

# Practice and Thinking of Project Teaching Based on BIM Course

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## Abstract

In the practice of project-based teaching, students are the main body of learning, while teachers are transformed into guides and helpers. Project-based teaching is gradually changing the face of education and providing students with a broader and more free learning space. Based on the theory of constructivism, this paper introduces and discusses the teaching requirements, practice path, teaching reflection and evaluation of BIM course, and studies a teaching mode that emphasizes practice and application in combination with the project teaching practice of BIM course, aiming at stimulating students' creativity and autonomous learning ability through specific projects.

## Keywords

Constructivism; BIM; Teaching practice; Project.

## 1. A Project-based Research Foundation

### 1.1. Constructivism teaching research

Constructivism, also known as structuralism, originated from the school of cognitive psychology and was put forward by Piaget, a Swiss psychologist. Emphasize how individuals construct, establish or form their own knowledge structure and cognitive model. Constructivism emphasizes that learners build knowledge and meaning based on their own experience, mental structure and beliefs; Learning is an active construction process, which involves the cognitive development process of assimilation, adaptation and balance. There are mainly two modes: cognitive constructivism based on Piaget's theory and social constructivism based on Vygotsky's theory, which emphasizes the role of social culture and history in human development.

Deconstruction emphasizes student-centered and active exploration and discovery. It is emphasized that trainers should become learning guides, create situations and promote cooperation and communication. It is emphasized that knowledge should be integrated into specific situations and a new understanding should be constructed through repeated application. Constructivism theory provides an important perspective for understanding and guiding the learning process, emphasizing learners' initiative and the authenticity of the situation.

Common constructivist teaching modes are as follows:

#### 1.1.1. Anchored Instruction.

The characteristic of anchored teaching is to guide students to study and explore around a real event or problem (that is, "anchor"). By creating situations, determining problems, autonomous learning, collaborative learning and effect evaluation. Solve practical problems, make students deeply understand relevant theories and phenomena, and cultivate their problem-solving ability.

### **1.1.2. Scaffolding Instruction (scaffolding instruction)**

The characteristic of scaffolding teaching is that teachers provide appropriate support and guidance according to students' abilities and needs (that is, "scaffolding"), and gradually withdraw the scaffolding with the improvement of students' abilities. Through scaffolding, entering the situation, independent exploration, collaborative learning and effect evaluation. Help students gradually build up their self-confidence and improve their autonomous learning and problem-solving ability.

### **1.1.3. Random Access Instruction.**

The characteristic of entering teaching immediately is that students can enter the learning situation from different angles and ways, and achieve a comprehensive understanding and mastery of knowledge through "entering" many times. By presenting situations, randomly entering learning, thinking development training, group cooperative learning and learning effect evaluation, students' multiple thinking ability and innovation ability are cultivated.

### **1.1.4. Cooperative learning (Collaborative Learning)**

The characteristic of cooperative learning is that students work together in groups to complete tasks through discussion, communication and cooperation. Through grouping, defining tasks, collaborative learning, achievement presentation and evaluation feedback, students' teamwork, communication and problem-solving abilities are improved.

### **1.1.5. Interactive Instruction (interactive instruction)**

Interactive learning is characterized by emphasizing the interaction and dialogue between teachers, students and students, and promoting knowledge construction through communication. By creating situations, asking questions, teacher-student interaction, student-student interaction and summarizing feedback. Objective: To cultivate students' critical thinking ability and oral expression ability.

