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Research on Teaching Reading Building Construction Drawings Based on BIM Technology

Song Ronghui*

Zhejiang Tongji Vocational College of Science and Technology, Hangzhou, China
**Corresponding author: 42763610@qq.com*

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Abstract: Reading building Construction Drawings course is a supporting course for cultivating reading ability, but there are many problems in the teaching. On the basis of analyzing the existing problems of the course, this article lists the traditional solutions and their drawbacks. Then, a teaching method based on BIM technology is proposed, and its feasibility is analyzed and its specific application methods are introduced. Finally, the advantages and effects of this teaching method were introduced, hoping to provide assistance for the teaching of others.

1. The problems in teaching the reading building construction drawings

In civil engineering majors, the ability to read building construction drawings (hereinafter referred to as "ability to read drawings") is a basic ability for students, which not only affects the learning effectiveness of core professional courses, but also has a profound impact on future employment and career development. However, as a supporting course for cultivating reading ability, there are mainly problems in the teaching of "Reading Building Construction Drawing".

There are many symbol standards that are difficult to master, and students lack spatial imagination ability.Even if students master the basic graphic components and symbols, it is still difficult for them to fully understand and accurately comprehend the actual appearance of the building described in the drawings. To convert flat drawings into three-dimensional entities, students are required to have rich and active spatial imagination. However, vocational college students generally exhibit relatively weak abstract logical thinking abilities in their studies, and the lack of spatial imagination has become a major obstacle to learning how to recognize drawings[1-2].

These problems seriously constrain the effectiveness of cultivating students' ability to read drawings.

2. Traditional solutions and their drawbacks

There are mainly five traditional solutions, which are in order:

2.1. Multimedia images or videos

The pictures or videos taken at the construction site can help students understand some professional terms, but due to the inability to compare physical objects with drawings at the same

time, or the inability to compare drawings with physical objects 100%, the improvement of drawing recognition ability is limited. Additionally, due to the progress of the project, only the components constructed during the current period can be seen. Additionally, due to factors such as networking and confidentiality, the number of projects available for photography is very limited. Multimedia images or videos cannot display the full cycle dynamic form of components and all typical engineering components.

2.2. Physical models

Although physical models can meet the requirements of teaching to a certain extent, they have insurmountable limitations. The shortcomings are as follows:

2.2.1. Few types of physical models

The types of physical models for teaching available on the market are limited and can only cover commonly used typical components or constructions. In our actual engineering, there are many types of components, and each type of component has different styles; There are even more diverse types of structures, and even if the types of components are the same, different factors such as component cross-sections and elevations can lead to vastly different forms of combined structures. At present, physical models can only display individual components or the overlapping relationships of different components with limited quantities, which can only be considered as the tip of the iceberg. There are few types of physical teaching models, making it difficult to effectively display the content expressed in the sectional view, and it is also difficult to display the primary and secondary relationships of multi component overlap in a three-dimensional manner. For inexperienced beginners, it is far from meeting their learning needs.

2.2.2. Most physical models are "dead" and cannot be disassembled

If the physical model cannot be disassembled, the teaching function will be greatly reduced. It can only display the exterior of the entire house or the limited components and structures in some parts, and cannot fully display all the components and structures inside a building. However, currently, almost all models on the market are non removable, and even if there are, only a few simple components can be disassembled without any substantial effect. The author has consulted a large number of product catalogs of building or teaching model production companies, and has not found any companies that produce detachable models on a large scale; To customize a self-designed detachable model, the feasibility is very low, either due to inadequate production processes or high customization costs[3-4].

2.3. Site visit to the construction site

Taking students to visit the construction site can provide a more intuitive and comprehensive understanding than showing them pictures. However, in addition to the shortcomings listed in the aforementioned "2.1 Multimedia images or videos", the safety of construction sites cannot be ignored. Students entering the construction site on a large scale may have some safety hazards, and it can also affect the construction progress. In addition, expenses such as round-trip transportation and remuneration for construction site leaders also need to be considered.

