Reform and Exploration of the BIM Curriculum Teaching System from the Perspective of Industry-Education-Competition Integration

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Abstract: With the advancement of construction industry informatization, BIM technology has become a core driving force for the transformation of the construction industry. National policies explicitly support its development, creating an urgent industry demand for BIM talents with both theoretical and practical capabilities. However, current university BIM courses suffer from issues such as outdated teaching methods, weak practical components, single assessment methods, and a lack of teaching content focused on BIM technology development and innovative application. This paper proposes a teaching reform scheme based on the integration of industry, education, and competitions (I-E-C integration). Guided by industry service and leveraging academic competitions, the reform plan integrates industry needs and real competition tasks into teaching, implements stratified talent cultivation, and enhances teacher training. Teaching practice shows that this model has significant effects in enhancing student initiative and sense of achievement, optimizing teaching content, and improving the evaluation system. The college has achieved excellent results in major competitions, and students' adaptation period in their jobs has noticeably shortened. This model provides a new practical paradigm for BIM talent cultivation, potentially supplying the construction industry with interdisciplinary talents possessing both hard skills in software operation and soft literacy in engineering collaboration.

Keywords: BIM Technology; Industry-Education-Competition Integration; Talent Cultivation; Teaching Reform

1. Introduction

With the accelerated development of construction industry informatization, Building Information Modeling (BIM) technology, by virtue of its core advantages in information integration and collaborative management throughout the building lifecycle, has become a key driver promoting the transformation of the construction industry towards intelligent construction [1]. Against this backdrop, national policies have been successively introduced, explicitly requiring the promotion of digital management throughout the engineering construction lifecycle, providing clear and specific guidance for industry technological innovation and talent cultivation [2]. However, a significant gap exists between the BIM talents currently cultivated by universities and the actual needs of the industry, leading to an increasingly urgent demand for BIM technical talents with solid theoretical knowledge, strong practical application, and innovative abilities. This necessitates higher education institutions to re-examine the teaching system of BIM courses.

Currently, most engineering majors in universities offer BIM technology-related courses, positioning them as core courses for cultivating new types of civil engineering talents. However, literature research indicates that existing BIM courses still face numerous problems in teaching practice, such as lagging teaching methods [3], weak practical components [4], single assessment methods [5], and teaching content that emphasizes modeling over development [6]. These issues result in students acquiring a certain degree of 3D modeling capability but still struggling to meet the practical work skill requirements of enterprises. Therefore, it is particularly urgent to introduce enterprise production practice needs into the course teaching content and use academic competitions as a powerful tool for enhancing abilities to promote practical teaching reform.

This study takes the BIM course teaching reform at the School of Civil Engineering, Xiamen University Tan Kah Kee College as an example, detailing how the research team built a bridge between the digital construction industry and education through academic competitions, constructing a new integrated talent cultivation model based on I-E-C integration. This model aims to address the problems in the existing teaching system, enhance students' practical and innovative abilities, and cultivate high-quality BIM technical talents for the digital transformation of the construction industry.

2. Current Status of BIM Course Teaching

Currently, our college offers three majors: Civil Engineering, Engineering Management, and Engineering Cost, and has established multiple courses related to BIM technology, including "BIM Technology Principles and Applications," "Application of BIM Technology in Building MEP Engineering," "BIM Comprehensive Application Training," and "Engineering Cost Software Application." These courses cover a progressive complete system from basic theory to specialized application, from single skills to comprehensive training. The teaching content primarily focuses on key core software such as Revit and Glodon. However, based on past course teaching experience, the research team has identified some issues in the existing teaching system that need urgent improvement.

2.1 The Disconnection Dilemma in Industry-Education Linkage

Taking basic courses as an example, Revit software, due to its powerful functionality and widespread use in the industry, has become the teaching focus of BIM basic courses. The teaching process mainly emphasizes cultivating students' basic modeling abilities. The openness of Revit software allows it to meet the personalized needs of enterprises through secondary plugin development to solve specific production problems, especially suitable for collaborative design, modeling visualization, clash detection, and construction simulation functions in complex projects (such as free-form surfaces, long-span spatial structures). However, limited by traditional teaching scenarios and teachers' capabilities, the teaching of these advanced functions is often difficult to fully reflect in the courses. Consequently, when students encounter such large and complex projects during internships and work, they often lack the relevant knowledge and skill reserves, making it difficult to quickly adapt to project requirements, thereby affecting their performance in practical work and career development. Meanwhile, with the rapid development of the domestic digital industry, domestic Glodon series software has rapidly captured a large share of the domestic BIM market by leveraging its advantages in localization and standard adaptation in segmented fields such as engineering cost and construction management. Glodon software is flexible and easy to operate, able to comprehensively integrate industry construction, cost, and management links, better meeting the actual needs of enterprises.

