

Application of Project Teaching Method Based on BIM in the Course of Engineering Cost

Lirong Bao^{1,a,*}

¹*School of Civil and Architectural Engineering, Nanjing Tech University Pujiang Institute, Nanjing, China*

^a*blr1234@126.com*

^{*}*Corresponding author*

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Abstract: With the rapid development and wide application of building information modeling (BIM) technology, its application value in the field of engineering cost has been paid more and more attention. In order to make students better adapt to the needs of the development of the industry, it has become an inevitable trend to integrate BIM technology into the course of Engineering Cost. Project teaching method, as a teaching method with students as the main body, actual projects as the carrier and practical application as the orientation, provides an effective way for the application of BIM technology in the course of Engineering Cost. This paper will focus on how to effectively apply the BIM-based project-based teaching method in the course of Engineering Cost, aiming to improve students' practical operation ability, innovation ability and teamwork spirit, and lay a solid foundation for their future career development.

1. Introduction

In the traditional "Engineering Cost" course, students often master relevant knowledge and skills through theoretical study, but lack of practical operation opportunities, resulting in a disconnect between theory and practice. The project teaching method based on BIM can combine theoretical learning with practical operation, so that students can deeply understand and master the core knowledge and skills of engineering cost in the process of completing the actual project. In addition, the parameterization characteristics, visualization advantages and powerful information sharing ability of BIM technology make project-based teaching method more efficient and practical, which helps to improve students' practical ability and cultivate their innovative thinking and teamwork spirit.

2. The concept of BIM project teaching method

The English name of BIM technology is Building Information Modeling, that is, building information modeling. It manages information in construction projects by creating 3D models that are updated in real time throughout the project lifecycle to ensure that all involved have access to the latest and most accurate information.

2.1. Overview and development of BIM technology

Building Information Modeling (BIM) technology, as a revolutionary technology in today's construction industry, has gradually become an important tool in the engineering construction industry. BIM technology covers not only the geometric information of a construction project, such as length, width and height, but also non-geometric information, such as the maintenance cycle of equipment and the sustainability of building materials. This comprehensive information management helps to improve the efficiency and accuracy of decision making, reduce project risks, and reduce resource waste. It uses a digital way to manage the entire life cycle of a building, from design, construction to operation and maintenance. BIM technology enables project participants to work together better and improve the transmission and sharing of information. With the rapid development of China's construction industry, the application of BIM technology is increasingly extensive, and the demand for professionals who master BIM technology is also increasing^[1].

2.2. The basic concept and application significance of project-based teaching method

Project teaching method is a practical project as the carrier, students as the main body, practice-oriented teaching method. By guiding students to complete practical projects, it enables students to master knowledge and skills in practice and improve their ability to solve problems. In the course of Engineering Cost, project-based teaching method can help students combine theoretical knowledge with practical operation to better understand and master the core content of engineering cost. Combining BIM technology with project-based teaching method can better realize the combination of theory and practice. Through BIM technology, students can simulate real projects in a virtual environment and improve their practical ability. At the same time, project-based teaching method can stimulate students' learning interest and initiative, and cultivate their teamwork and innovation ability^[2]. This teaching method has important application significance for training high-quality engineering cost personnel who can adapt to the development of the industry.

The application of BIM technology in the course of Engineering Cost can change the traditional teaching mode and enable students to better understand and master the core knowledge and skills of engineering cost. Through BIM technology, students can carry out engineering quantity calculation, cost analysis, construction simulation and other operations in a virtual environment to improve their practical ability^[3]. In addition, the visualization characteristics of BIM technology can also help students better understand the overall structure and detailed design of the project, and improve their spatial imagination ability and drawing reading ability.

The application of BIM based project-based teaching method in the course of Engineering Cost can realize the organic combination of theory and practice. Through the introduction of practical projects, students can master the application skills of BIM technology in engineering cost during the completion of projects. At the same time, this teaching method can stimulate students' learning interest and initiative, and cultivate their teamwork and innovation ability. In the implementation process, teachers need to design project cases with practical application value in combination with the characteristics of BIM technology. At the same time, teachers also need to establish a sound project implementation and management mechanism to ensure the smooth progress of the project and the effective improvement of students' ability.