2.4. On campus training base - Half finished project

The half finished project can allow students to visit the under construction project on the premise

of safety. However, the cost of half finished project is high, often ranging from hundreds of thousands to millions. Secondly, there are many types of structures and components in buildings, and it is impossible to display all of them in a half finished project. In addition, with the continuous introduction of new processes and materials, the expensive construction of half finished projects will gradually become outdated and useless.

3. Feasibility of teaching based on BIM technology

How to accurately and quickly recognize plan drawings as a three-dimensional building in the brain after seeing the entire set of drawings is the difficulty of reading building construction drawings teaching. In view of the problems existing in the traditional methods mentioned above, the author attempts to integrate BIM technology into reading building construction drawings teaching to help students eliminate obstacles to read drawings, improve spatial imagination ability, and ultimately enhance their interest and ability to read drawings.

Due to the development of the economy, multimedia teaching has been greatly popularized, and most classrooms have installed multimedia teaching facilities. BIM related software is a necessary professional teaching software, which schools will purchase to meet the hardware conditions for BIM application in reading drawings teaching. Using purchased BIM related software for reading drawings teaching at no additional cost can be considered as fully utilizing existing teaching resources, which is economically feasible; The operation methods of BIM related software are easy to learn. Even in multimedia classrooms without installed computing software, pre madereading drawings resources can be used for teaching. The specific method is to pre create ireading drawings resources in BIM related software, selectively take screenshots or record videos, and then create PPT or WORD documents, which have good display effects and are technically feasible.

4. Specific methods for integrating BIM into drawing recognition teaching - ZBZ circular teaching method

Teachers prepare 2-3 sets of construction drawings covering various typical structures and various typical components, distribute them to students, model these drawings in BIM-related software, and then use the ZBZ circular teaching method for teaching.

The ZBZ cycle teaching method refers to the process of two-dimensional drawings - BIM three-dimensional architecture - two-dimensional drawings. Students first look at the two-dimensional drawings, then look at the three-dimensional models in BIM-related software, and then draw their own two-dimensional drawings (sketches) to complete the ZBZ process from two dimensions to three dimensions and back to two dimensions. Each cycle is not a cycle in situ, but a cycle that moves up a step. Students' spatial imagination and ability to read drawing are trained in this way, and continue to improve. Here we focus on how to operate the "B" (three-dimensional models in BIM-related software) in the ZBZ[5-6].

4.1. Reading of planar detail drawings of components

Step 1: Display the selected components. In the software, independent foundations, columns, beams, slabs, stairs, canopies, steps, aprons, etc. are all referred to as components. In the "Component Element Display Settings", you can select the components that need to be displayed and hide those that are not needed for the moment. Selective display of components can also be achieved through keyboard shortcuts. Adjust the input method to uppercase and press the corresponding letter of the component.

Step 2: Use the "3D Dynamic Viewer" command to rotate the building model arbitrarily and

observe the 3D solid model from any angle, so as to choose the best angle for observation.

Step 3: The "Top Down" command can display the graphic of the building viewed from directly above, that is the plan view. Combining "Top Down" with "3D Dynamic Viewer" can achieve the transformation between plan view and 3D model, it can also enable students to better understand the principle of drawing component plan details and establish spatial imagination ability.

4.2. Reading of component section (elevation) detail drawings

The commands "Left", "Right", "Front", and "Back" display the four-direction elevation views of the component, respectively. When they combined with the "3D Dynamic Viewer" command, they can be used to convert section (elevation) views to 3D models, these enabline students to better understand the principles of drawing section (elevation) views and build spatial imagination skills.

4.3. Recognition of floor plans

The reading method for floor plans, foundation plans, column layouts, pile layouts, beam reinforcement plans, slab reinforcement plans, and other floor plans is basically the same as that of component plan details. The difference is that the floor to be displayed is selected in the "floor".

4.4. Recognition of sectional (vertical) plane diagrams

The reading method for the overall profile of the building, as well as the four facades in the southeast, northwest, and northwest, is the same as the reading method for the component section (elevation) detail drawings.