If teaching focuses solely on Revit software, on the one hand, the high complexity of the software operation increases the learning threshold for students; on the other hand, it easily leads to a deviation between the skills students learn and enterprise needs due to the lack of linkage with actual industrial scenarios. However, completely abandoning basic modeling software like Revit and switching entirely to Glodon software for teaching might prevent students from thoroughly understanding the underlying logic of BIM technology (such as whole-lifecycle information integration, parametric modeling principles), making it difficult to meet the needs of solving personalized problems in complex projects. Therefore, achieving the teaching integration of Revit and Glodon series software, ensuring the continuity of students' skill learning while precisely aligning teaching content with actual industry needs, has become a key issue urgently needing breakthrough in the current industry-education linkage. The "project-oriented, task-driven" integrated teaching mode of course-competition-certificate provides a feasible idea for software teaching integration and industry-education linkage. It can connect the teaching of different software through real project tasks, achieving precise matching of skills and industry needs [7].

2.2 The Challenge of Stimulating Student Interest

In the teaching of basic BIM courses, our university uses "BIM Application: Revit Building Case Tutorial" published by Peking University Press as the main textbook and employs its case drawings for modeling training.

This textbook starts with a BIM overview and Revit basics, uses a teaching building project as a case study, explains in depth the creation and editing methods of various building components, covering walls, columns, floors, curtain walls, doors, windows, etc., from simple drawing to complex shaping, such as special-shaped curtain wall creation and irregular roof creation. The textbook also introduces functions like drawing design and quantity statistics based on the established building model, as well as architectural presentation (such as rendering, walkthroughs) and content related to Revit secondary development. The content is systematic, comprehensive, and clearly organized.

However, due to the operational complexity of Revit software itself and some complex graphic components in the textbook, many students find the modeling process difficult, gradually lose patience, experience reduced interest in the course, find it hard to perceive the industry value and application prospects of BIM technology, and lack the internal drive for self-learning. Specifically, most students only complete classroom training and basic assignments and do not actively explore new software functions or industry trends. They also lack the initiative to investigate complex projects like large commercial complexes or super high-rise buildings outside the classroom. In the context of digital construction, integrating BIM skill competitions into course teaching can stimulate student interest through the competitive and practical nature of competitions. This reform idea provides an important reference for solving the current problem of student interest [8]. Therefore, how to stimulate students' learning enthusiasm through course content teaching reform has become an important issue for instructors to solve urgently.

2.3 The Bottleneck in Perfecting the Evaluation System

The existing BIM course evaluation system is consistent with traditional courses, combining usual grades with final exam grades for the comprehensive score. The final exam is primarily a closed-book or computer-based test, while usual grades are based on classroom performance and homework. However, BIM courses are highly practical and collaborative. Teaching experience shows that traditional final exams struggle to objectively reflect students' mastery of knowledge and skills, application ability, and teamwork skills, and are also inadequate for accurately evaluating students' comprehensive ability and problem-solving potential in applying BIM technology in real engineering scenarios.

Analyzing final outcomes and student literacy reveals that students' mastery of the course shows a clear tendency towards theorization and mechanization. The learning focus is more on the utilitarian goal of "passing the exam" rather than truly understanding and mastering the core logic and application methods of BIM technology. This learning state makes it difficult for students to achieve integrative understanding of knowledge and effectively transfer what they have learned to actual work scenarios. There is even a disconnect phenomenon of "high exam scores but low actual modeling efficiency." The multi-dimensional evaluation system proposed in the integrated education model combining "post-course-competition-certificate" for building information modeling technology courses emphasizes constructing evaluation dimensions based on post requirements, competition standards, and certification requirements, providing direction for breaking through the limitations of traditional assessment [9]. Therefore, instructors need to build a more diversified assessment system, break through the limitations of traditional written exams, and focus evaluation on students' practical ability to use BIM technology to solve real engineering problems, thereby promoting a shift in learning style from "exam-oriented memorization" to "practical application."

3. Reform Measures Based on I-E-C Integration

The teaching team proposes comprehensive I-E-C integration reform measures as a grasp to better solve the problems in teaching and achieve positive results in effectively improving teaching effectiveness.

