

# Hybrid Teaching Reform and Practice of Construction Organization Design Based on BIM Technology

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## Abstract

"Construction Organization Design" is a required professional course of engineering management major, training students to use the construction site organization principles and methods, compile and implement the construction organization design ability, to lay a foundation for the subsequent professional course learning and the direction of graduation. In view of the "pain points" existing in the course teaching, the course follows the "234" classroom teaching mode and the "1 + N" course assessment mode, which takes students as the center and integrates "knowledge, ability and quality". Through the deep integration of modern information technology and BIM technology and course teaching, students can use BIM technology to compile construction organization design and use digital technology to solve practical engineering problems.

## Keywords

**BIM technology; construction organization design; teaching reform.**

## 1. Basic Information of the Course

"Construction Organization Design" is a required course of engineering management major, which is a course combining theory and practice. The course aims to compile a complete construction organization design, cultivating students' ability to use BIM technology to prepare the construction organization design and the ability to solve practical engineering problems. Since 2019, this course has conducted online learning and integrated with BIM technology. It uses mobile teaching tools to carry out mixed teaching, realizing that "the classroom is alive, students are busy and teaching is strict".

Knowledge objectives: (1) master the knowledge of construction organization; (2) master the preparation of documents of construction organization design;

(3) Be familiar with the preparation of construction plan, time organization, resource organization and plane organization; (4) understand the organization and various guarantee systems.

Ability objectives: (1) be able to use principle knowledge to analyze the construction organization plan; (2) be able to actively learn, consult and analyze data, and use BIM technology to prepare the construction organization design documents; (3) be able to effectively communicate and cooperate well to promote the implementation of the construction organization design.

Value objectives: (1) inherit the craftsman spirit of a big country, establish professional ethics and the concept of advocating science; (2) cultivate engineering literacy, sense of professional mission and responsibility.

## 2. The "Pain Point" Problem in The Course Teaching

### 2.1. Lack of connection with building informatization

The teaching objects of this course have weak professional foundation, poor independent learning ability, and lack of understanding of engineering practice and norms. The core content of the construction organization design course is "one picture, one table and one plan". The traditional teaching content is old, and the key and difficult points are not prominent, which is out of touch with The Times. In the "one table" schedule of the traditional teaching, the network plan still focuses on six time parameters. It takes too much time to explain the knowledge points and the effect is not ideal; the preparation process of the progress plan, what work items that a plan includes, the logical relationship between the processes and the working duration are not clear, and the students still do not understand how to prepare the construction progress plan after learning.

In traditional teaching, the construction site layout of "one map", due to the little information of two-dimensional map, difficult expression of spatial position and difficult disclosure upward and downward, the expression is not intuitive, the scheme has no bright spot, frequent design modification and no basis for settlement. In traditional teaching, the construction scheme of "one scheme", the scheme framework is not clear, the sequence between the process is not understood and the scheme preparation is difficult to express.

### 2.2. Lack of connection with characteristic education

In the traditional course teaching, teachers pay attention to knowledge transmission and ability cultivation, and the guidance of students' values is not deep, and the effect of curriculum education is not obvious. How to explore the ideological and political elements contained in the curriculum by centering on the educational characteristics of civil engineering majors, give full play to the role of the main channel of curriculum education, guide the values into knowledge transmission and ability training, and realize the organic combination of curriculum and ideological and political education.

### 2.3. Lack of connection with the practical application

Currently, classroom teaching activities are primarily focused on problem-solving and examination, which fail to stimulate students' interest in learning and underutilize the practical value of construction organization courses. Given the limited teaching resources available, it is crucial to explore how to effectively integrate theory with practice and cultivate students' ability to solve practical engineering problems.

## 3. Innovative Ideas and Measures of Course Teaching

In view of the long-term pain points in teaching, the company deeply integrates modern information technology and BIM technology with course teaching through mixed teaching, and carries out "234" classroom teaching mode and "1 + N" course assessment mode.

### 3.1. Adjust the teaching content to form the knowledge structure of "one picture, one table and one plan"

Original content: basic concepts, principles and methods of construction organization; water construction and network plan; two-dimensional floor plan layout

Adjust to: update synchronously with relevant laws, regulations and standards; add new changes in construction organization due to informatization, networking and intelligence. The advantages of BIM technology are mainly reflected in visualization, simulation, analysis and deduction. Construction organization design based on BIM: steps and precautions for construction scheme, schedule, resource plan and plane organization.

