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Original Paper

Research on BIM Practice Exploration Based on the Concept of "OBE+CDIO"

Ling Li[1*]

[1] Chengdu College of Arts and Science, Chengdu, Sichuan, 610401, China

[*] Corresponding author, Ling Li, Chengdu College of Arts and Science, Chengdu, Sichuan, 610401, China

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Abstract

With the upgrading of the national industry and the adjustment of the economic structure, the society has put forward higher requirements for the training quality of skilled talents, and the importance of education has gradually become prominent in university. As an important part of university education, vocational education is the key position to cultivate skilled talents for the society, and undertakes the responsibility of cultivating students' professional knowledge and vocational skills. However, there are some problems in the training of students in university, such as unclear learning objectives and lack of practical operation ability, which can not meet the social demand for professional skilled talents. Therefore, this study attempts to introduce OBE and CDIO into BIM teaching courses and practices. In order to improve the teaching situation, enhance the quality of talent training. The lack of systematic curriculum system in BIM education makes it difficult for students to fully grasp the basic theory and application of BIM technology. Therefore, this study will establish a systematic BIM practice exploration based on the concept of "OBE+CDIO", so that students can fully grasp the basic theory and application of BIM technology.

Keywords

OBE, CDIO, BIM Teaching Practice

1. Introduction

The promotion and application of Building Information Modeling (BIM) technology has set off great changes in the construction industry. Under the BIM environment, the construction industry has put forward new requirements for civil talents, especially for engineering management talents. Universities are an important source of engineering management talents, however, under the existing training mode,

the number of graduates with BIM ability meeting social requirements is not sufficient, which greatly hinders the development of the construction industry. In order to break through the bottleneck of lack of engineering management talents in line with the requirements of the industry, it is urgent to reform the training mode of engineering management majors in colleges and universities. At present, there are some difficulties and defects in BIM talent training in colleges and universities, especially in practical teaching. For example, due to the limitation of practical training venues and equipment, students' learning effect of practical courses is poor. The uniqueness and complexity of construction projects make it difficult for students to connect theoretical knowledge with engineering practice. However, the knowledge system of BIM technology itself is very complex, which needs a lot of theoretical knowledge as the basis of practical operation. This paper analyzes the application of BIM technology in the knowledge system of BIM technology, and puts forward the corresponding countermeasures. In order to improve the quality of practical teaching and cultivate students' practical ability of engineering, teaching researchers have introduced innovative teaching ideas into practical teaching. Among them, the education concept based on learning output (Outcomes-Based Education, OBE) and engineering teaching concept (Conceive, Design, Implement, Operate, CDIO) have attracted wide attention due to their result-oriented and practical project characteristics respectively.

For practical teaching, the expectation of teaching output based on the OBE concept and the reverse design of practical teaching curriculum system can ensure that the practical teaching meets the actual needs. The practical courses guided by the CDIO concept can be used as a powerful means to achieve the expected results of practical teaching. The combination of the two can determine the training objectives and formulate the corresponding courses more pertintively, and at the same time provide the projects closest to the training objectives for students to practice, so as to ensure that students reach the ability level required by the industry. The OBE and CDIO concepts are combined to guide the BIM practical teaching reform, but there are few studies, and there is a lack of systematic practical teaching framework and mode design under the OBE-CDIO concept, as well as a lack of practical teaching cases for demonstration. This paper proposes a BIM practical teaching framework based on the concept of OBE-CDIO in engineering management specialty, designs the corresponding practical teaching mode, and demonstrates its effect through teaching practice.

