains and other scenes to architectural perspectives, and comprehensively express the complete architectural perspective works. In the section of flat section learning, teachers use a large number of drawings to explain, focusing on the composition and reading of drawings, drawing norms and principles, so that students can further draw flat section of works. In the process of designing small architectural works, it explains the principle of architectural space combination and the method of architectural form formation, explains the architectural space scale with dimensional data, and emphasizes the application of spatial design principles and three components.

3.2.2. The Experience Group

On the basis of traditional teaching, the experimental group uses virtual simulation platform to learn, as follows:

Table 2. Comparison between experiential teaching and traditional teaching

stage	Experiential teaching class (experimental group)		Traditional teaching class (control group)	
	Teacher activities	Student activities	Teacher activities	Student activities
before class	Release learning tasks; D-sketch experience resources	Learning teaching videos and teaching materials; immersive experience	Prepare teaching contents and materials	Preview textbook (students hardly read it)
In class	Ask questions to guide learning Combined with students' experience, lead to key and difficult points	Learning architectural cases Participate in the discussion in groups Situational experience	Picture explanation summary Assign homework	Lectures Practical training
after class	Online support	Students' mutual evaluation and sharing	None	finish one's homework

Case experience stage. Before class, teachers use d-sketch platform to establish building cases corresponding to the teaching content, and distribute them to students for pre class experience through QR code. Scan the code before class to enter the immersive experience preview. In class, the platform is used to explain the abstract two-dimensional drawings and students' questions before class. After class, the d-sketch platform is used for review and interaction (Table 2). Many links of instructional design will use the content on the platform. For example, the use of mobile phone code scanning in the explanation link can enable students to participate in the architectural space experience. In the evaluation link, students can comment and praise each other to realize the interaction between teachers and students and student interaction. In this

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link, teachers guide students to experience classic architectural works in the virtual space, so that students can truly experience the immersive feeling, just like entering the external environment and content space of the building. On the other hand, students actively participate in learning activities, interact with mobile phones or tablets, and stimulate students' interest in learning.

Observation and reflection stage. Students need to learn how to use the d-sketch platform to achieve greater experience sharing. After the teacher's lecture, let students find models of similar architectural works, import them into the platform, create virtual simulation QR codes as part of case interpretation, and expand the model library. In order to guide students to carry out a wider range of experience observation and thinking, when students experience the virtual simulation, while introducing the understanding and operation of the platform one by one, teachers ask students to recognize architectural works, and ask students to record the experience VR and compare the similarities and differences seen when watching pictures. Combined with the application of superstar platform, set questions or discussions to master the answer of the whole class, and display the students' discussion in real time through the projection screen, so that teachers can really understand the mastery of knowledge of the students in the whole class at the first time, and decide whether to repeat it according to the situation.

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3.3. Research Method

3.3.1. Evaluating Indicator

After the training, the students in the two classes will be assessed, including ordinary assessment and final assessment, with a full score of 100. The scores of objective questions are automatically derived from the examination platform, and the subjective questions are scored anonymously by professional teachers, including architectural cognition, architectural expression, architectural composition and introduction to architectural design. (2) In the field of higher education, the measurement of teaching satisfaction is usually based on the American customer satisfaction model (ACSI). Zhang Bei [9] explored and studied the influencing factors and satisfaction of bilingual teaching based on ACSI. On this basis, through the analysis of relevant literature and the sorting of survey data, through design, expert review, pre-test, modification and improvement, it is finally determined that the questionnaire includes two parts: the first part is general information, including class, gender, age, filing score and graduation category; The second part is the teaching satisfaction scale. Each item of the scale adopts Likert grade 5 scoring standard, i.e. 0-4 points. 0 indicates "very disagree", 1 indicates "disagree", 2 indicates "neutral", 3 indicates "agree", and 4 indicates "very agree". The higher the scoring result, the higher the satisfaction. The scale finally forms 5 latent variable dimensions and 32 measurement items.