## **1.2. Teaching Research of Cognitive Development Theory**

The theory of cognitive development, mainly put forward by Piaget, a Swiss psychologist, deeply discusses the stages and characteristics of children's cognitive development and provides an important theoretical basis for teaching practice. Piaget divided children's cognitive development into four main stages, namely, perceptual movement stage, pre-operation stage, concrete operation stage and formal operation stage. Each stage has its specific cognitive characteristics and abilities. According to cognitive development theory, assimilation, adaptation and balance are three basic processes of cognitive development. Assimilation refers to the process in which individuals incorporate new information into existing cognitive structures; Adaptation refers to the process that individuals adjust their existing cognitive structure to adapt to new information; Balance means that individuals maintain a dynamic balance between assimilation and adaptation in cognitive development. Teachers choose appropriate teaching methods and contents according to students' cognitive development stages. For example, in the stage of perceptual movement, students should pay attention to their sensory experience and hands-on operation; In the pre-operation stage, concrete teaching materials should be used to help students understand abstract concepts; In the specific operation stage, students should be guided to deepen their understanding through logical reasoning and problem solving; In the stage of formal operation, students should be encouraged to think abstractly and creatively. Teachers should provide students with rich and varied learning environments and materials to promote their cognitive development. This includes objects, pictures, models, experimental equipment, and modern technical means such as virtual reality and online learning. Cognitive development theory emphasizes students' initiative and constructiveness. Teachers should encourage students to explore actively and construct their own knowledge and understanding through trial and error, experiment and problem solving.

This helps to cultivate students' innovative thinking and problem-solving ability. Cognitive development is not only an individual process, but also a social process. Teachers should pay attention to the interaction between teachers and students, and promote students' cognitive development and social skills through discussion, cooperation and sharing.

### **1.3. Teaching Research of Multiple Intelligences Theory**

The theory of multiple intelligences was put forward by Howard Gardner, an American psychologist. He thinks that intelligence is divided into multiple dimensions, such as language, logic and mathematics, space, etc. Everyone has different intelligence tendencies in different dimensions. Its teaching research emphasizes student-centered, and pays attention to cultivating its comprehensive quality and personality potential. Guided questioning can stimulate students' thinking and meet the needs of different intelligence dimensions through open and enlightening questions. Cooperative learning exerts students' interpersonal intelligence and language intelligence through teamwork. Visual Aids use visual aids such as charts and pictures to stimulate students' spatial intelligence and sports intelligence. Teaching influence: The multi-intelligence teaching strategy can stimulate students' interest in learning, develop their personality potential, and promote teachers' professional development to meet the educational needs of the new era.

## **2. BIM Course Project Teaching Requirements**

### **2.1. BIM course teaching objectives**

**Knowledge goal.** Students should fully grasp the basic concepts and principles of BIM (Building Information Model) and its application in the whole life cycle of architectural design, construction, operation and maintenance. In-depth understanding of the functions and operation skills of BIM software (such as Revit, Navisworks, BIM 360, etc.).

**Skill goals.** Through the project practice, students can skillfully use BIM software for 3D modeling, collision detection, engineering statistics, construction simulation and other operations. Cultivate students' teamwork ability so that they can effectively communicate and coordinate with team members in BIM projects.

**Ability goal.** Improve students' problem-solving ability and enable them to use BIM technology to solve problems in practical projects. Cultivate students' innovative thinking and encourage them to find new solutions and optimization methods in BIM application.

**Professional accomplishment.** Enhance students' professional ethics awareness and make them abide by industry norms and standards in project practice. Cultivate students' awareness of continuous learning and encourage them to pay attention to the latest development of BIM technology.

### **2.2. BIM course project teaching requirements**

**Project-oriented.** The content of BIM course should be project-oriented, so that students can combine theoretical knowledge with practical operation through project practice. The project should be representative and cover the application of BIM in the whole life cycle of architectural design, construction, operation and maintenance.

**Teamwork** Encourage students to cooperate in teams, and cultivate their teamwork ability through group project practice. Teachers should provide necessary guidance and support to ensure effective communication and coordination among team members.

**Practical operation.** Emphasize the importance of practical operation to ensure that students have enough practical opportunities to master the skills of using BIM software. Teachers should provide detailed operation guides and case studies to help students better understand and apply what they have learned.

Innovation encouragement. Encourage students to play innovative thinking in project practice and try different solutions and optimization methods. Teachers should provide students with necessary resources and support to help them realize innovative ideas.