3.1 Industry-Education Linkage: Deepening School-Enterprise Cooperation and Establishing Feedback Mechanisms

In the past three years, our university has been committed to building a school-enterprise cooperation platform, signing internship base agreements with technology companies like Glodon and Haimai, and conducting horizontal research projects, aiming to deepen school-enterprise cooperation and expand student practice and employment channels. During multiple company visits, both sides engaged in in-depth and fruitful discussions centering on the current status and future prospects of BIM technology and construction informatization. Companies showcased their latest technological breakthroughs and benchmark engineering cases, systematically sorted out the demand for core competencies such as "BIM full-process application" and "cross-disciplinary collaborative management" in digital transformation, clarified job skill lists, provided precise basis for the university to optimize the curriculum system and update talent cultivation plans, and promoted the dynamic alignment of teaching content with cutting-edge industry technology and actual job requirements.

Research on the integrated teaching reform of BIM courses through school-enterprise cooperation also emphasizes the dynamic adaptation of teaching to industry needs through a two-way feedback mechanism, which highly aligns with the school-enterprise cooperation approach of this study [10]. To this end, our university has established a regular feedback mechanism, systematically sorting out specific problems encountered by teachers and students during the teaching process regarding software operation and course adaptation, and feeding them back to enterprises. For example, software crash issues encountered in Glodon's Digital Design modeling, format compatibility issues between various stage-specific BIM software from Glodon, matching deviations between Glodon's quantity calculation software and local quota standards, as well as missing functional modules when students simulate real engineering projects. These practical feedbacks from the teaching frontline contain not only optimization suggestions for software operation convenience and functional completeness but also improvement needs for teaching scenario adaptability. They provide fresh samples from the education end for enterprises to iterate and upgrade software versions and improve technical service systems, promoting enterprise technology R&D to better fit the dual needs of talent cultivation and engineering practice, forming a virtuous cycle of "teaching feedback - technical optimization - industry upgrade."

3.2 Competition-Education Integration: Transformation of Competition Resources and Cultivation of Practical Ability

In the field of BIM university competitions, companies such as Glodon Technology Co., Ltd., Shenzhen Swere Technology Co., Ltd., and Luban Software Co., Ltd. actively participate in hosting relevant events. These companies have deep accumulation in the field of construction informatization, and their software products occupy a very high market share in China. Strengthening school-enterprise linkage, using these companies deeply involved in construction informatization as a link, to build a collaborative mechanism of "competition resource transformation - teaching content update - practical ability cultivation," synchronizing classroom content with cutting-edge industry technology and competition assessment standards. Relying on the competition platforms provided by enterprises offers practical training opportunities, allowing students to get early exposure to the logic of handling complex problems in real engineering scenarios, cross-team collaboration modes, and the latest industry technological developments during the competition process, shortening students' adaptation period from campus to workplace.

In our university's competition-education integration, by decomposing competition projects into course training modules, students can simulate real engineering scenarios in the classroom and gradually master core BIM skills. In this process, students can not only access cutting-edge technologies in the field of construction informatization and systematically learn the operation logic and practical skills of mainstream industry software but also have the opportunity to deeply participate in BIM modeling, clash detection, or construction simulation links of real enterprise engineering projects. Compared to traditional classroom teaching, this immersive competition-based learning experience can better promote students to transform abstract concepts into concrete operations, thereby achieving proficient mastery of practical skills and significant improvement in comprehensive application ability [6].

3.3 Enhancing Student Internal Drive: Competition Incentives and Promotion of Self-Directed Learning

Competition-education integration, through the competitiveness and practicality of real competition questions, can effectively stimulate students' active learning awareness and break through the passive acceptance mode of traditional classrooms. Competition tasks are often based on real projects, requiring students to complete comprehensive tasks such as BIM modeling and scheme optimization within a limited time. This challenging scenario can stimulate students' desire to explore theoretical knowledge [5]. More importantly, by participating in competitions and striving for awards, students have the opportunity to apply their learned skills to serve enterprises and solve practical engineering problems. For example, software issues fed back in Glodon competitions were adopted and optimized by the company, Revit modeling results reduced engineering design changes through clash detection, etc. This closed loop of "learning - practice - output" allows students to intuitively feel the application value of knowledge, thereby generating motivation for continuous learning from within.

