

Teaching Practice of Architecture Courses based on Virtual Simulation

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Abstract Virtual simulation teaching of architecture courses is a teaching mode based on the deep integration of information technology and design class in intelligent environment. Under the background of new engineering, relying on a national virtual simulation laboratory, the exploration of green low-carbon simulation in architecture courses is of great importance for improving the dimension of scientific thinking of architecture undergraduates. In this study, based on the background of architecture curriculum construction, the practical content of the teaching reform of architecture courses based on virtual simulation was expounded from three dimensions of reshaping teaching objectives, updating teaching content and improving teaching evaluation. The practical paths of teaching reform of architecture courses were put forward under virtual simulation experiment teaching, namely building teaching teams, strengthening pilot courses, reforming teaching methods, optimizing classroom teaching content and evaluation methods, constructing practical classroom teaching form in line with the learning situation of architecture courses, building a smart learning platform, and closely combining resource construction, application and curriculum content. This study has important practical significance for optimizing and improving the teaching system of professional courses, adapting to the needs of the industry, enhancing competitiveness, and promoting the construction of first-class architecture courses.

Keywords Architectural design, Virtual simulation, New engineering, Green building, Teaching reform

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At present, there are many problems in architecture courses, such as weak green building design, lack of professional practice training and students' weak consciousness of innovation. The teaching of green building courses is conducive to cultivating mathematical thinking of architecture major^[1]. Based on the practice of green buildings, this study builds a training model for talents with distinctive characteristics to enhance practical innovation ability, solves the problems of weak innovation ability, weak innovation consciousness and separation between theory and practice of architecture major, and has carried out effective teaching reform and practical exploration.

Virtual simulation teaching is the development trend of computer information technology, as well as one of the important contents of new engineering teaching and research reform. Virtual simulation technology combines creative thinking and computer technology to achieve the purpose of architectural innovation design^[2]. How to apply virtual simulation technology to the teaching of architecture courses to train professional talents who can master green building technology under the background of new engineering is the frontier direction to promote the better and faster development of

China's construction industry and improve the technical level of the construction industry^[3].

In this study, combining the characteristics of architecture major and the needs of talent training, the methods and paths of collaborative education between enterprises and colleges and the selection of application-oriented talents are explored to improve students' practical application ability. With the construction of off-campus practice base as the starting point, the virtual simulation technology is applied to construct the practice training mode of undergraduates and postgraduates based on collaborative education between enterprises and colleges.

This research team has been engaged in the theoretical teaching, practical teaching and teaching management of green buildings in the architecture major for many years^[4-5], and is familiar with the cultivation rules of professional talents such as architectural design and architectural technology, and has a solid foundation for preliminary research. Under the guidance of the teachers of the teaching research group, the architecture students of Xi'an University of Science and Technology have achieved excellent results in architectural design competitions at home and abroad for many times. In order

to meet the needs of smart construction and green building development in the new era, the research team should constantly update the teaching content and teaching concept, and explore the education model of virtual simulation and school-enterprise cooperation^[6].

1 Practical content of teaching reform of courses of architecture major based on virtual simulation

1.1 Remolding of teaching objectives

Virtual simulation teaching has a high degree of compatibility with architecture courses, which is an effective way to train professionals to adapt to the future social and market needs^[7]. For the course teaching of architecture major, the ability of innovative practice can not only be obtained by classroom teaching, but also the design link is the key to cultivating students' creativity. In the virtual simulation mode, combined with the development needs of talents in the architecture industry, the teaching objectives of architecture courses are repositioned, and innovative engineering and technical talents adapted to the market needs of local social and economic development are cultivated by focusing on green building design and ecological building

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mode, so as to guide the updating of course teaching content and the selection of methods, and provide the basis for the organization, implementation and management of innovative practical teaching.

1.2 Updating of teaching content

Relying on multiple platforms such as the needs of schools, colleges and enterprises, the teaching content of courses of architecture major is updated based on the interdisciplinary characteristics of economics, humanities, ecology and other disciplines, and covers the following aspects. Firstly, virtual simulation experiment teaching is added, such as 3D modeling, energy consumption simulation, sound, light and thermal visualization simulation and other practical teaching content. Secondly, practice topics should be enriched, such as using real engineering practice projects, competition design topics, etc., enhancing the richness of teaching content and students' participation and initiative. Thirdly, students are organized to expand the second class, which is mainly reflected in extracurricular academic science and technology works competition and teaching practice, and the content learned in class is extended and improved to expand the overall thinking of students, and ensure the effect of overall teaching content on the cultivation of students' overall quality and skills.

1.3 Improvement of teaching evaluation

Improving the evaluation system is an important part of supervising teaching and innovative management. Teaching evaluation should not only pay attention to students' mastery of practical knowledge and assessment of students' practical ability, but also absorb employers' feedback on students' practical ability, and strengthen the continuous construction of teachers' practical ability. A teaching evaluation system based on virtual simulation teaching should be established, and a three-way linkage evaluation feedback mechanism of "teaching" and "learning", "use" and "teaching", "use" and "learning" should be implemented. Mutual evaluation between teachers and students is conducted, and the evaluation standards of curriculum teaching is improved.