3. The application of BIM technology in the course of Engineering Cost

As a core course of engineering management major, Engineering Cost aims to train students to master the basic theory, method and technology of engineering cost, and have the ability to engage in engineering cost management. With the rapid development of the construction industry and the

continuous improvement of information technology, BIM technology has been applied more and more widely in the field of engineering cost^[4]. The introduction of BIM technology into the course of "Engineering Cost" can not only help students better understand and master the course content, but also improve their practical ability and comprehensive quality.

3.1. The advantages of BIM technology in engineering cost

The application of BIM (Building Information Modeling) technology in the field of engineering cost has brought many significant advantages, making traditional engineering cost management methods innovative (see table). Firstly, the parametric characteristics of BIM technology make the calculation of engineering quantities more accurate and efficient. The traditional engineering quantity calculation mainly relies on manual labor and is prone to errors, while BIM technology can quickly and accurately obtain the engineering quantity in each engineering stage by building a three-dimensional model, and provide reliable data support for the estimation of engineering cost.

Secondly, BIM technology can achieve multi-stage collaboration. At different stages of design, construction and cost management, participants can share data and work together on the same platform. This greatly improves the efficiency of information transmission and reduces errors and delays caused by poor information. Each participant can update the data in real time on the platform, ensuring the real-time and accurate information.

The visual characteristics of BIM technology also bring convenience to engineering cost management. Through the BIM model, the designer, the construction party and the cost party can intuitively see the overall structure and detail design of the building, and better understand the actual situation of the project. This helps to identify potential problems in advance, optimize design solutions, and reduce late changes and cost increases. In addition, BIM technology also helps to achieve fine management. With the help of BIM model, the whole process of the project can be dynamically monitored, and the progress and cost consumption of the project can be tracked in real time. This enables the management to identify problems in time and make adjustments to ensure the smooth progress of the project and the effectiveness of cost control^[5].

The application of BIM technology has also promoted industrial upgrading. With the improvement of information technology and intelligence in the construction industry, BIM technology has become the development trend of the industry. Promoting the application of BIM technology can improve the production efficiency and management level of the entire industry, and promote industrial upgrading and innovation.

3.2. The concrete application example of BIM technology in the course

In the course of "Engineering Cost", the application of BIM technology has been more and more extensive. Below are some concrete examples that demonstrate the practical application of BIM technology in the course.

Firstly, the use of BIM model for engineering quantity calculation is one of the important contents in the course. Students learn how to build 3D models using BIM software and automatically extract engineering quantity information based on the models. This process not only improves the efficiency and accuracy of engineering quantity calculation, but also helps students better understand the basic principles and methods of engineering quantity calculation. In practice, students can calculate engineering quantities according to the model data of different construction stages in order to optimize the design scheme and analyze the cost.

Secondly, BIM technology can also be applied to construction simulation in the course. Through the virtual construction process, students can simulate the actual construction process in the course and understand the situation of each construction stage. This helps students better understand the

construction process, construction difficulties, and potential risk factors. At the same time, by simulating the construction process, students can also optimize the construction plan, improve the construction efficiency and reduce the cost. This is of great significance for cultivating students' practical operation ability and problem-solving ability.

In addition, BIM technology is also applied to collaborative work in the course. Using the collaborative characteristics of BIM technology, students can collaborate with multiple people on the same platform. For example, when developing a construction plan, students can discuss it together, make plans, and update them in real time. This helps to develop students' teamwork, communication and project management skills. Through collaborative work, students can better understand the roles and responsibilities of different participants in the project and improve the management ability of the entire project.

In the course of "Engineering Cost", the application examples of BIM technology are very rich. Through practical operation and application, students can better understand and master the basic theory, method and technology of engineering cost, and improve their practical ability and comprehensive quality. At the same time, teachers can also improve teaching methods and means by introducing BIM technology to improve teaching effect and quality.

