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Application of Prefabricated Building Model in Practical Teaching of Architecture Specialty in Vocational Colleges

Bin Zhang*

Zibo Vocational Institute, Zibo 255314, China

***Corresponding author:** Bin Zhang, kainingbao11@163.com

Abstract: In order to transmit more application-oriented talents to the society, and to give full play to the value of vocational college training and education in the society, by taking the practical teaching of architecture major in vocational colleges as an example, this paper analyzes the form of teaching in vocational colleges and the application value of prefabricated building model in the practical teaching. Additionally, the application of the prefabricated building model combined with BIM Technology in the practical teaching of architecture major in vocational colleges as a reference was analyzed in this paper.

Keywords: Vocational colleges; Architecture; Prefabricated building model

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1. Introduction

School is a place for cultivating talents, therefore schools is not only the place to reserve national talents, but also the training place of national talents. The construction of innovation and entrepreneurship curriculum system by the school plays an important role in training the national talents. In 2019, the Ministry of Education of the People's Republic of China put forward the implementation work plan on vocational training of students, which requires vocational colleges to their responsibility in training the national talents [1], reform and develop the school education and training system, diversify the training of talents with innovative technological ability, give full play to students' working ability of innovation and entrepreneurship, and contribute to students' access to the society, and lastly creating value for the society. At present, especially in the construction field, the assembly technology and BIM technology represent the most advanced technology in the construction industry. Therefore, how to combine these two fields is the direction and innovation of the teaching of construction, especially in many higher vocational colleges is the question of many scholars.

Prefabricated building is to complete the design, production, assembly, and processing of many prefabricated components in the production workshop, and then transport a large number of building components to the construction site to assemble the scattered building components. At present, the development of prefabricated buildings is an important driving force to promote the rapid development of China's modern construction industry. In addition, the rapid changes of economic structure and construction industry provide many opportunities for the sustainable development and application of modern prefabricated buildings. With the introduction of policies related to energy conservation, emission reduction and sustainable development, prefabricated buildings have gradually become the development trend of

urban building materials industrialization. The prefabricated building construction system realizes the standardization of enterprise prefabricated building component construction design, production plant, transportation, logistics process, and construction installation, thereby improves the production efficiency of prefabricated building construction, and also reduces the construction waste [2]. In short, the construction of prefabricated buildings has broad development prospects in China [3].

Adopting the teaching method of combining theory and practice in the education of architecture, especially in vocational colleges can effectively improve the utilization efficiency of prefabricated building training base, give full play to the value of training base, and improve the effect of education. Firstly, teachers should apply prefabricated building training base to effectively design talent training plan in line with students' career development requirements, to make a plan suitable for students' career growth, and secondly, teachers should create a new teaching environment, effectively modify their personal teaching methods and teaching strategies in the prefabricated building training base, and improve the efficiency and quality of students' participation during the learning process. Finally, teachers should apply different teaching methods, innovate teaching methods, integrate network teaching system, strengthen students' training and guidance, provide an effective guarantee and support for students, and promote students' personal growth and development [4].

2. Significance teaching form of prefabricated building model for practical teaching of architecture specialty in vocational schools

2.1. Significance of practical teaching

Compared with other colleges and universities, vocational colleges have certain guidance in the direction of cultivating talents. The main purpose of vocational colleges is to cultivate post matching talents for the society, and mainly for social employment [2]. The education of professional architecture should focus on practicality, and only by highlighting practicality more outstanding talents can be exported to the society. There is a certain connection between prefabricated building mode and the architectural practice training of vocational education, which plays an important role in the practical education of architecture especially in the vocational education. Building a practical training platform based on a prefabricated building model in the relevant courses of prefabricated building in vocational schools may help to enrich the overall practice of model-based training, reflecting the application of the model, and play an important role in the training of prefabricated building talents [5]. Most of the students can be directed and practically exposed to various situations of prefabricated construction work, integrate the learning, and knowledge points of the theoretical part, and improve the professional application ability of the prefabricated construction technology. The practical learning and teaching of prefabricated buildings in vocational schools should not be implemented in the classroom a without prefabricated solid building model. Therefore, it is very meaningful to have the educational tools, and the foundation of the model, and further use it more.