2. Basic Concepts

2.1 The OBE Concept

The OBE concept is one of the three concepts of engineering education certification. It organizes, implements and evaluates education centering on expected learning outcomes. This teaching mode mainly includes four steps: Defining learning outcomes, Realizing learning outcomes, Assessing learning outcomes and using learning outcomes. In the process of teaching implementation, we should follow the principles of clear focus, expanding opportunities, raising expectations and reverse design. When teaching activities are carried out, they mainly focus on four questions: first, what are the

learning results that teachers want students to achieve; The second is why teachers want students to achieve such results; The third is how teachers can effectively help students to achieve these learning results; The fourth is how teachers determine the students have achieved these learning results. The OBE concept emphasizes what students have learned and what abilities they have acquired in the teaching process. In teaching, they closely focus on students, take the goal as the orientation, organize course content, design teaching activities, determine teaching strategies and evaluation methods, and cultivate students' comprehensive abilities. In general, OBE, as an advanced educational concept, has formed a complete theoretical system and teaching mode, which provides strategies and ideas for the teaching reform of university education. The OBE concept attaches importance to students' learning results and the engineering cost major attaches importance to the acquisition of students' professional knowledge and practical ability.

2.2 The CDIO Teaching Mode

The CDIO has a complete teaching mode and implementation system, which is inspired by the life cycle process of products/systems. The CDIO teaching mode takes ability cultivation as the goal, and takes the whole process of conception, design, implementation and operation as the carrier. It changes from traditional teaching emphasizing theory over practice to both theory and practice, and students take the initiative and practice in the whole teaching process. The CDIO teaching mode pays attention to the real background and environment, emphasizes that the complete production cycle should include the conception, design, implementation and operation of products, and pays attention to the cultivation of engineering ability and accomplishment. Through the completion of project tasks, students can build a knowledge system and acquire professional skills, emphasizing the cultivation of students' individual ability. The educational purpose of the CDIO advocates cultivating "complete people"; The goal of education is to cultivate students' ability to solve problems. In terms of teaching ideology, students are the subject of learning activities, physical and mental development and self-education. In terms of teaching method, it emphasizes integrated teaching and "learning by doing", which is the concentrated embodiment of "learning by doing" and "project-based learning". The CDIO teaching mode is a teaching mode that integrates the basic knowledge of the subject with the practical ability, which can meet the current training needs of engineering cost major in university, improve the teaching effect, and cultivate skilled talents. Therefore, this study integrates the "conception, design, implementation and operation" of the CDIO teaching mode into the teaching design of BIM courses, so that students can master professional theoretical knowledge and practical ability in the project practice, and improve their comprehensive quality.

2.3 BIM Teaching Practice

BIM has the characteristics of construction combination, construction association and database organization and sharing. The design information of information modeling is saved in the database in the form of digital, which is easy to update and share. Through the association relationship between data and components in the database, it is easy to create a virtual BIM. At the same time, the

application of BIM can bring many benefits: first, visualization, what you see is what you get. Second, coordination, effective use of BIM coordination process can reduce the probability of unreasonable changes. Third, simulation, BIM can achieve 3D, 4D and even 5D simulation, can achieve effective emergency evacuation, sunlight, heat conduction and other simulation. Fourth, optimizability: BIM and its supporting optimization tools can optimize the project and use the model to provide various information for optimization. Fifth, graphability, architectural design drawing plus after collision inspection and design modification can complete the comprehensive design construction drawing.

The application of BIM technology improves the accuracy of design estimate, simplifies the adjustment of engineering cost control work, and provides relevant data information for the whole process of the project. With the rapid development of BIM technology and concept, vocational education needs to face the rapid changes in BIM talent training, the application of BIM technology in China is in the stage of rapid growth, and the demand for talent training is imminent. The BIM talent training mode has the characteristics of multi-stage and multi-level. Multi-stage means that the training of BIM ability of engineering cost students can not be solved by one or two courses or practical courses, but is a comprehensive system engineering, which needs to connect various disciplines to form a systematic training system. Multi-level means that the ability requirements of BIM personnel in engineering practice are multi-level, and students should be taught according to their aptitude according to different needs. The current BIM teaching method is single, which is difficult to stimulate students' interest in learning. In BIM course teaching, we can draw on the educational concepts of OBE and CDIO, apply scientific teaching methods, adopt multi-form, multi-channel and all-round teaching methods, and highlight practical teaching.

