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Research on the Teaching Reform of Building Information Modeling Course Based on "Post, Course, Competition, and Certificate" Integration

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Abstract: With the rapid development of information technology, the utilization of building information modeling (BIM) is increasingly prevalent in the construction industry. In order to cultivate BIM application-oriented talents capable of effectively addressing industry development demands, this study proposes a reform plan for BIM courses that integrates post, course, competition, and certificate. The reform plan implements the teaching methods of post-course integration, competition-based teaching integration, and course certificate integration in the BIM course. It also carries out curriculum reform from four aspects: curriculum system, teaching mode, teaching content, and assessment method. Reform should be implemented to enhance students' professional and practical skills, thereby enabling them to secure improved employment opportunities and prospects for career development.

Keywords: Post-Course-Competition-Certificate; BIM course; Teaching reform

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1. Introduction

Building Information Modeling (BIM) technology, serving as a comprehensive virtual model platform for building information, integrates all aspects of a building including its structure, materials, equipment, and personnel. This integration facilitates efficient information management and collaborative work throughout the entire life cycle. The platform facilitates enhanced communication and collaboration among designers, engineers, builders, and owners, thereby improving design and construction efficiency, minimizing errors and conflicts, as well as providing superior project management capabilities and decision support. Consequently, BIM technology has been widely used and promoted in the construction industry.

In 2022, the Ministry of Housing and Urban-Rural Development issued a notice on the "14th Five-Year Plan" development plan for the construction industry, proposing to expedite the comprehensive implementation of BIM technology throughout all stages of project life cycle [1]. With the successive issuance of policy documents by the state to promote the in-depth development of BIM technology in construction engineering, new requirements for composite applied talents with BIM expertise have been put forward by the construction

industry in civil engineering.

The concept of a "post-course-competition-certificate" comprehensive education was proposed by the 2021 National Vocational Education Conference, taking the lead in higher vocational colleges and application-oriented universities [2]. The "post-course-competition-certificate" model represents a novel approach to vocational education, encompassing the integration of "employment position + curriculum teaching + vocational skills competition + vocational qualification certificate" [3]. This teaching approach aligns well with the contemporary educational philosophy of integrating production and instruction, promoting learning by competition and practicing teaching.

The BIM course is characterized by its high level of practicality and application. Through the implementation of the "post-course-competition-certificate" system in BIM courses, it is conducive to enhancing students' comprehensive competitiveness in terms of skills, knowledge, and quality, thereby enabling them to better align with future developmental demands. Therefore, the implementation of the "post-course-competition-certificate" teaching method in BIM courses is a vital measure for educational reform.

2. Construction of BIM course system

BIM course is a required professional course for civil engineering majors, it also serves as a crucial foundation for students pursuing careers in engineering technology, construction management, and engineering cost analysis. Through the analysis of the teaching content of the traditional BIM course, the following problems are discovered. Firstly, the traditional teaching content often focuses solely on imparting basic concepts, failing to integrate them with actual jobs, which makes it difficult for students to deal with practical problems in enterprise practice. Secondly, the teaching content does not align with the competition, leading to students having to participate in competitions during their extracurricular time. Consequently, this significantly diminishes students' enthusiasm and initiative towards BIM course. Lastly, the course content does not relate to the BIM professional certificate. Students need to spend extracurricular time studying and preparing for exams, resulting in a low pass rate, which diminishes their competitiveness in the job market.

Based on the aforementioned teaching status, this course reform integrates the pedagogical concept of the "post-course-competition-certificate," aligns with industry demands, utilizes competition as an assessment method within the course, and integrates vocational skill level certification content to establish a new course system, as shown in **Figure 1**.