4.5. Comparison and Reading of Plan and Section (Vertical) Surface

Combining the "Floor" command with the "Selective Display of Components" command, that is, select the floor to be displayed in the "Floor Selection Box", select the components to be displayed in the "View" menu or shortcut key, can display all or selected components in a floor, as well as all or selected components in certain floors. Combined with the rotation of the "3D Dynamic Observer" angle and the zooming in and out of the page display, the building components and internal structure can be fully displayed in a three-dimensional manner. Not only it can help students understand the drawing principle of drawings, but it can also demonstrate the construction problems of different component combinations (overlaps), such as underground engineering. Due to the strong concealment, it has always been a pain point in learning. In the three-dimensional drawings of BIM related software, the shapes, heights, and overlapping relationships of various components such as cushion layers, independent foundations, foundation beams, and frame columns can be clearly seen, and the difficulties can be easily solved. The construction problem of component combination (overlap) is precisely the difficulty and focus of the reading drawings course, and the ingenuity of BIM related software in Reading building construction drawings teaching also lies in this[7-8].

5. Teaching effectiveness of reading drawings course based on BIM technology

After several years of practice by the author, the teaching effect of teaching reading drawings course based on the BIM technology is good, as follows:

5.1. It can stimulate students' interest in learning

Research by domestic and foreign education scholars has found that if students enjoy a certain activity, they will repeat it and enjoy it tirelessly, thereby improving their skills. The visual display of three-dimensional models using BIM technology allows students to no longer struggle to imagine the content expressed by boring drawings, greatly increasing their interest in learning how to read drawings. A questionnaire survey shows that students' willingness to learn has increased from 72.63% to 93.46%. In addition, in general, vocational college students study reading drawings courses in their first year. During the process of learning reading drawings courses, they are exposed to BIM technology and see software in the hands of teachers, transforming from flat drawings to lifelike 3D building models. This will generate infinite longing for BIM related software and a strong interest in learning, which will be very beneficial for them to learn BIM related software in the future.

5.2. Achieving twice the result with half the effort in teaching from simple to complex, from easy to difficult

BIM related software can create different 3D models based on different building construction drawings, so that teaching can be carried out using different building construction drawings according to the learning stage and level of students, achieving teaching organization from simple to complex, from easy to difficult, and achieving twice the result with half the effort.

5.3. Display various building structures and components

BIM related software has the function of viewing by floor or selected components in a "3D dynamic observation" state, which can display all or some selected components of a certain floor at the best angle in a three-dimensional manner, and can also display all or some selected components of certain floors. In this way, BIM related software can easily solve the problem of limited types of physical models and dead models, displaying various building structures and components.

5.4. It can effectively improve students' spatial imagination and ability to read drawings

BIM related software, due to its inherent characteristics of flat graphics and three-dimensional views, can display both flat drawings and three-dimensional models from multiple angles; Not only does it clearly express the principles and methods of drawing each type of diagram, enabling students to deeply understand how a certain type of diagram is drawn, but it can also achieve the mutual transformation between flat drawings and 3D models. By comparing 3D models with 2D flat drawings, and through repeated training, students can establish a good sense of spatial scale and improve their ability to read drawings. The questionnaire survey shows that the satisfaction of students with learning outcomes has increased from 79.57% to 93.36% in the current period; The satisfaction of graduates with learning outcomes increased from 65.39% to 84.74%.

5.5. Save teaching expenses

The school's teaching budget is limited, and the types and quantities of models for reading drawings teaching that can be purchased are limited. Due to limitations such as exhibition venues and a large number of students, these expensive models have very limited impact on teaching. BIM related software is an essential professional teaching software for architecture. Using BIM related software already purchased by the school to create teaching and training resources for reading

drawing courses requires minimal or even zero expenditure. Compared to purchasing physical models, the cost is very low, which can save a lot of teaching expenses for schools.

6. Conclusions

Compared to traditional reading drawing teaching, the teaching based on BIM technology can quickly and economically create various engineering models, with multiple display angles and strong three-dimensional sense. The key technologies involved are also not many. After reasonable application, it can greatly stimulate students' learning interest and achieve good teaching effects, which is worth promoting.

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