2 Practical path of curriculum teaching reform under virtual simulation experiment teaching

2.1 Establishing a teaching team and strengthening pilot courses

The literature of the integration of modern information technology and education and teaching is collected and summarized, and

a teaching and research team is set up. The optimization and adjustment of curriculum construction is completed based on relevant literature review and virtual simulation learning club. The Principle of Site Design is selected as the pilot course of teaching reform of architectural design courses, and the design task book is updated to integrate it into the virtual simulation teaching experiment. The course teaching outline and assessment outline are updated. Combined with building simulation software, further study, research and practice of virtual simulation technology is conducted, including the operation and use of various simulation software and VR equipment.

2.2 Reforming teaching methods and optimizing the classroom content

It is necessary to innovate teaching methods, improve teaching effects, strengthen classroom design, integrate online teaching and virtual simulation experiment teaching, and pay attention to the cultivation of students' ability and quality. Besides, the deep integration of modern information technology and education and teaching should be strengthened to solve the problem of teaching and learning model innovation. The interaction between teachers and students and students in the classroom is strengthened to solve the problem of innovative and critical thinking training.

2.3 Optimizing classroom teaching content and evaluation methods

It is needed to reform the evaluation method of architecture curriculum, combine "process assessment" with "result assessment", and increase the proportion of process teaching content and assessment such as classroom interaction, design presentation, and virtual simulation experiment. The effective and efficient teaching contents for the cultivation of students' design thinking, research analysis and design expression are selected to strengthen the teaching.

2.4 Constructing the practical classroom teaching form according with the learning situation of architecture curriculum

The real site natural conditions, composition content and functional requirements of the actual construction project are used to prepare course design topics, guide students to conduct research and design in the real environment around them, analyze the interaction between buildings and people in the specific environment, guide students to experience and gradually realize the design concept of "green ecology" and "people-oriented" in the context, and stimulate students' interest in learning, and cultivate

students' ability to combine theory with practice.

2.5 Building a smart learning platform, and closely integrating resource construction, application and course content

It is needed to make full use of the teaching platform of the national virtual simulation experiment Center of the college, and closely combine the course teaching content with the platform application (Fig.1). In the classroom teaching, a variety of multimedia software technologies are used to edit the video recorded in lectures, movies and audio that students are interested in and are related to classroom knowledge points into teaching clips to make MOOCs. Combined with "Rain Classroom", "Xuexitong" and other Internet means, MOOCs can be applied in the classroom, and introduced into the teaching. Through the support of Internet platform and new teaching software, the construction of MOOCs is promoted, and students' interest in learning is stimulated.

3 Significance and extension value of teaching practice

3.1 Optimizing and improving the teaching system of professional courses

This research on teaching reform practice is conducive to promoting the reform and research on the construction of first-class architecture courses in Xi'an University of Science and Technology, plays a positive role in improving the quality of innovative practice education and teaching for architecture students and the training plan for architecture professionals, and is also conducive to forming a sound teaching system of architecture design courses.

3.2 Adapting to the needs of the industry and enhancing competitiveness

Guided by the OBE education concept, the seamless connection between the demand for talents in the construction industry and the training mode and curriculum system setting of architectural professionals can make architecture graduates better adapt to the market demand, so as to combine teaching with social employment and combine theoretical knowledge and practical skills^[8]. It is needed to enhance the employment rate of students and further strengthen the competitiveness of architecture major in Xi'an University of Science and Technology in the industry.

3.3 Promoting the construction of first-class architecture courses

Based on the optimization of the practice teaching system of architecture major by virtual simulation, the knowledge structure of