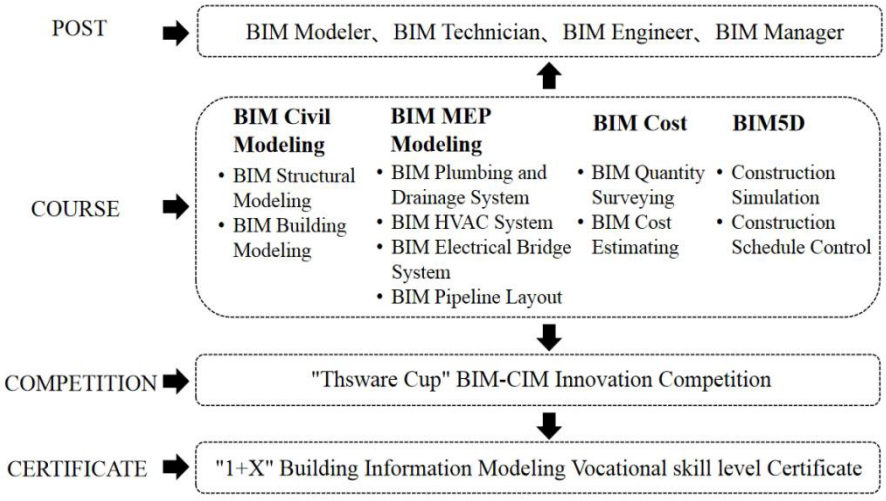

Figure 1. "Post-Course-Competition-Certificate" BIM course system

2.1. Integration of post and course

Before formulating the syllabus, colleges and universities should engage in comprehensive communication with the company to gain profound insights into the genuine requirements of the industry and prevailing job market trends. This ensures that the content aligns with industry requirements and produces graduates who are equipped to meet the job demands [4]. During the course development process, the curriculum is divided into different modules according to the work field and skill requirements of various positions. Through modular design, students of varying majors can have different emphases in the process of learning BIM courses, thereby enhancing the course's alignment with distinct major requirements and fostering practical skills among students (**Table 1**).

Table 1. The relationship between job requirements, course modules, and applicable majors

Job requirements	Course modules	Applicable majors
Modeling	BIM civil modeling	Civil Engineering, Architecture
Multi-professional collaborative construction, collision inspection	BIM MEP (Mechanical, Electrical, and Plumbing) modeling	Water Supply and Drainage, Electrical Engineering, Heating and Ventilating
Project management, operation, maintenance	BIM quantity surveying and cost estimating; BIM5D	Engineering Management, Engineering Cost Estimation

2.2. Integration of competition and course

Competition effectively stimulates students' learning enthusiasm and serves as a crucial means to validate their learning results. In the form of skill competition, students' knowledge is assessed and evaluated to achieve diversified assessment methods. At present, as part of the course reform, Guangdong Technology College has organized the BIM technology innovation application competition on campus, and integrated the "Thsware Cup" BIM-CIM innovation competition for national universities into its course system. Students can participate in different modules of the individual competitions through their major, as well as join team competitions by forming interdisciplinary student teams. By participating in the competition, students can apply their acquired knowledge to practical situations and enhance their proficiency in problem-solving skills. The adoption of this pragmatic learning approach facilitates students in acquiring a deeper comprehension and mastery of knowledge, as well as enhancing their capacity to apply knowledge proficiently in practical settings [5].

2.3. Integration of certificate and course

The course is associated with the vocational skill level certificate, facilitating the seamless integration of theory and practice, knowledge, and skills, thereby fostering a comprehensive enhancement of students' vocational proficiency. By obtaining vocational certificates through courses, students can improve their employability and adaptability in the job market. Currently, through participation in the "Thsware Cup" BIM-CIM innovation competition, students can obtain a "1+X" certification for BIM vocational skills level, which will be highly favored by enterprises in future employment.

3. Specific countermeasures of BIM course reform

3.1. Implementing a mixed teaching mode between online and offline

BIM courses employ a blended approach to teaching, combining online and offline methods, enabling students to access a diverse range of learning resources through the online platform while also offering flexibility in

arranging their online learning schedule. In the instructional design, teachers upload the teaching video onto the online platform, and the students carry out the learning task to complete the online learning. The online courses primarily focus on acquiring a comprehensive understanding of the fundamental principles of BIM and proficiently mastering the essential modeling techniques.

In the offline class, practical training is conducted using the actual BIM competition project as an assignment for practice. Through the online learning of basic operations before class, students can master the basic operations of modeling, and subsequently deepen their proficiency in modeling through the training of competition projects. In the practice, timely consultation with teachers is possible when problems are encountered. This kind of teaching-oriented teaching method replaces the traditional teaching method whereby teachers perform step by step demonstration to the students in class, which greatly improves the efficiency of learning.