3.3. Comparative analysis of BIM technology and traditional methods

Compared with traditional methods, BIM technology has significant advantages in the course of Engineering Cost (Table 1). First, traditional methods tend to rely on manual calculations and paper drawings, which are error-prone and inefficient. The BIM technology can automatically complete the engineering quantity calculation and cost analysis, which greatly improves the work efficiency and accuracy. Secondly, it is difficult for traditional methods to achieve multi-stage collaboration and information sharing, while BIM technology can achieve effective collaboration at all stages and real-time update and sharing of information. In addition, traditional methods have limitations in data analysis and sustainability assessment, while BIM technology can provide multi-dimensional data analysis capabilities and comprehensive sustainability assessment.

Table 1: Comparative analysis of BIM technology and traditional methods

Comparative aspect	BIM technology	Traditional method
Data source	Comprehensive building information model	Single engineering drawing and documentation
Information representation	Visual, 3D model	Text description, two-dimensional drawings
Information processing capability	Powerful data processing and simulation capabilities	Weak information processing ability
Design flexibility	Easy to modify and optimize the design	Design changes are difficult and need to be redrawn
Cost control	Real-time monitoring, precise cost control	After control, cost control is difficult
Time schedule management	Real-time simulation of construction progress, precise control of time nodes	Time schedule management is not accurate, easy to delay the construction period

However, the traditional method also has its advantages. For example, for some simple or small

projects, the traditional method may be simpler and more intuitive. In addition, some teachers and students may be more familiar with traditional methods and therefore more receptive and applicable. Therefore, the selection and application should be combined with the actual situation in the actual teaching.

4. Project teaching method design based on BIM

BIM based project-based teaching method is a teaching method that combines BIM technology with project-based teaching method, aiming at improving students' practical ability and comprehensive quality.

4.1. Project selection and design principles

First of all, it should be noted that although in the school environment, the actual teaching project should also come from the actual project, with authenticity and practical significance, so as to reflect the actual situation of the project and the actual needs of cost management, so that students can better understand the problems and challenges in the actual project, and improve the ability to solve practical problems.

Secondly, the project should be systematic, covering the whole process of project cost management, including investment decision, design, bidding, construction and other stages. In this way, students can have a comprehensive understanding of the whole process of engineering cost management and better grasp the contact and collaboration at various stages^[6]. At the same time, the project should be operable, moderate in difficulty and easy to allow students to complete in a limited time. At the same time, the project should also be scalable and can be adjusted and expanded according to the actual situation of students to meet the needs of students at different levels.

Project-based teaching method should be student-centered and pay attention to students' participation and practice. The design of the project should fully consider the interests and abilities of students, stimulate students' initiative and enthusiasm, and cultivate students' innovative ability and teamwork spirit.

4.2. Construction cost process based on BIM

In the process of construction project cost management, the effective application of BIM technology can avoid the management drawbacks caused by the traditional project cost pricing and measurement, and better analyze and compare the relevant engineering quantities and project prices by establishing an effective mathematical model, so as to calculate the scientific and effective engineering quantities. It provides an important technical basis for more convenient improvement of the accuracy of the calculation structure, and greatly reduces the input of manpower and material resources. Through the scientific form of cost control calculation, the cost control results can be better reflected (Figure 1).

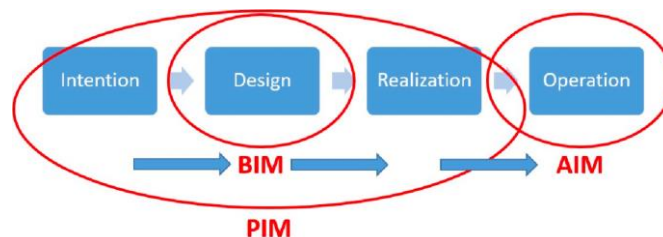


Figure 1: BIM schematic diagram

- (1) Building BIM model: Using BIM software to build 3D models, including professional models

of architecture, structure, and mechanical and electrical engineering. The model should contain all the information and parameters of the building, so that the subsequent quantity calculation and cost analysis can be carried out.