2.2. Practical teaching form

2.2.1. Practical training

Hands on training is referring to students' on-the-job simulation and employment. Students can strengthen some of the core skills in specific training bases and places to improve their hands-on ability. In addition, in practical training, the students' personal and comprehensive skill training should be included. Further, during the training, students can effectively master the key skills, and form professional qualifications related to their major.

2.2.2. Internship

Internship follows a 'simply to learn while doing' concept. Usually, when the students complete the learning task, they have to attend an internship to apply the knowledge which they have learned in the school, is a way to test the students' mastery of the knowledge. Technical training practice is referring to the training that students performed the practical operation in the training base or in and out of the school under the guidance of teachers to understand specific skills or working methods. An internship allows the students to understand the knowledge better, and also get to know the application of the skills which they learn, which may improve their employability opportunity.

Practice is an important part of practical education in vocational schools. Practice is divided into knowledge, professional, post-employment, and other types of practice. In the cognitive practice, students visit the workplace or factory site to understand the knowledge and learning environment in advance, which may become the basis for the future performance. In the process of professional practice, students have mastered the relevant professional knowledge and can further improve their professional skills by engaging in practical work on the construction and production site. After the practice, the course an cultivates students' ability to use their own operation skills and professional knowledge, and exercises students' ability to solve production practice challenges. Based on the relevant documents from the Ministry of Education, vocational colleges should arrange employment internships for graduates, which needs to meet the vocational students demands after employment internship, which requirements of 6 months of internship, and further refine the job requirements and operation skills of graduates through practical training with cooperative units and enterprises, which can further enhance their employment competitiveness.

3. Application of prefabricated building model in practical teaching of architecture specialty

3.1. Teaching of prefabricated building construction based on BIM technology

3.1.1. Construction practice training module

The construction education and training module are mainly aimed at the construction personnel. It is a training mode which can help the construction personnel to quickly understand the prefabricated building. The construction training module is composed of construction simulation, rapid modeling, and self-assembly functions. There are many modules such as prefabricated buildings and prefabricated slabs, which have the function of construction simulation. Constructors can use VR glasses to look in all directions. The overall construction process of prefabricated buildings in the virtual world can be observed. The self-assembly function allows the construction personnel to wrap the precast slab, select the tower crane, and deploy the construction personnel by using the VR equipment of the virtual function module according to the construction process learned in the construction simulation [6]. With laboratory model, one can understand the precast slab of prefabricated buildings. In addition, the constructors can bring the construction drawings to the platform, establish a model with rapid modeling ability for their own projects, and simulate the nesting of precast slabs and layout on the construction site in virtual mode [7]. The system can automatically provide judgment and identification, lock the errors in the virtual construction process, find and report the actual problems before they become actual problems, report them to the construction personnel, and eliminate them in time according to the actual problems. BIM technology based on informatization and repeated demonstration are very effective, significantly saves the investment, reduce the resource waste, and lastly save the construction cost.

3.1.2. Deepen the teaching module

Strengthening teaching module is referring to the expand of the teaching depth in the prefabricated architecture. Teaching module is mainly for school students and industry researchers with sufficient learning time. The training module is aimed at personnel with different professional backgrounds and can