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3.3.2. Data Collection

This study mainly collects and arranges the data by means of questionnaire. The surveyed students have a good understanding of the questionnaire, and the survey data are relatively reliable. At the end of the semester, questionnaires were conducted in the experimental group and the ordinary group. Before the investigation, the author informed the students of the main purpose and significance of this investigation, and carried out the investigation on the basis of their voluntary participation. All survey data shall be filled in by the respondents.

3.3.3. Statistical Method

Using SPSS24.0 statistical analysis and processing of data. The measurement data were described by two independent samples t-test and repeated measurement analysis of variance; The counting data were described by example and percentage, and compared by test. P<0.05 was statistically significant.

3.4. Research Results

Table 3. Comparison of teaching comprehensive assessment results between experimental group and ordinary group ($\bar{x} \pm s$, points)

group	Number of cases	Comprehensive assessment score
General group	37	83.31±7.75
experience group	40	86.75±5.04
T value		2.287
P value		0.026

Table 4. Comparison of teaching satisfaction results between experimental group and ordinary group ($\bar{x} \pm s$, points)

dimension	Measure term	General group (n=37)	experience group (n=40)	T value	P value
Student ability	I have certain professional basic knowledge	2.14±0.673	2.13±0.648	-0.067	0.947
	I like this major and am willing to continue to study	2.92±0.795	2.75±0.840	-0.905	0.369
	I have studied other architecture courses	0.43±0.647	0.50±0.679	0.446	0.657
	I find it easy to learn "preliminary architecture"	2.46±0.869	3.08±0.656	2.690	0.009
	I like this course and try to improve my design ability	3.00±0.667	3.50±0.506	2.966	0.004
	I took the initiative to preview before class	1.65±1.006	2.60±0.841	3.443	0.001
	I take the initiative to review after class, find and solve problems	1.68±0.973	2.78±0.530	4.818	0.000
	I can think independently and put forward my own point of view	2.92±0.722	2.93±0.764	0.036	0.972
Teacher ability	Teachers can teach clearly and fluently	3.65±0.484	3.63±0.490	-0.213	0.832
	Teachers can interact with students in class and the atmosphere is active	2.89±0.737	3.43±0.675	2.689	0.009
	Teachers have affinity and are willing to communicate with students	3.30±0.618	3.35±0.580	0.386	0.700
	Teachers have enterprise experience and teach post ability	2.86±0.855	3.03±0.660	0.924	0.358

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	Teachers have a sense of responsibility and can patiently answer students' questions	3.51±0.559	3.45±0.597	-0.481	0.632
	Teachers have good moral sentiment, teaching and educating people	3.49±0.692	3.30±0.687	-1.186	0.239
content of courses	The course objectives are clear and the progress is reasonable	3.35±0.676	3.30±0.687	-0.330	0.742
	The textbook has a wide range of knowledge and strong readability	3.41±0.498	3.40±0.632	-0.041	0.967
	Rich extracurricular activities	3.32±0.580	3.30±0.564	-0.187	0.853
	There is a teaching network communication platform	3.38±0.492	3.30±0.516	-0.681	0.498
Incentive guarantee	Advanced teaching equipment	3.14±0.536	3.40±0.545	2.149	0.035
	The examination questions are moderate and the form is flexible	3.08±0.759	3.20±0.608	0.761	0.449
	Conducive to scholarships	3.35±0.484	3.43±0.501	0.655	0.514
Satisfaction	I am satisfied with the teaching of the course as a whole and have received a lot of goods	2.76±0.723	3.40±0.632	3.299	0.001
	Receipt greater than expected	2.70±0.909	3.38±0.628	3.019	0.004
	I feel relaxed and enjoy learning	2.70±0.661	3.30±0.648	3.476	0.001
	Get a good experience in the course and benefit a lot	2.95±0.705	3.53±0.506	4.165	0.000
	Didn't complain to the management about the teacher	3.78±0.479	3.73±0.640	-0.453	0.652
	Didn't complain to the teacher himself	3.86±0.419	3.90±0.304	0.423	0.673
	I haven't complained to my classmates about the teacher	3.49±0.507	3.60±0.496	0.993	0.324
	I will tell my learning experience to other students	3.03±0.897	3.63±0.628	3.363	0.001
	I will recommend other students to choose this major	2.84±1.041	3.60±0.709	3.779	0.000
	I'll take this course again when I have a chance	2.51±0.961	2.75±0.809	1.172	0.245
	I think this course is superior to other courses	2.92±1.064	3.55±0.846	2.892	0.005

4. Implementation Effect Analysis

Through the teaching implementation, investigation and analysis of 77 students in n universities, the semester comprehensive assessment results and teaching satisfaction scale are used to test. The results better explain the impact of the virtual simulation platform on teaching satisfaction.