3. Necessity Analysis of OBE-CDIO Applied to BIM Course Practice

3.1 OBE-CDIO Helps Teachers and Students to Clarify Learning Outcomes

In the traditional teaching design, the teaching objectives are mainly to help teachers clarify the classroom teaching content and complete the teaching tasks, which largely ignores the students' perception of the teaching objectives. Students cannot clearly know their learning objectives and the learning results they should obtain in the whole teaching process, while OBE-CDIO emphasizes the learning results of students and enables students to achieve them, and expects learning results as the teaching goal, lets students understand why to learn, stimulates students' interest in learning to help students obtain learning results.

As an important course for engineering cost major, BIM practice course needs students to clarify their learning objectives, carry out practical operation, and cultivate their practical operation ability and comprehensive quality. The OBE concept and CDIO teaching mode, which focus on students' expected learning results, enable students to obtain professional knowledge and practical ability in practical operation, and meet the curriculum needs, can effectively help students to clarify learning results, stimulate students' learning motivation, and improve students' professional quality. Therefore, the

application of OBE-CDIO, which combines the advantages of both, in the teaching of engineering cost major courses in university is expected to help students clarify their learning outcomes to a certain extent.

3.2 OBE-CDIO Improves Students' Practical Ability

In the traditional teaching design, knowledge transfer is often the main task and practical teaching is ignored. However, the BIM practical course has a strong practicality and focuses on cultivating students' logical thinking and practical ability. Both OBE concept and CDIO teaching mode emphasize the importance of students' practical ability. In the teaching process, teaching should be organized around students, and effective and diverse teaching methods should be adopted to allow students to actively participate in practice, so as to acquire professional knowledge and practical skills, which can help improve students' practical ability. Therefore, the application of OBE-CDIO, which combines the advantages of both, in the teaching of engineering cost major is expected to improve students' practical operation ability and help them acquire vocational skills.

3.3 OBE-CDIO Improves Students' Practical Ability

The training needs of engineering cost major require students to have comprehensive qualities such as practical ability, teamwork ability and independent student ability while mastering the basic professional knowledge. The OBE concept focuses on students' learning results and the CDIO teaching mode aims at cultivating students' engineering ability, which is of certain help to improve students' vocational ability and cultivate skilled talents in line with professional needs. In the course teaching based on OBE-CDIO, it is necessary to design the teaching process and evaluation method based on the needs of professional training, the needs of course teaching and the cultivation of students' engineering ability, so that students' vocational ability can be developed. Therefore, the application of OBE-CDIO in the teaching of engineering cost courses is expected to improve the comprehensive quality of students and cultivate skilled talents in line with the needs of the profession.

3.4 OBE-CDIO is Expected to Improve the Evaluation Method

BIM practical courses have both theory and practice, so it is necessary to evaluate students' learning results from two aspects of theoretical knowledge and practical skills. OBE concept and CDIO teaching mode in order to test students' learning achievements and mastery of practical skills, diversified evaluation methods can be adopted to understand students' learning achievements from different perspectives, timely find the problems existing in teaching, pay attention to students' individual development, point out the problems existing in students' learning, and continuously improve teaching methods. Therefore, the application of OBE-CDIO combining the advantages of the two in the teaching of engineering cost major courses in university will be helpful to improve the teaching evaluation method of the current courses.

4. Teaching Design Ideas Based on OBE-CDIO

4.1 To Determine Teaching Objectives

In the whole instructional design model, teaching objectives are the basis of teaching design, and clear teaching objectives can guide the design of teaching process and teaching evaluation. According to the connotation and characteristics of the OBE concept, when designing teaching, we should first clarify the expected learning outcomes of students, and further determine the teaching objectives according to the expected learning outcomes of students. Therefore, the teaching design based on OBE-CDIO inherits this feature of the OBE concept. When designing instruction, it is necessary to specify the expected learning outcomes, which is the cornerstone of determining the teaching objectives. When determining the expected learning outcomes, we should first fully understand the needs of professional training; Secondly, it is necessary to understand the learning characteristics of students and their learning needs for the course. Both teachers and students need to clarify what the expected learning results should be achieved in learning, what the teaching objectives and learning objectives should be achieved.