Original content: a chapter of unit engineering construction organization design document compilation

Adjustment is: using BIM technology, convey teaching knowledge based on work tasks, the content is divided into independent tasks, the teaching knowledge points are integrated into the learning situation one by one, break and reorganize the construction organization course, combining theory with practice, and complete a construction organization design at the end of the course, in line with the training goal of applied talents.

The combination of theoretical teaching and practical training teaching, to meet the new requirements of industry talents.

In the training and teaching session, the students use Zebra Menglong software to compile the construction schedule based on BIM technology, and the students calculate the process duration according to the process quantity and construction period quota according to the steps of the schedule preparation, and then determine the logical relationship and draw the schedule. BIM5D is used to simulate and optimize the schedule, and the schedule is controlled. The ability to use BIM construction site layout software to carry out construction site planning based on BIM technology. Through BIM technology, the three stages of the construction site are presented, including the foundation stage, the main stage, and the decoration stage. The ability to use BIM formwork scaffolding to prepare special construction plans based on BIM technology. The safe calculation and three-dimensional drawing of the scheme facilitate the tracking and dynamic inspection of the later scheme.

### **3.2. "234" classroom teaching mode**

"2" refers to two classroom objectives: "to promote students to think and seek classroom efficiency".

"3" refers to each teaching process divided into three modules: systematic teaching, independent learning, and feedback. The systematic teaching module realizes the knowledge memory, understanding and other teaching objectives. The independent learning module realizes the teaching objectives of knowledge application and analysis. The display feedback module realizes the teaching objectives such as knowledge internalization and expansion.

"4" means that the main teaching activities are required in accordance with the four links of plan, implementation, inspection and feedback.

### **3.3. Intelligent teaching tools for mixed teaching**

Under the background of "Internet +", course teaching should actively draw lessons from the advantages of online teaching and mixed teaching, and make full use of learning platforms and resources such as MOOC and architecture cloud class in the teaching process. Create the "smart classroom" through the smart teaching platform, and use a large number of flipped classroom teaching, rain classroom, architecture cloud class and other tools are popularized in the course. Online and offline mix, reflecting the student-centered, student-centered, teacher-leading.

Preview the architecture cloud class platform before class. Use the building platform to carry out online teaching of the whole process, covering lesson preparation, teaching, practice, examination and evaluation; carry out full-scene teaching activities to meet the requirements of pre-class preview, classroom teaching and after-class summary;

Explain in class (process teaching interactive management) task teaching. Based on cloud class platform to carry out the classroom teaching, attendance, classroom teaching effect, classroom sign in, classroom test, classroom questioning, classroom voting, practice after class tasks, understand the class students learning progress, learning results, classroom participation, to master the classroom teaching progress, to ensure that the overall teaching atmosphere and effect, learning situation analysis to improve the teaching.

After-class evaluation teaching evaluation management. The course teaching process focuses on the collection and analysis of teaching and learning behavior data. Taking the practical training platform as the carrier, it integrates the theory and practical training question bank, and is equipped with the automatic scoring function. Teachers carry out the assessment and evaluation of teaching and practice according to the target requirements.

### **3.4. Curriculum ideological and political integration into teaching**

The course takes the modern information technology as the means, the teaching design is integrated into the ideological and political education of the course, the teaching reform is carried out, the ideological and political teaching objectives of the course teaching are determined, and the entry point of integrating the ideological and political elements into the course teaching is found, namely, the cultivation of professional ethics and craftsman spirit.

Four kinds of thought policy slightly into the "construction organization design" teaching course, (1) engineering ethics ideological education: in the professor "construction organization design" course, ethical thoughts throughout the course teaching, in further understanding and master engineering thinking and ethics, on the basis of redesign course teaching scheme, concentrated week training.(2) Ideological and political education: When explaining the construction preparation work, the construction cases of "Huoshenshan" and "Leishenshan" in the COVID-19 response process in early 2020 can trigger the application discussion of "China Speed" in the prefabricated structure in the new field of construction, and stimulate students' national pride and professional confidence.(3) Craftsman spirit, ideological and political education: the case of Du Tiangang, a "waterproof expert" in the series of great country craftsman reports.(4) Practice and guide ideological and political education: integrate ideological and political elements into the practice and discussion process before, during and after class, so as to provide students with improvement space for active exploration, active research, repeated practice and continuous perception, and gradually internalize and absorb the professional knowledge they have mastered to form a higher level of understanding and cognition.