The dimension of students' ability shows that the initiative of pre class preview and post class review of the experimental group is better than that of the ordinary group, the learning of preliminary architecture is significantly easier than that of the ordinary group, and the popularity of the course is significantly improved. Generally speaking, learning motivation is divided into internal motivation and external motivation. Internal motivation comes from learners' pleasure and satisfaction with the activity itself [10]. With the help of d-sketch platform, this study applies experiential teaching to design courses, and promotes learners' learning motivation by presenting personalized characteristics, rich and colorful media forms and stimulating dialogue. A large number of cases have proved that experiential teaching can bring students positive emotions such as relaxation, pleasure and interest, and stimulate the internal motivation of learning [11]. Learning motivation is affected by both internal motivation and external motivation. With the help of d-sketch platform, we can create realistic scenes and

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provide dynamic high interaction settings, in which learners show high learning motivation and participation. Whether it is virtual simulation architecture, simulated indoor space, or digital planning and design, the platform allows students to learn in an immersive experience. Learners, especially young learners, are often used to self representation and express their thoughts and feelings through roles. More importantly, this experiential learning stimulates learners' creativity and imagination.

The dimension of teachers' ability shows that the virtual simulation platform is conducive to the interaction between teachers and students and activate the class atmosphere. With the rapid development of network technology, in digital applications, computers are no longer the only tool to support teaching, and students are more inclined to use mobile phones for learning. Therefore, the d-sketch plug-in and VR cloud platform are introduced into the architectural design teaching of this subject to generate the architectural panorama, and students can use mobile phones to learn anytime and anywhere. D-sketch + VR technology has brought the reconstruction of traditional teaching methods, teacher-student interaction, student student interaction, and realized the interaction between media and media, between teachers and students and media resources, and remote interaction inside and outside the classroom.

The dimension of teaching content showed that there was no significant difference between the two groups. The teaching implementation of the experimental group is based on the traditional teaching of the ordinary group. Although there are differences in classroom forms, the curriculum standards, teaching objectives, classroom evaluation standards and teaching materials are consistent. On the other hand, no difference in the dimensions of teaching content is also a necessary condition for the comparison of other dimensions.

The dimension of incentive guarantee shows that it is particularly necessary to use modern teaching equipment. In the teaching process, it is always difficult for students to form abstract thinking through the curriculum. Just as people who haven't eaten hamburgers can't understand the taste of hamburgers, people who haven't experienced space can't understand the scale of space. Students lack experience, so it is futile for teachers to describe architectural space, and students are tired of being indoctrinated. In addition, it is difficult for students to establish three-dimensional communication space, and students' interest in learning is reduced. In order to solve this difficulty, traditional teaching often uses pictures and videos to enhance intuition, but pictures and videos can not reflect the concept of spatial scale, which affects the quality of learning and teaching to a great extent. In the teaching course, it is difficult to arrange students to visit the construction site. It is inconvenient to visit during the construction period. When they go, they can only understand the current situation at a certain time. Moreover, it is more unrealistic to take students around the world to see classic buildings. Therefore, with the rapid development of information technology, the use of new equipment and technology in architectural design classroom will bring new highlights and changes to the course.

5. Conclusion

The teaching quality of "preliminary architecture" directly affects the school running quality of architectural design specialty. Traditional teaching methods require students to have strong autonomous learning ability, which happens to be lacking in higher vocational students. This paper puts forward the reform of experiential simulation teaching, empirically analyzes the students' comprehensive assessment results and their satisfaction with the course teaching, and provides theoretical basis and teaching reference for colleges and universities to promote the course teaching of architectural design specialty.

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