Furthermore, teamwork, achievement presentation, and award incentives in competitions can enhance students' sense of achievement and professional identity. Practice at Guizhou Institute of Technology shows that participating in BIM competitions made students show higher enthusiasm in course learning, with the proportion of self-directed extended learning after class increasing by 40%, and they actively paid attention to industry technology trends [4]. Research on the cultivation path of BIM application and innovation ability for civil engineering majors under the background of emerging engineering education also points out that competition incentives are an important means to enhance students' self-directed learning ability and innovation awareness, which is consistent with the practical conclusions of this study [11].

4. Reform Plan for the Teaching System

The research team has constructed a technology roadmap for teaching reform that fully integrates industry, education, and competitions, as shown in Figure 1. This technology roadmap is guided by industry needs and core to ability cultivation, aiming to promote the optimization of teaching content, the improvement of the cultivation system, and the enhancement of teacher capabilities. Simultaneously, this study uses academic competitions as an important means to test teaching effectiveness, forming a closed-loop system that starts from industry needs, is supported by ability cultivation, tested by academic competitions, and ultimately delivers qualified talents to the industry. The specific content of this technology roadmap is as follows:

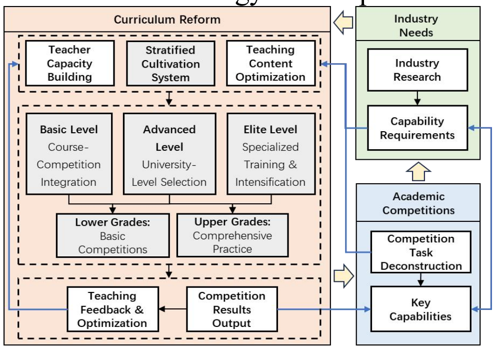

Figure 1. Technology Roadmap for Teaching Reform Integrating Industry, Education, and Competition

4.1 Optimization of Teaching Content

From the perspective of ability demands identified through industry research and enterprise feedback, BIM talents cultivated by traditional teaching models have significant shortcomings: professional abilities are limited to basic software operation, interdisciplinary integration ability is weak, there is a dual lack of innovative thinking and practical experience, and communication, collaboration skills, and professional literacy fail to meet job requirements, making it difficult to satisfy actual enterprise needs. The core issue in the cultivation process leading to this phenomenon is: teaching emphasizes operational training over thinking cultivation, resulting in insufficient independent thinking and innovation awareness; and there is a lack of systematic design for teamwork scenarios and practical opportunities to contact large projects and real industry needs, making the cultivation of professional literacy and cross-role communication skills merely formal. Students cultivated under this teaching model lack training in independent thinking and innovation awareness, and cultivation of professional literacy and communication and collaboration skills is deficient. Therefore, the research team relies on existing competition resources to promote the optimization of teaching content. By integrating real industry needs and competition ability standards into the curriculum system, it aims to specifically compensate for the aforementioned shortcomings and ultimately achieve precise alignment with enterprise talent cultivation goals. Currently, our university focuses on the "National Digital Building Innovation

Application Competition" and the "Tenth International University BIM Graduation Design Innovation Competition" as key events. The former has unified propositions and unified scoring, focusing on the assessment of software application ability; the latter allows students to choose real project drawings themselves, deeply utilize BIM technology, complete practical operations, and focuses on the comprehensive practical application of BIM.

Taking the former as an example, the reform focus is integrating real competition questions into teaching tasks. For instance, its first track is the "BIM Digital Design Modeling Competition," which uses Glodon's Digital Design modeling software. Research by our university's professional teaching and research office concluded that this software currently has low maturity and market penetration, making it unsuitable as teaching software. Therefore, after the reform, Revit is still retained as the main modeling software for the "BIM Technology Principles and Applications" course, but the complex and difficult-to-understand textbook drawings reported by students are replaced with real competition question drawings. The real questions are broken down into multiple modules corresponding to the textbook content, and the course outline is reorganized. During daily teaching, students simultaneously become familiar with competition question types and scoring standards, achieving precise alignment between teaching content and competition requirements.