After class, the students take part in the competition according to teachers' arrangement. As the practice in class has enabled students to master the content and practical application of the competition, there has been a noticeable enhancement in their success rate. The winning students can also acquire the "1+X" BIM vocational skill level certificate through their achievement, thereby fulfilling the requirement of obtaining a vocational skill certificate relevant to their actual position through course study. The teaching design is shown in **Figure 2**.

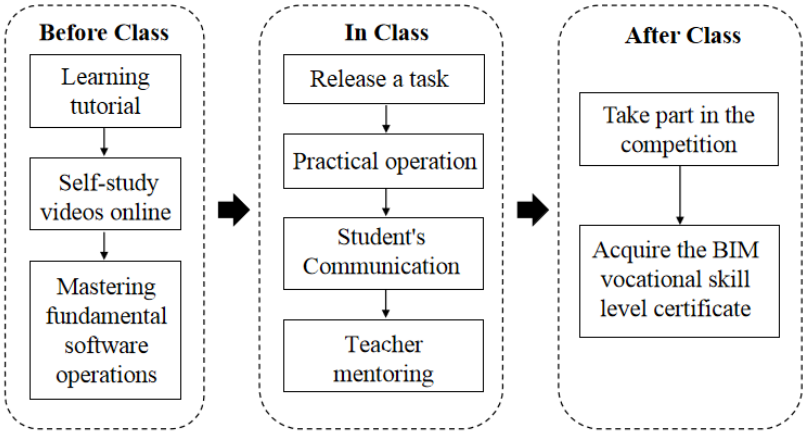

Figure 2. BIM courses teaching design

3.2. Establishing a diversified evaluation system

In order to integrate the new course system, the assessment methodology has been reformed and a more comprehensive and diversified evaluation system has been developed. The new assessment system combines competition results, skill certificates, and course examinations. If the student is awarded a prize in the competition, it will serve as their final examination result, obviating the need to undertake the school-organized exam. The final examination of the school has also eliminated the traditional examination papers, and the practical examination combined with the enterprise post and vocational certificate examination is implemented. In addition to the final examination, the completion progress of the pre-class self-study videos will also contribute to the overall course grade, thereby significantly enhancing students' motivation for independent learning.

3.3. Inviting industry experts to conduct lectures

To enhance students' perspectives, BIM courses also incorporate guest lectures by industry experts into the

curriculum. For instance, on November 30, 2023, Guangdong Technology College organized a lecture for engineering cost estimation majors, featuring experts invited from the "Thsware Cup" innovation competition organizers. During the lectures, experts shared their expertise and practical experience in the field of Building Information Modeling, facilitating students' acquisition of a profound comprehension regarding BIM technology and its diverse applications. Through this expert lecture, students gained valuable insights into the latest industry trends and technical requirements, thereby enhancing their practical skills and bolstering their employability.

4. The outcomes of BIM course reform

BIM course has achieved excellent results in the national competition by integrating the teaching reform into the post-course-competition-certificate. In the "Thsware Cup" BIM-CIM Individual Innovation Competition 2023, three students won first prize, ten students won second prize, and ten students won third prize. The students have all obtained a "1+X" Building Information Modeling Vocational Skills Intermediate Certificate, which was awarded to them for their outstanding performance in the competition. According to the award results, the BIM course reform has yielded significant positive outcomes.

In addition, the course reform has effectively enhanced students' learning enthusiasm and resulted in a significant improvement in the average class score. After the reform, greater emphasis will be placed on evaluating students' practical and innovative thinking skills through course arrangement, homework assignments, and exam design, rather than solely focusing on their theoretical mastery. The reformed course has yielded a 100% pass rate among participating students, with an average score exceeding 80. The students' scores demonstrate that the curriculum reform has yielded significant outcomes.

5. Conclusion

The integration of post, course, competition, and certificate in the BIM course reform represents an innovative approach to cultivating skilled professionals. By incorporating practical projects, teaching competitions, and vocational skills certificates into the BIM course, students will not only develop a profound understanding of industry demands but also acquire invaluable experience and professional certifications.

The course reform has effectively reshaped the course system and teaching content, aligning instructional practices more closely with current societal needs. The evaluation system is concurrently optimized to comprehensively assess students' abilities and qualities, thereby fostering their holistic development. In conclusion, the reformed teaching mode not only aligns with the current societal demand for talent acquisition but also enhances students' preparedness to confront future career challenges.

Disclosure statement

The authors declare no conflict of interest.

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