Assessment and evaluation. Establish a scientific evaluation system, and comprehensively evaluate students' learning effect through project practice, homework and examination. Assessment and evaluation should focus on students' practical operation ability and problem-solving ability, not just the mastery of theoretical knowledge.

The project-based teaching objectives and requirements of BIM course aim to comprehensively improve students' BIM technology application ability and comprehensive quality, and lay a solid foundation for their future career development. At the same time, through the teaching requirements of project practice, teamwork, practical operation and innovation encouragement, students can truly master the core points of BIM technology and apply it to practical projects.

### **3. BIM Course Project Teaching Practice Path**

#### **3.1. BIM course project teaching practice path and method**

##### **3.1.1. Project Practice Path**

Project selection and design. Select representative and practical engineering projects as teaching cases, and design specific teaching tasks and practical activities according to project characteristics and teaching objectives.

Preview and preparation. Students preview before class to understand the background of the project and the basic operation of BIM software. Teachers provide preview materials, including project materials, software tutorials, etc.

Implemented in stages. The project is divided into several stages, such as modeling, analysis, optimization, etc. Each stage sets clear goals and tasks, and students practice in groups.

Display and evaluation of achievements. Students show the project results, including models, reports, demonstrations, etc. Teachers and students jointly evaluate the results and provide feedback and suggestions.

Summary and reflection. After the project is over, a summary meeting will be held to review the project process, achievements and gains. Students reflect on themselves and write their learning experience and experience.

##### **3.1.2. Project-based teaching implementation method**

Task-driven teaching method. Driven by specific tasks, guide students to actively study and practice. The task should be challenging and interesting to stimulate students' interest and motivation in learning.

Cooperative learning method. Students are divided into groups to study cooperatively and complete tasks and projects together. Cultivate students' teamwork ability, communication ability and problem-solving ability.

Case teaching method. Through the analysis of actual project cases, students are guided to understand and master BIM technology. The case should be representative and typical, covering the core points of BIM technology.

Flip the classroom method. Students learn BIM software operation and theoretical knowledge by themselves through videos and textbooks before class. Class time is mainly used to practice, discuss and solve problems, and improve learning efficiency and quality.

Simulation method. Use BIM software for simulation teaching, such as construction simulation and collision detection. Through simulation, students can understand and master the application of BIM technology more intuitively.

### 3.1.3. Project-based teaching practice concept

Educational ideas and models. BIM project teaching is usually based on OBE(Outcome-Based Education) education mode, that is, learning achievement-oriented education. This educational model emphasizes student-centered, pays attention to students' learning output, and improves teaching quality by designing educational structure and evaluation system in reverse. In BIM project teaching, students will carry out learning activities around specific projects and master BIM skills and application ability through practical operation.

Teaching objectives and contents. The goal of BIM project teaching is to cultivate practical and technical talents to meet the needs of society and market. The teaching content covers the basic knowledge of BIM technology, software operation and project application. Students will learn how to use BIM software and understand the application of BIM in the whole project life cycle, including design, construction, operation and maintenance.

Teaching methods and means. BIM project teaching usually adopts a variety of teaching methods and means, such as case teaching method, interactive teaching method, multimedia teaching method and project practice teaching method. Through practical project cases, students can understand the application of BIM in practical projects; Through classroom discussion and interaction, students' interest and participation in learning can be stimulated; Through multimedia materials and practical operation, students can understand BIM technology and process more intuitively.

Teaching resources and environment. BIM project teaching needs rich teaching resources and good teaching environment support. Teaching resources include BIM software, model library, component library, teaching materials, etc. The teaching environment includes computer laboratory and training base. In addition, it is necessary to cooperate with enterprises to provide students with real project practice opportunities.

Project management and implementation. The implementation of BIM project teaching needs scientific project management and organization. Teachers need to make detailed project plans according to teaching objectives and students' characteristics, including project topic selection, grouping, schedule arrangement, achievement evaluation and so on. In the process of project implementation, teachers need to pay close attention to students' progress and give timely guidance and help to ensure the smooth completion of the project.

