

Exploration of Educational Technology on Building Information Modeling (BIM) Course under the 1+X Certificate System

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Abstract: With the development of computer technology, the Building Information Modeling (BIM) technology has been widely applied in civil engineering field. Based on the BIM course of civil engineering major in China's higher vocational education as the carrier, guided by the "1+X" vocational skill certificate examination system, this paper explores the educational technology reform of BIM course in China's higher vocational education with the aim of students mastering BIM computer technology. In this paper, curriculum reform of BIM technology is carried out in three stages: building a solid foundation, targeted training and obtaining a certificate. Meanwhile, the corresponding teaching methods are implemented in each stage to realize mutual recognition of credits and vocational skill certificates, and finally enable students to improve their computer BIM modeling ability and obtain vocational skill certificates after completing the courses.

1. Introduction

With the development of science and technology and the advancement of informatization process, informatization technology has been successfully applied in many industries, including architecture and civil engineering. Among them, building information modeling (BIM) technology is an important force to promote the revolution of the construction industry [1]. BIM Technology is a complete and highly integrated building information modeling based on the relevant information data of construction projects. The database information contained in it can be dynamically changed and adjusted in the whole process of construction, and the data in the system database can be called timely and accurately, so as to speed up the progress of decision-making, improve the quality of decision-making and project quality, reduce project costs, and increase project profits. Its ultimate goal is to enable the whole project to effectively establish resource plans, control capital risks, save energy, save costs, reduce pollution and improve efficiency at all stages of design, construction and use, so as to truly realize the full life cycle management of the project [2]. The technology has been applied in the architectural design stage, construction process and later operation management stage in China, mainly for collaborative design, rendering and animation display, and strengthening the

constructability of design drawings, as well as three-dimensional collision inspection, engineering calculation, virtual construction and construction simulation [3]. In the field of architecture, building information modeling (BIM) is not only the progress and upgrading of existing technology, but also indirectly reflected in the transformation of production organization mode and management mode. The information revolution of BIM will have a far-reaching impact on engineering construction from design, processing, construction, sales, management and other links [4].

With the transformation and upgrading of China's economic structure, it is urgent to deepen the reform of the training mode of compound technical talents. As an important place for higher technical personnel training, higher vocational colleges must give full play to their own role, promote development with educational effectiveness, further expand talent training channels, optimize talent training methods, and effectively improve the level of vocational education. In the traditional talent training process, whether undergraduate education or College (Higher Vocational) education, the proportion of students' practice is small, which has certain obstacles to improving students' practical ability [5]. Therefore, as the cradle of training a new generation of engineers, higher vocational colleges should adopt the "1+X" compound talent training mode, constantly innovate vocational teaching practice, explore the teaching mode under information technology, and contribute to the training of compound professional talents needed by the society. At the same time, the ministry of education is also implementing the pilot policy of "1+X" building information modeling (BIM) vocational skill level certificate. This policy not only ensures the gold content of the certificate, but also standardizes the relevant rules of the industry and widens the employment scope of students [6].

The teaching mode of BIM-related courses also needs to be reformed to give full play to its important role in the construction field, and the goal of the BIM technology course is to integrate teaching with skills certification, so that students can take the BIM skills certificate examination after learning BIM technology and obtain a certificate of competence. The teaching mode of integrating the course and certificate is not only a reflection of learning to apply, but also highlights the importance of people-oriented, and the mechanism of mutual recognition of certificate and credits also stimulates students' learning initiative. In order to explore the integration between the course and the certificate, teachers must have years of teaching experience and a grasp of the content of the "1+X" Building Information Modelling (BIM) Vocational Skills Level Certificate assessment, in order to organically combine the two and integrate them with each other [7].

2. Curriculum Reform Ideas

According to the assessment requirements of the "1+X" Building Information Modelling (BIM) Vocational Skills Level Certificate and the characteristics of the BIM technology course which focuses on practical operations, the curriculum reform idea is summarised in the following three stages.

2.1. Stage 1: Building a Solid Foundation

The emphasis at this stage is on learning the basics, as the saying goes, a solid foundation is a guarantee for subsequent learning. This stage is conducted through a combination of online and offline teaching modes. In the online part, teachers upload learning materials to the learning platform by recording videos, and students follow the exercises by watching the videos. The online videos also serve an important purpose in helping students to review and consolidate their learning at the end of the lesson. In the offline part of the course, the teacher explains and demonstrates, leading students to form a knowledge system and solving any problems they may have.