4.2 To Design Teaching Process

The OBE concept is oriented by learning outcomes. After determining the teaching objectives, the teaching process is designed in reverse, and the cultivation of students' professional knowledge and practical operation ability is emphasized. The CDIO teaching mode designs the teaching process according to the idea of "idea-design-implementation-operation", and focuses on cultivating students' engineering ability and practical ability. Therefore, the teaching design based on OBE-CDIO combines the characteristics of the two, determines the teaching objectives according to the OBE concept, sets the teaching links according to the CDIO teaching mode in the whole teaching design process, and uses micro-project teaching to carry out teaching activities. Teachers guide students to actively participate in the conception, design, implementation and operation of micro projects, and help students acquire professional knowledge and engineering practice ability in practical learning.

4.3 To Design Teaching Evaluation

Both OBE concept and CDIO teaching model emphasize the importance of teaching evaluation. Therefore, in the instructional design based on OBE-CDIO, the single evaluation method in the traditional instructional design is changed in order to test whether students achieve the expected learning results, acquire professional knowledge and engineering practice ability. Students' learning process and learning results are evaluated in the form of learning performance, classroom learning effect and micro-project works, so as to guide students to summarize and reflect, and help students find problems in the learning process. Teachers adjust and improve the whole teaching design mode in time according to the evaluation results.

5. To Construct the Teaching Design Mode Based on OBE-CDIO

According to the teaching design ideas of OBE-CDIO, combined with the needs of professional

training, the teaching content of BIM courses and the characteristics of students, this study attempts to construct the teaching design mode of BIM courses based on OBE-CDIO. In this model, teaching design is divided into three parts: teaching objective, teaching process and teaching evaluation. According to the OBE concept and the connotation of CDIO teaching mode, teaching objectives should be determined according to the learning results and learning needs that students can achieve. Therefore, it is necessary to fully understand the needs of professional training, the teaching objectives of the course, the teaching content and the learning needs of students before determining the teaching objectives. Teaching process is an important step to achieve teaching objectives. When designing teaching process, appropriate teaching methods should be selected according to teaching objectives and content. Based on the CDIO teaching mode, the teaching design mode constructed in this study divides the whole teaching process into four links according to the concept of engineering education: "conception - design - realization - operation", so as to carry out teaching activities to guide students to cooperative learning and independent thinking, fully stimulate students' autonomy and enthusiasm in learning, and cultivate students' engineering practice ability. Teaching evaluation aims to confirm whether students have achieved the expected learning outcomes and whether teachers have achieved the teaching objectives. Therefore, it is necessary to use a variety of different evaluation methods to understand from multiple aspects whether students have achieved the expected learning results and whether the teaching has achieved the teaching objectives. Based on the feedback results of teaching evaluation, the teaching design mode is constantly adjusted and improved.

5.1 Design of Teaching Objectives Based on OBE-CDIO

Teaching objectives occupy an important position in the whole teaching design, teaching process, teaching activities and teaching evaluation are all measures to achieve the teaching objectives. Both OBE concept and CDIO teaching mode pay attention to the cultivation of students' practical ability and comprehensive quality. In the teaching design model based on OBE-CDIO, the formulation of teaching objectives must fully consider whether students can achieve the expected learning outcomes.

(1) To determine expected learning outcomes

The teaching objectives need to be determined according to the expected learning results, and the expected learning results need to be determined according to the needs of professional training, students' learning needs and curriculum teaching needs. Among them, professional training needs require teachers to fully understand the professional talent training needs and social needs. Student demand requires teachers to understand the learning characteristics and learning needs of students, so as to ensure that the determined expected learning outcomes can meet the learning needs of students, and conform to the learning characteristics and cognitive level of students. Curriculum requirements require teachers to fully grasp the curriculum objectives and content in order to determine reasonable expected learning outcomes. The building BIM course in this study is the core course of engineering cost major, which requires students to have the ability of using BIM software modeling, so as to meet the dual needs of students' further study and employment. Therefore, when determining the expected

learning outcomes, the curriculum needs of "improving students' practical operation and comprehensive quality and ability" should be fully considered, and the curriculum objectives, content and practical operation should be closely combined. In addition, the determined expected learning outcomes should not only meet the needs of professional training, students' needs and course needs, but also ensure that students can achieve learning outcomes.