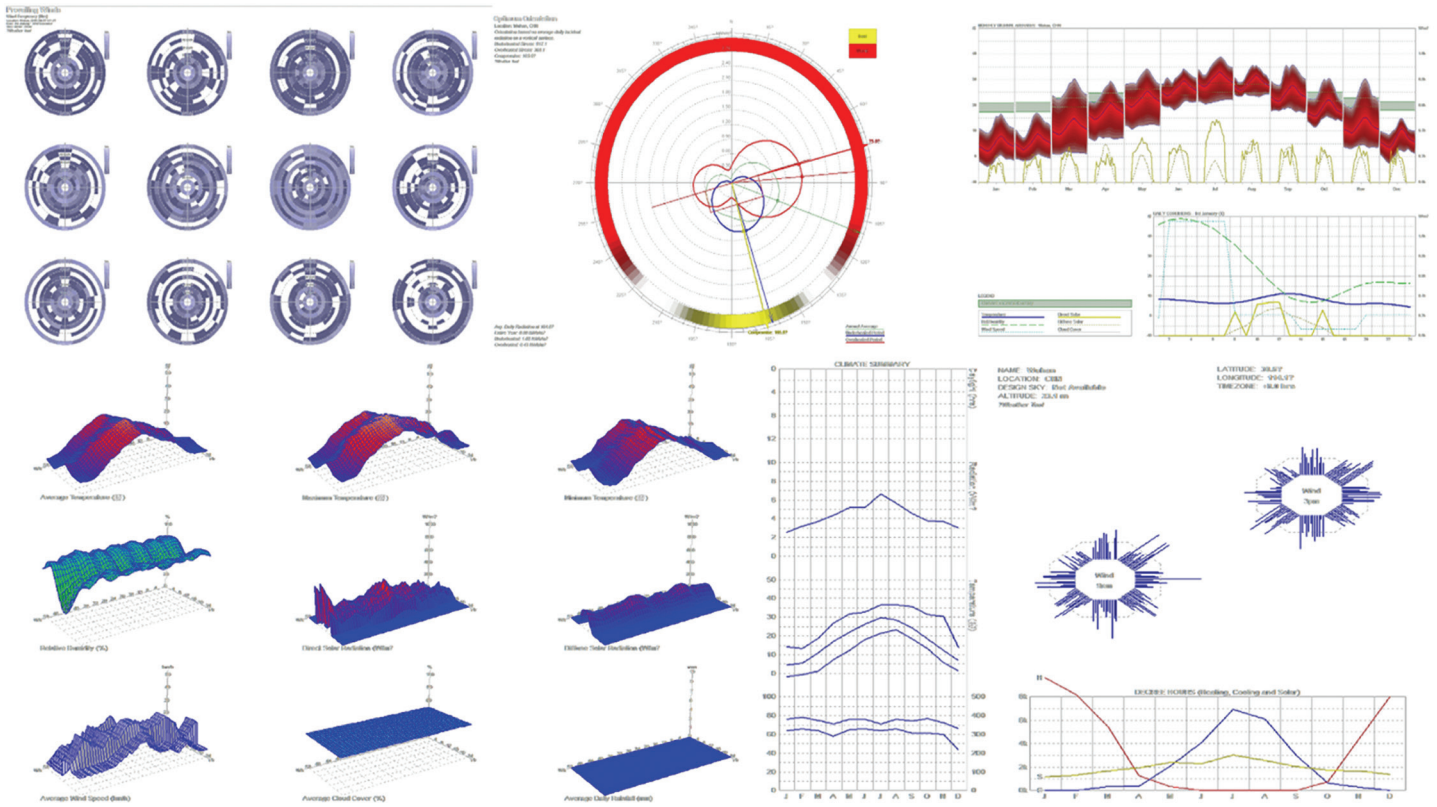


Fig.1 Use of simulation software for architectural design by students in architecture courses

traditional architecture disciplines is optimized, and characteristic majors are refined to form a unique discipline system, which will play a positive role in promoting the application construction of provincial and national first-class architecture courses of Xi'an University of Science and Technology.

4 Conclusion

To cultivate application-oriented architecture professional and technical talents with solid basic skills and the ability to solve practical problems on site, the research on teaching reform practice adheres to the talent training concept of “giving priority to virtue, attaching importance to ability, and all-round development”, and use “four-in-one” talent training mode to construct a new model of multi-direction architecture professional talent training based on the advantages and characteristics of architecture of Xi'an University of Science and Technology. It is necessary to strengthen the in-depth cooperation between schools, enterprises, industries, univer-

sities and research institutes, deepen the reform of teaching content and methods and assessment methods, actively explore the integration of science and education, optimize the architecture professional structure, expand professional service fields, and enhance the adaptability of talent training.

References

- [1] Hong, X. Q., Shi, F. (2022). Construction of teaching system of Green Building series courses under the background of “New Engineering”. National Supervision Board of Architectural Education, Architecture Teaching Steering Committee, Building Digital Technology Teaching Committee. Digital intelligence Empowerment: Proceedings of National Conference on Teaching and Research of Digital Technology in Architecture in 2022. *School of Architecture and Civil Engineering, Xiamen University*, 156-159.
- [2] Lu, Y. L. (2024). Research 3D digital modeling and virtual simulation technology of architecture. *Green Construction and Intelligent Building*, (3), 81-83, 135.
- [3] Yang, Q. Y. (2023). Application of virtual simulation technology in the field of architecture. *Urban Architecture Space*, 30(S1), 310-311.
- [4] Sun, Q. Q. (2019). Teaching exploration of green building design practice. *Journal of Landscape Research*, 11(5), 152-154.
- [5] Sun, Q. Q. (2021). Research on teaching practice under flipped classroom model. *Higher Education Research of Xi'an University of Science and Technology*, (1), 24-26.
- [6] Ren, X., Sun, Q. Q. (2022). Exploration and research on the construction of first-class under graduate major of architecture. *Journal of Landscape Research*, 14(4), 57-60.
- [7] Li, L., Zhang, H. (2018). Research on building spatial perception teaching mode based on VR interactive technology. *Chinese & Overseas Architecture*, (11), 54-56.
- [8] Lu, J. S. (2018). Analysis on the necessity of establishing virtual training center for architecture majors. *The Guide of Science & Education*, (25), 77-78.