2.2. Stage 2: Targeted Training

This is the stage where students can sort out modelling ideas, read modelling drawings, combine models and drawings for training and transform knowledge into skills for targeted training after they have mastered the basics. According to the assessment requirements of the Vocational Skills Certificate, the assessment content is integrated into the BIM technology course, and the creation of families and comprehensive modelling are practised in a targeted manner.

2.3. Stage 3: Obtaining a Certificate

At this stage, students voluntarily register for the "1+X" Building Information Modelling (BIM) Vocational Skills Level Certificate Examination to obtain the certificate according to their learning situation.

Through these three stages of study, students gain not only knowledge but also an understanding and derivation of learning methods. The "1+X" certificate is also a timely recognition of students' abilities and gives them more motivation to study.

3. Approach to Curriculum Reform

Building Information Modelling (BIM) is a tool for information exchange in the construction industry. In order for students to master this technology, they should not be limited to the traditional teaching method of teachers speaking and students listening, but should fully mobilise their subjective initiative and let them have the will to explore the mysteries of the information age and master the secret keys of the building information age. The BIM technology curriculum reform with the integration of the curriculum and certificate takes the BIM technology course as the carrier, the vocational skills certificate assessment as the guide, and the mastery of BIM information technology as the purpose, so that students have the ability to obtain the vocational skills certificate when they finish the course [8].

In the BIM technology curriculum reform, teaching is implemented according to three phases of reform thinking [9-10].

3.1. Stage 1: Building a Solid Foundation

For the learning of knowledge, the basic concept of foundation knowledge is the key and important part, only after mastering the basic operation can the software be applied freely. The key points of the foundation knowledge of BIM technology course are shown in Figure 1.

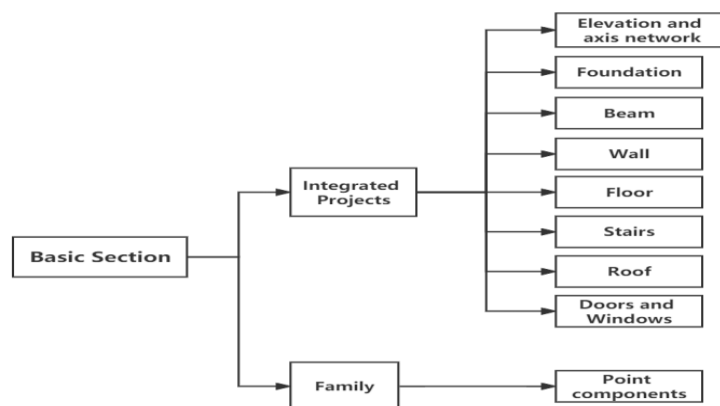


Figure 1: Essentials of BIM Technology Course

This stage is taught through a combination of online and offline methods. Teachers record basic knowledge through video recording software and use the "Cloud Class" app to flip the classroom. The "Cloud Classroom" can upload teaching resources for pre-course pre-reading and post-course revision, real-time check-in and failure warning to control students' learning, group assignments, polls and questionnaires, question and answer sessions, and course tests for interactive classroom teaching and course assessment. The application of information-based teaching methods organically combines the teacher's lecture, demonstration and students' practical exercises, students' questions and teachers' answers and guidance, and enables timely evaluation of the teaching effect during and after class, allowing students to master the main points of knowledge in the process of "teaching, learning and practice".

The teaching organisation of this course is illustrated by the example of "Creating a wall".

1) *Pre-learning*: Before the lesson, the teacher uses the Cloud Class App to upload the recorded video and issue the teaching task to the students. The teacher reminds students in the class group to enter the Cloud Classroom to preview the course content in advance.

2) *During class*: During class, use Cloud Classroom to sign in and check students' revision and pre-reading in real time.

3) *During class*: Before teaching a new lesson, a knowledge review is conducted and new questions are posed to students in relation to what they have learnt, leading to the content of this new lesson - how walls are created.

4) *During class*: The teacher teaches the new lesson, using the demonstration method, using the e-classroom software to control the students' screens, while explaining and demonstrating the operation.

5) *During class*: After the teacher has taught the lesson, students follow the video of the teacher's operation demonstration and practise on their own a few times, asking questions if they do not understand something and having the teacher answer them on the spot.