The latter requires more emphasis on cultivating students' comprehensive professional abilities during the teaching process, particularly focusing on linkage with actual industry needs. Therefore, the reform focus lies in deeply integrating real industry BIM technology application scenarios into teaching tasks, achieving seamless connection between "teaching content and workplace practice." Our university's professional teaching and research office, through researching BIM application examples from construction enterprises, has sorted out key links of industrial BIM technology application—including BIM modeling throughout the project lifecycle, multi-disciplinary clash detection, construction progress simulation, cost correlation analysis, etc.—and integrated these links into the core teaching modules of courses like "BIM Comprehensive Application Training" and "Application of BIM Technology in Building MEP Engineering." Students are required to work in teams, simultaneously introducing enterprise BIM acceptance standards, to complete full-process BIM training. This model of transforming industrial BIM technology application scenarios into teaching tasks does not require adjusting specific teaching subject settings. The concept of "transforming industrial scenarios into teaching tasks" proposed in the research on talent cultivation optimization paths under the background of intelligent construction professional group construction provides theoretical support for the teaching content optimization of this study [12].

4.2 Construction of the Cultivation System

Construct a stratified cultivation system of "whole participation - echelon selection - key cultivation" to expand competition participation and precisely incubate outstanding talents. The basic level targets all students, reduces modeling difficulty, decomposes competition tasks into built-in course assignments, optimizes assessment methods, strengthens process assessment, and focuses on comprehensive ability cultivation and teamwork; the advanced level participates in university-level selection competitions with no limit on participants, increases the overall participation rate, and screens potential contestants; the elite level forms special competition classes, organizes pre-competition specialized training by teachers, and conducts intensive practice on high-frequency test points for competitions. At the same time, distinguish between lower and upper-year students. Lower-year students mainly focus on the modeling events in the innovation application competition, while upper-year students are more suitable for the more practical and comprehensive graduation design competition, selecting more difficult large comprehensive projects such as hotels, office buildings, and airports for modeling and extended application. While completing their graduation design, they can also directly submit their results to the competition platform for competition. Multiple approaches are used to build a complete talent incubation chain with layer-by-layer screening and stratified cultivation from the classroom to competitions.

Compared to the past traditional single assessment method, this layered and progressive cultivation system breaks through the limitation of "one exam determines superiority" and achieves deep binding of evaluation dimensions and ability cultivation. Traditional assessment focuses on final outcomes, making it difficult to track students' learning trajectories in processes like modeling logic, collaboration methods, and problem-solving, let alone measure their ability to cope with complex engineering scenarios. The stratified cultivation system, through multi-dimensional evaluation, incorporates students' specific performances at various levels into the ability assessment scope—for example, daily feedback on "modeling standardization" at the basic level can help students correct operational habits timely; scoring on "multi-disciplinary collaboration efficiency" in the advanced level selection competition can force students to strengthen cross-role communication awareness; the strict requirements for "accuracy of large project progress simulation" at the elite level directly align with real enterprise job standards. This model of replacing traditional assessment with a cultivation system essentially transforms "result-oriented score evaluation" into "process-oriented ability incubation." It allows students to clearly perceive their own shortcomings and improvement paths at each level, and also enables teachers to dynamically adjust teaching strategies, ultimately achieving a virtuous cycle of "evaluation is cultivation, cultivation is growth," forming a precise echo with the "whole-cycle ability literacy" required by BIM technology.

4.3 Enhancement of Teacher Capability

In terms of teacher team construction, comprehensively enhance capabilities through participation in the practical application of enterprise BIM technology, serving enterprise production, and participating in teacher training.

By deeply participating in the practical application of enterprise BIM technology and serving enterprise production practice, teachers can transform the technical needs and engineering pain points from the industry frontline into teaching resources, achieving the ability enhancement of "practice feeding back into teaching." Our university promotes teachers to join the project teams of cooperative enterprises like Glodon and Haimai, participating in the full-process BIM services of real engineering projects. During the service process, these experiences from the production frontline are systematically sorted into teaching cases. For example, the real scenario of "construction rework due to pipeline clashes" in enterprise projects is transformed into introductory cases and discussion topics in the classroom, guiding students to understand the application value of BIM technology from an engineering practical perspective, making classroom teaching closer to job requirements.

Furthermore, competition organizers like Glodon organize teacher training. In recent years, our university has actively encouraged teachers to participate in various trainings, establishing a teacher cultivation mechanism of "dual enhancement of competition and teaching ability" to ensure that teachers are both competent in course teaching and able to accurately guide competitions. Taking the aforementioned Glodon Digital Design modeling software as an example, this software has low market share, and many teachers have not been exposed to it. Through Glodon's teacher training, they can master its basic modeling skills in a short time, integrate it with the Revit software from traditional courses, and better guide students to quickly get started with the software. On the other hand, through post-competition review meetings, the key points of integrating teaching and competitions are summarized. Simultaneously, cross-university teaching research is conducted with other institutions to share competition guidance resources and teaching cases, ultimately building a "dual-qualified" team with both course design ability and competition guidance experience.