(2) To determine the teaching objectives

The expected learning results are refined and transformed into teaching objectives. According to the selected teaching content and designed micro-projects, the teaching objectives are divided into three dimensions: knowledge and skills, process and method, emotional attitude and values. Knowledge and skill objectives require students to master professional basic knowledge and practical operation skills; The objective of process and method requires students to solve practical problems by means of independent learning, cooperation and communication. Emotional attitude and values goals require students to form good learning habits and professional ethics and establish a positive learning attitude in the process of learning. In the design of teaching objectives, professional knowledge and practical operation should be closely combined, reasonable determination of teaching objectives, to ensure that students can achieve through efforts, and can exercise students' practical ability and problem-solving ability.

5.2 Teaching Process Design Based on OBE-CDIO

In the traditional teaching process, teachers mainly teach knowledge, and students passively accept knowledge, the learning objectives are not clear, and the class participation is low, which leads to the difficulty of achieving the teaching objectives. Therefore, in order to ensure that students can clarify their learning objectives and actively participate in the teaching process, it is necessary to design the teaching process reasonably, select appropriate teaching methods, stimulate students' interest in learning and initiative, so as to achieve better teaching effects. In this study, the teaching process design is guided by teaching objectives, combined with CDIO teaching mode and micro-project teaching method, and the whole teaching process is divided into four links: "conception - design - realization - operation". In the design of the whole teaching process, it is necessary to fully consider the training needs of engineering cost specialty, the teaching needs of BIM course and the needs of students, and take students as the main body to help students acquire professional knowledge and engineering practice ability in the process of realizing the teaching goal.

(1) Ideation

In the process of conception, teachers should consider the characteristics and learning needs of students based on the training needs of engineering cost specialty and BIM course objectives, determine the teaching content and teaching methods, combine the teaching content of the course with the concept of engineering education to design the project, design the teaching resources, and make the project task book and distribute it to students before class. According to the requirements of the project, students preview the knowledge involved in the course, clarify the classroom learning objectives and group division of labor, and conceive the idea of project design.

(2) Design process

In the design process, teachers need to check students' preview and organize classroom activities, and preset problems according to teaching objectives and subject knowledge involved in the project, and guide students to solve problems in the way of group cooperation. In the practice process of solving problems, students acquire professional knowledge and gradually form engineering practice ability. In addition, teachers provide supplementary explanations on the basis of students' learning, so that students can master the basic professional knowledge that should be possessed by the design project. Teachers need to give guidance and help to students in the process of designing project works. After mastering the basic knowledge of the subject, according to the requirements of the project, the students will make clear the methods and steps to realize the project in the way of cooperation within the group, and apply the knowledge learned to the design of the project. In this link, all students should participate in the design of the project, exercise students' teamwork, language communication and problem-solving skills, and help students gradually form engineering practice ability.

5.3 Teaching Evaluation Design Based on OBE-CDIO

When the teaching design mode based on OBE-CDIO is applied in the course of engineering cost, it is necessary to evaluate whether students achieve the expected learning results and the teaching effect in various aspects, and improve the teaching design in time according to the feedback results of teaching evaluation. Therefore, on the basis of fully understanding the characteristics and learning needs of students, combined with the OBE concept and the evaluation method of CDIO teaching mode, this study designs a teaching evaluation system suitable for schools to carry out project teaching activities. The evaluation system adopts three methods: teacher evaluation, student self-evaluation, and mutual evaluation within the student group to evaluate the students' academic performance, project quality and classroom learning effect. Diversified evaluation methods can not only evaluate students' mastery of professional basic knowledge, but also evaluate students' engineering practice ability, language communication ability, team cooperation ability and autonomous learning ability.

6. Conclusion

It is a lifelong research topic for educators to improve the effect of education and teaching, stimulate students' learning potential and cultivate students' vocational ability. Therefore, in the future teaching, it should continue to carry out practical research based on the OBE-CDIO teaching design model, integrate it with other teaching methods as much as possible, expand the scope of teaching practice, and strive to promote and apply the teaching design model constructed in this study to engineering cost courses, and then to other majors, so as to enhance the universality of the teaching design model.

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