(2) Engineering quantity calculation: The engineering quantity calculation is based on the BIM model, including the engineering quantity of each profession and each stage. Engineering quantity calculation shall be carried out in accordance with relevant codes and standards to ensure accuracy and reliability.

(3) Cost analysis: Conduct cost analysis based on BIM model and engineering quantity data, including pricing and cost estimation. With the powerful function of BIM software, multi-dimensional cost analysis can be carried out, such as time dimension, cost dimension, geographical dimension, etc. At the same time, sensitivity analysis and risk assessment can also be carried out to provide strong support for decision-making.

(4) Optimization and decision: Optimize and decision based on BIM model and cost analysis results. The optimization mainly includes design scheme optimization, construction scheme optimization, etc. Decision-making involves investment decision-making, bidding decision-making and so on. Through optimization and decision-making, costs can be reduced, benefits and risk control can be improved.

(5) Collaborative management: the collaborative characteristics of BIM technology are utilized for collaborative management. In the whole process of the project, the participants can share data, exchange information and collaborate on the same platform. Through collaborative management, information obstruction and error can be reduced, and work efficiency and cooperation effect can be improved.

4.3. The implementation plan of project-based teaching method in curriculum

The implementation plan of project-based teaching method is a very important link in the course of Engineering Cost, aiming at improving students' practical ability and comprehensive quality (Table 2). The implementation plan mainly includes: according to the curriculum content and teaching objectives, the teacher chooses the actual project as the project, and defines the project objectives and requirements; Students should understand the background, requirements and objectives of the project, as well as their own roles and tasks in the project; Students set up a project team according to the needs of the project and their own interests and abilities; Each team should include students with different professional backgrounds and skills for better cross-professional collaboration and communication. Teachers guide and coordinate the composition of the team to ensure the effective operation of the team; Team members discuss together to make a detailed project plan, including project time arrangement, task division, schedule control, etc. Teachers review and guide the project plan to ensure its feasibility and effectiveness. At the same time, the team members will carry out the implementation of the project in accordance with the established project plan and division of labor. In the process of implementation, teachers should provide necessary guidance and support to help students solve problems and difficulties encountered. Students are expected to actively collaborate, communicate, and innovate in order to achieve the goals and requirements of the project^[7].

After the project is completed, the team members should present and report the results. Through presentation and reporting, let other students and teachers know the implementation process and results of the project. At the same time, through evaluation and feedback, students can better understand their own strengths and weaknesses, and further improve their practical ability and comprehensive quality^[8]. At the same time, team members should summarize and reflect on the whole project implementation process. Summarize the harvest and experience and lessons of the project, reflect on their own performance and shortcomings in the project. Through summary and reflection,

students can better learn lessons and improve their practical ability ^[9].

Table 2: Implementation plan of project-based teaching method

Procedure	Content	Goal
1	Identify project tasks	Select the actual project as the project, clearly define the objectives and requirements
2	Build project team	According to the interests and abilities, set up a team, division of labor cooperation
3	Make project plan	Make detailed project plan, including time arrangement, division of tasks, schedule control, etc
4	Implement project plan	Implement according to the plan, with regular checks and adjustments during the process
5	Project results display and evaluation	Demonstrate project results, report and evaluate, and summarize lessons learned
6	Summary and reflection	Summarize and reflect on the whole project implementation process, and learn lessons

The implementation plan of project-based teaching method should take actual engineering as the background, and let students learn and master the knowledge and skills of engineering cost through teamwork and division of labor. At the same time, teachers should provide necessary guidance and support to help students solve problems and difficulties encountered. The implementation of project-based teaching method can improve students' practical ability and comprehensive quality and lay a solid foundation for their future career development ^[10].

5. Conclusion

The application of BIM based project-based teaching method in the course of Engineering Cost has broad development prospects and practical application value. It can improve students' practical ability and comprehensive quality and promote their all-round development; At the same time, it can also improve the teaching level and professional ability of teachers, and promote the sustainable development of engineering cost specialty. Therefore, it is suggested to promote the application of BIM project-based teaching method in more education processes, so as to contribute to cultivating more excellent engineering cost talents.

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