Ideological and political cognitive evaluation will be included in the assessment and evaluation system. Grasp the combination of quantitative and qualitative, qualitative main, quantitative auxiliary principle.

### **3.5. "1 + N" classroom assessment mode**

"1" refers to one course assessment and reform objective: "comprehensive evaluation of the achievement of learning objectives".

"N" means the diversification of assessment. That is, the forms are diversified, using in-class evaluation, task completion, problem solving, discussion, oral report, examination paper examination and other forms of diagnostic evaluation, process evaluation and final evaluation. The content is diversified, including: knowledge, ability, professional literacy and ideological and political literacy. The scores are diversified, and the course scores are obtained by individual scores, group scores and final scores.

### **3.6. Competition promotes creation and competition promotes new**

Based on the learning of this course, a cross-disciplinary team will be formed to participate in the national BIM graduation Design Innovation Competition for colleges and universities, so that students can make full use of the professional knowledge they have learned, combine reality with reality, and combine theory with practice to work as a team and complete the tasks specified in the design assignment book, such as the ability of construction schedule planning and control based on the Zebra Dream network technology. Construction site planning ability based on BIM technology enables students to comprehensively apply theoretical knowledge and professional skills to solve engineering practice problems; Cultivate students' thinking of

global management, improve the ability of integrated application of BIM, and be able to apply BIM and other information technology, computer and related software to complete the job; Cultivate students' communication ability and teamwork ability. Lay a solid theoretical foundation and BIM technology application foundation for its future work.

Through the comparative analysis between the participating students and the non-participating students, the participating students' ability to identify maps, professional knowledge integration ability and BIM application ability are significantly improved, and their employment competitiveness is enhanced. The results of the competition will be applied to the teaching process to stimulate students' interest in learning and promote teaching and curriculum innovation.

#### **4. Practical Application Effectiveness**

Taking students majoring in engineering management from the 2019 to 2023 intakes as the practical targets, the course of construction organization design has incorporated BIM technology, virtual simulation, information technology teaching tools, and more. Students can now gain a deeper and more intuitive understanding of the knowledge they learn through QR codes. In the teaching process, two engineering cases with different structural types are interwoven into the practical training process of each chapter. By using the corresponding BIM software to complete the task requirements, the application of BIM technology in the process of preparing construction organization design is realized.

After five years of deep integration of information technology and BIM technology with the course, the course has gradually transformed from a traditional classroom to a smart classroom and from a knowledge-oriented classroom to an ability-oriented classroom. Students' ability to solve problems using BIM technology has been significantly enhanced, and the quality of graduation design related to construction organization design has been significantly improved. The participation and award-winning rate in BIM graduation design competitions have also steadily increased. In future teaching processes, it is necessary to fully utilize modern information technology to guide students who are not very active or engaged, and mobilize their enthusiasm for independent learning. Teaching reform and innovation need to be further refined, explored, and expanded to promote the comprehensive development of students.

#### **5. Summary**

The course of construction organization design is deeply integrated with modern information technology, to carry out teaching reform and practice of the course. Students are able to independently complete the preparation of construction organization design and apply BIM technology to solve practical engineering problems. In the future teaching process, we should make full use of the modern information technology, guide the students with low activity and weak sense of participation, and mobilize their enthusiasm for independent learning. Teaching reform and innovation need to be further refined, dug deep and expanded to promote the comprehensive development of students. Other problems that need to be solved: implementing the cultivation of ideological and political quality, exploring the engineering and practice of ideological and political education, and the integration of professional knowledge; coordinating the construction of curriculum resources, realizing the full participation of society, enterprises, schools and students in the construction of curriculum resources, and the construction of online and offline, paper and electronic curriculum resources.

## Acknowledgments

2023 Dianchi College of Yunnan University School-Level Scientific Research Project: Exploration of Cultivating Innovative Talents in Applied Universities for Smart Construction (2023XJ22). 2023 Dianchi College of Yunnan University School-Level Education and Teaching Reform Research Project: Research on the Practical Teaching Reform of Construction Courses Based on BIM+ Technology (2023XJJG13).

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