6) *During class*: after the students have practised, they complete the tasks given to them by the teacher, who assesses and marks their completion on the spot.

7) *During class*: 10 minutes before the end of class, the teacher discusses and explains the problems that have arisen with the students.

8) *Review after class*: Students review the class through the "Cloud Class" and consolidate and reinforce their learning through the PPTs, teaching videos, cases and other resources uploaded.

3.2. Stage 2: Targeted Training

Once students have mastered the basic operation of the software, they are ready for the creation of families and the comprehensive modelling of complete projects. The teacher leads students through a large number of practice exercises to enable them to meet the requirements of the "1+X" Building Information Modelling (BIM) Vocational Skills Level Certificate assessment.

The creation of point families requires students to be familiar with and master the operations of stretching, rotation, fusion, release and release fusion in the BIM software, and the modelling ideas are shown in Figure 2. Through the practice of a large number of real-life problems, students will master the modelling process and methods of point families.

Integrated modelling is the creation of a complete model of a small cottage and requires students to create a model and export the results based on the drawings given. The model creation skills required are shown in Table 1.

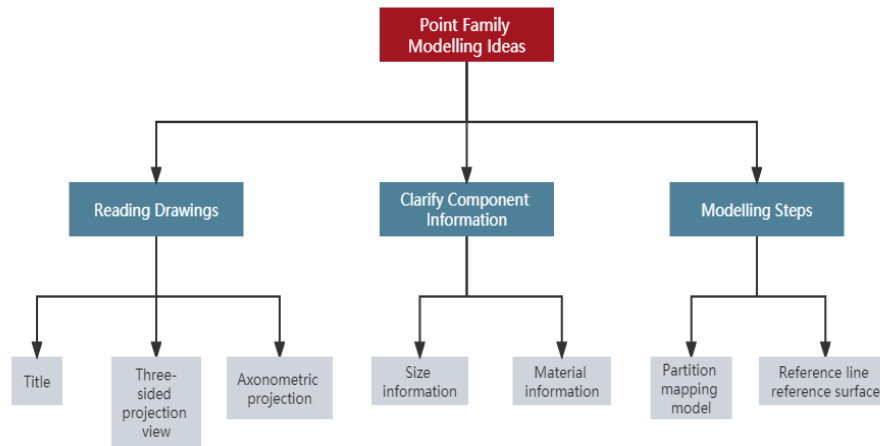


Figure 2: Point Family Modelling Ideas

Table 1: Integrated modelling skills required

NO.	Modelling Content	Skill Requirements
1	BIM modelling environment setup	Set the project release date, project name, and project address.
2	BIM parametric modelling	Create elevations, axial networks, columns, walls, doors, windows, floor slabs, roofs, steps, loose water, stairs, etc. from the drawings given.
3	Creating drawings	Create window and door schedules, create plans, sections etc., create metric drawings and adjust the scale of views.
4	Model rendering	Rendering of the 3D model of the house, quality settings, setting backgrounds, lighting schemes.
5	File saving	Name the project file as required and save the project file.

3.3. Stage 3: Obtaining a Certificate

Students are required to summarise their modelling methods and ideas, sort out their understanding of BIM technology and strengthen their practice during the day. Students are encouraged to enrol in the "1+X" Building Information Modelling (BIM) Vocational Skills Level Certificate Examination. Students who pass the 1+X Vocational Skills Level Certificate Examination can achieve mutual recognition of credits and Vocational Skills Level Certificate. Through the credit mutual recognition mechanism, students can obtain credit for the BIM technology course without taking the examinations for the course through credit mutual recognition. This reduces the pressure on students to face course examinations and increases their motivation to learn, while at the same time gaining a vocational skills level certificate.

4. Conclusions

Through the educational technology reform of Building Information Modeling (BIM) course, students participated in the "1+X" Building Information Modeling (BIM) Vocational Skill Level Certificate (primary) examination for the first time, with a passing rate of 78%, indicating that the effect of the course reform is obvious. Under the system of 1 + X certificate, the integration of BIM course reform and BIM certificate examination can promote teachers' teaching quality, improve students' ability of computer actual operation practice, help students to gain "1 + X" Building

Information Modeling (BIM) Certificate (primary). In addition, the integration also provide reference for the reform of other courses in 1 + X certificate system.

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