5. Evaluation of Reform Effectiveness

5.1 Positive Changes in Student Behavior

After the reform, through measures such as "integrating real competition questions into teaching tasks" and a "stratified competition mechanism," and by promoting the relevance of various competitions to BIM courses to students, emphasizing the importance and practicality of BIM courses, according to research by the teaching and research office, students' classroom concentration and interaction enthusiasm have increased. Class attendance rates reached over 95%, the effectiveness of homework completion improved by over 30% compared to before, and the time spent on self-directed extended learning after class significantly increased. The student learning state shifted from "passive acceptance" to "active exploration."

5.2 Significant Improvement in Course Evaluation

Taking "BIM Technology Principles and Applications" as an example, after the reform, student evaluation of this course significantly improved. 89% of students highly agreed with the teaching content and resources; after adjusting the case drawings, the overall course difficulty decreased, and 84% of students found the course's challenge acceptable. Meanwhile, students believed that the integrated industry-competition-education content was highly aligned with industry job requirements, leading to a significant increase in overall course recognition.

5.3 Major Breakthrough in Award Achievements

In the university-level selection competition held by our university, hundreds of students actively registered and participated, and multiple outstanding award-winning students were selected and encouraged with college certificates and scholarships. Teams formed through classrooms and the university selection competition, after professional training, achieved excellent results in various national competitions. In the past three years, our university-led teams have won 8 first prizes, 4 second prizes, and 9 third prizes in two national competitions organized by Glodon, achieving major breakthroughs in both the quantity and quality of awards.

5.4 Deep Expansion of School-Enterprise Cooperation

With the advancement of I-E-C integration reform, school-enterprise cooperation has upgraded from "base co-construction" to "deep collaboration," forming a long-term mechanism of "resource sharing, mutual feedback of needs, and value symbiosis." On the one hand, enterprises participate in course content design and dispatch engineers as external tutors, integrating industry standards more precisely into teaching links. On the other hand, relying on the excellent student teams cultivated through competitions, our university has supplied a large number of high-quality talents with high BIM literacy to enterprises.

6. Conclusion and Outlook

This study, using the BIM course teaching reform at the School of Civil Engineering, Xiamen University Tan Kah Kee College as a case, systematically explored the application effects of the I-E-C integration model in solving existing BIM course teaching problems. The research results indicate that this model effectively promotes the linkage between industry, education, and competitions, significantly enhancing the practicality and cutting-edge nature of course teaching content. I-E-C integration not only stimulated students' learning interest but also enhanced their internal learning drive, thereby significantly improving students' practical ability and comprehensive application ability. Through the optimization of teaching content, the establishment of a stratified talent cultivation system, and the enhancement of teacher capabilities, the effective implementation of teaching reform was guaranteed from multiple dimensions, ensuring positive results from the teaching reform. Practical results of the course reform show good effectiveness in terms of positive changes in student behavior, significant improvement in course evaluation, major breakthroughs in competition results, and deep expansion of school-enterprise cooperation. These teaching and research results can provide useful experience and reference for teachers in similar universities.

Although this study has achieved certain results in BIM course teaching reform through the I-E-C integration model, the following limitations remain: Firstly, the research cycle is short, and the current reform effects are mainly based on teaching practice and competition results from the past three years. Long-term tracking analysis of graduates' career development after entering the industry has not yet been conducted. Secondly, the sample coverage is limited, as the reform practice is confined to our university and focuses on undergraduate-level BIM courses. Thirdly, there is insufficient in-depth exploration of the tripartite synergy of "industry-education-competition." Currently, school-enterprise cooperation remains more at the level of resource docking, competition-education integration still primarily focuses on decomposing real questions, and the systematic transformation of innovative methods emerging from competitions (such as parametric modeling techniques, cross-software collaboration strategies) into teaching content is not sufficient.

The future development direction of the course reform will strive to maintain the iterative synchronization of real competition questions and teaching content, and further increase the training efforts on teachers' practical abilities to continuously promote the optimization and improvement of the BIM course teaching system, laying a solid foundation for cultivating more high-quality BIM talents that meet industry needs. Follow-up research can extend the tracking period, expand the sample scope, and deepen the school-enterprise collaboration mechanism to further enhance the scientific nature and promotion value of the reform model.

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