be divided into project management module and architectural design module as described below.
(1) Engineering management teaching: In the existing teaching methods, only theoretical explanations are often given, where the theoretical teaching methods are too abstract for learners, and their knowledge and learning ability are relatively limited. The in-depth understanding of the whole construction process requires personal participation to achieve the traditional intuitive effect of capacity acceptance [8]. Factors such as location, cost and learning time led to fewer relevant opportunities and learning time. This training module is mainly for learners who could not enter the construction site. Additionally, this training module allows the learners to participate in the whole construction process through VR, and understand and master the project management. This training module is combined with project management training and mainly includes two functions, such as site layout and construction schedule management.
(2) Architectural design teaching: In nested components, learners can divide models to understand the design principle, and can also simulate the assembly of various prefabricated components, such as building blocks. In this process, learners can also compare and optimize the same type of 'family'. For example, some prefabricated components in a prefabricated building model can be disassembled and replaced with components of the same type and different materials [9]. Through the prefabricated model and BIM technology, students can understand the principle of prefabricated components, conduct in-depth analysis, and master the design process and construction process of the prefabricated buildings.

3.1.3. Read the construction drawings of prefabricated buildings

The project leader of the 'studio' assigned the engineers to read the construction drawings according to the existing construction drawings of the rigid fabricated structure education model of the university. The main task of the engineer is to read and complete the specific two-dimensional construction drawings and each node of the construction drawings, which correspond to the detailed drawings of the atlas nodes one by one. During reading, technicians can communicate with modelers in time to facilitate the modelers in conducting the BIM modeling on the construction drawings for the first time [10]. The analyst can check the practice of the rigid fabricated structure training model, while the quality inspector can check the construction quality of the rigid fabricated structure training model according to the acceptance requirements, and the personnel can record their work data at each post together with other post personnel.

3.1.4. BIM modeling

Based on BIM technology and construction drawing of fabricated structure, 3D model of fabricated structure is constructed. It uses BIM technology to convert 2D drawings into 3D models, and uses 3D buildings example to display the detailed and building structure. The project leader provides BIM 3D modeling guidance to the modeler, subsequently the modelers communicate with the technicians to complete the technical clarification, and then design the training model of robust assembly structure. The feedback and cooperation of analysts, quality personnel, and data personnel were included in the modeling process [11-13].

3.1.5. Comparative analysis of BIM model and rigid fabricated building structure model

By comparison to the established BIM 3D model with the rigid prefabricated building structure model to detect the construction defects in the solid prefabricated model (the construction defects designed by teachers in advance). Using the intuitiveness of 3D modeling of BIM technology, compare with the solid model, and analyze the causes of construction defects of the solid model and construction avoidance measures [14]. The project leader and the analysts of the team summarize and analyze the events and problems and propose solutions.

3.1.6. Testing and training of assembled building solid structure model

The construction quality of the existing prefabricated solid model was examined and approved based on the BIM 3D model. In accordance with the relevant requirements of the construction quality approval specifications, the quality of the solid model was tested in terms of handling and hoisting perpendicularity, reinforcement amount (diameter and spacing), and construction of joints (reinforcement location and quantity). During the test, students must be proficient in the test equipment, be familiar with the basic requirements of assembly structure approval, and have clear records of approval results. This process can be completed through communication and coordination between the team quality officer and other members [15,16].

3.1.7. Education summary report

Based on the engineering project of a solid prefabrication model, students write a summary, point out the specific errors, analyze the reasons, and discuss why the internal and external temperature difference is too large until can form cracks.

4. Summary

To sum up, in the practical teaching of architecture, specialty in vocational colleges, the rational application of the prefabricated building model combined with BIM technology has a good teaching effect. There are three forms of architectural practice teaching in vocational colleges, which are experiment, practice, and practical training are all ways to cultivate the professional ability of students majoring in architecture in vocational colleges. In the context of the development of prefabricated architecture, the practical teaching of architecture, specialty in vocational colleges should deepen the application of prefabricated architecture teaching, and strengthen the practical teaching of architecture, specialty in combination with BIM technology and prefabricated building model, including construction, construction drawings, building model construction, BIM model and assembled building model comparison, solid model structure test and the final practical teaching summary, and others. Prefabricated building model has important application value in the teaching of architecture, specialty in vocational colleges, and can realize the purpose of talent training in vocational colleges.

Disclosure statement

The author declares no conflict of interest.

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