Effect evaluation and feedback. The effect evaluation of BIM project teaching is an important link in the teaching process. Through the evaluation of students' project achievements, we can understand students' learning situation and mastery, and provide reference for subsequent teaching. At the same time, it is necessary to collect students' feedback, constantly improve teaching methods and means, and improve teaching effect.

## 4. BIM Project Practice Teaching Reflection and Evaluation

The author takes 45 teachers engaged in BIM teaching in six higher vocational colleges in China as the research object. In the practical teaching process of BIM course teachers, this study will collect relevant data by asking questions, and quantitatively analyze and sort out the data from five dimensions: improving problem analysis ability, positive reflection ability, learning method ability, exploring more solutions and analyzing solutions, so as to evaluate the research of communication skills, reflection skills and problem-solving skills based on project teaching. The teaching mode and teaching effect of PBL teaching method in the teaching process of architectural design specialty.



## Evaluation Form of Teachers' Reflective Skills on Project-based Teaching Practice

| index                                                             | Weighted average cue | Speech description description | Explain *       |
|-------------------------------------------------------------------|----------------------|--------------------------------|-----------------|
| <i>Project teaching ...</i>                                       |                      |                                |                 |
| 1. Improve my ability to analyze problems.                        | 1.86                 | often                          | Quite satisfied |
| 2. Let me reflect positively.                                     | 1.84                 | often                          | Quite satisfied |
| 3. Improve my study method.                                       | 1.92                 | often                          | Quite satisfied |
| It helps me to find more ways to solve the problem.               | 1.86                 | often                          | Quite satisfied |
| Let me learn how to better analyze the methods to solve problems. | 1.94                 | often                          | Quite satisfied |
| Overall weighted average                                          | 1.88                 | often                          | Quite satisfied |

The above table shows the evaluation level of teacher respondents on project-based teaching practice in terms of reflective skills. Teacher respondents' evaluation of project-based teaching practice is quite satisfactory, because they think that project-based learning can sometimes make them better analyze the methods of solving problems (WM=1.94), sometimes improve their learning methods (WM=1.92), and sometimes improve their ability to analyze problems. This will also help them find more solutions to their problems (WM=1.86), and sometimes make them actively reflect (WM=1.85). When dealing with unpredictable and complex situations, reflection exercises have potential benefits for practitioners. It can help professionals learn useful lessons for future practice. It has aroused the interest of many professional fields, including teaching, nursing and management (Sun Hua, 2022). Reflective teaching helps to establish teachers' reflective consciousness, thus improving teaching quality and efficiency (Wang Juqing, 2022). Reflective teaching method is conducive to strengthening the formation of reflective consciousness, enabling project teaching participants to think and analyze problems more deeply, and complete the teaching process and practice through active exploration. Reflect on your own teaching behavior, decision-making and the phased teaching evaluation content given by interns, find out potential problems, and take appropriate solutions to improve teaching quality and effect (Zhu Weiping, 2020).

Generally speaking, teachers' respondents rated the project-based teaching practice as quite satisfactory in terms of reflective skills, with an overall weighted average of 1.88.

## 5. Conclusion

BIM (Building Information Model) technology is an important tool in modern construction industry, and its teaching needs to comprehensively consider many aspects such as theory and practice, software operation and project management. The project teaching of BIM course should focus on the combination of theory and practice, and emphasize the dual cultivation of software skills and project management. Through case teaching, interdisciplinary integration and continuous learning, students' BIM application ability should be comprehensively improved, while their professional ethics and social responsibility should not be forgotten. In the teaching of BIM course, it is necessary to emphasize the professional ethics and legal responsibilities of BIM engineers, especially in data security, privacy protection and copyright awareness. Guide students to pay attention to the application of BIM technology in green building, energy saving and emission reduction, and sustainable development, and cultivate a sense of social responsibility.

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