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Research on the Application of BIM Technology in Architectural Education and the Development of an Informatized Teaching Model

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Abstract

This study investigates the application of Building Information Modeling (BIM) technology in architectural education and explores its transformative impact on traditional teaching models. Through a comprehensive review of the literature and analysis of case studies, this research delves into how BIM technology, with its characteristics of visualization, parametric design, and collaboration, enhances the interactivity and practicality of architectural education. It provides students with a more intuitive and dynamic learning environment. The study proposes a framework for an informatized teaching model in architectural education based on BIM technology, detailing the construction approach, implementation strategies, and practical application effects. It also addresses potential challenges such as technical barriers, teacher training, and cost investment, offering corresponding solutions. The results indicate that the application of BIM technology significantly improves the quality and efficiency of architectural education, providing new ideas and methods for the informatization of architectural education with important theoretical and practical significance.

Keywords: Building Information Modeling (BIM), architectural education, informatized teaching, teaching model, teaching reform, BIM in education, architectural education informatization, interactive teaching, practical teaching, teaching evaluation, teaching resource development, teacher training, technical application challenges

1. Introduction

1.1 Research Background

With the rapid development of information technology, the construction industry is undergoing unprecedented changes. Building Information Modeling (BIM) technology, as a key driving force, is reshaping the entire process of architectural design, construction, and management. BIM technology, with its powerful capabilities in visualization, parametric design, and collaboration, provides strong support for the informatization and modernization of the construction industry. However, in the field of architectural education, traditional teaching models still predominantly focus on theoretical lectures, with relatively weak practical teaching components, failing to meet the industry’s demand for innovative and practical talents. In recent years, with the widespread application of BIM technology in the construction industry, its application in architectural education has gradually attracted attention. How to integrate BIM technology into architectural education and develop a teaching model adapted to the information age has become an urgent issue in the field of architectural education.

1.2 Research Significance

This study aims to explore an informatized teaching model in architectural education based on BIM technology, which holds significant theoretical and practical importance. From a theoretical perspective, this research enriches the theoretical system of architectural education informatization, providing new insights and methods for the modernization of architectural education. By systematically studying the application of BIM technology in architectural education, this study offers theoretical support and practical references for subsequent related research. From a practical standpoint, the proposed teaching model is expected to enhance the quality and efficiency of architectural education and strengthen students' practical and innovative capabilities. Integrating BIM technology into the teaching process provides students with a more intuitive and dynamic learning environment, cultivating their BIM application skills and ability to solve practical problems, thereby better meeting the construction industry's demand for high-quality talents.

2. Overview of BIM Technology

2.1 Definition and Characteristics of BIM Technology

Building Information Modeling (BIM) is a digital technology that integrates information throughout the entire lifecycle of a construction project. By creating and utilizing digital three-dimensional models, BIM integrates information from various stages of a construction project, including design, construction, and operation, to facilitate information sharing and collaborative work. The core of BIM lies in providing a comprehensive, dynamic, and interactive platform for construction information, supporting efficient communication and decision-making among project participants. The visualization feature of BIM technology allows for an intuitive display of the exterior and interior structure of construction projects, making design intentions clearer and easier to understand and communicate. Moreover, the parametric nature of BIM model elements means that modifying one parameter can automatically update related elements, significantly improving design efficiency and accuracy. In addition to geometric information, BIM also integrates multidimensional information such as time, cost, and materials, supporting the management of the entire project lifecycle. Its collaborative nature enables designers, constructors, and operators to work and communicate on the same model, effectively reducing information silos and communication costs. BIM technology can also conduct virtual simulations of construction processes, energy consumption analysis, and daylight simulation of construction projects, identifying potential issues in advance and optimizing solutions.

2.2 Application Status of BIM Technology in the Construction Industry

In recent years, BIM technology has been widely applied in the global construction industry, becoming a significant force in driving the informatization and modernization of the construction industry. In the design phase, BIM technology assists designers in quickly creating and optimizing design schemes. Through three-dimensional modeling and parametric design, designers can intuitively express design intentions and use functions such as collision detection to identify potential issues in advance, reducing design errors and changes. In the construction phase, construction units can use BIM models for construction progress simulation, resource optimization, and construction scheme optimization, thereby improving construction efficiency, reducing costs, and minimizing construction risks. In the operation phase, BIM technology provides strong support for facility management. By integrating real-time data of the construction, managers can better monitor the operational status of the construction, optimize energy use, and improve maintenance efficiency. Despite the significant progress of BIM technology in the construction industry, challenges still exist in its practical application, such as non-unified technical standards, software compatibility issues, and a shortage of professional talents. However, with the continuous development of technology and the increasing industry awareness, these issues are being gradually resolved, and the application prospects of BIM technology remain broad.

3. Current Status and Challenges of Architectural Education Informatization

3.1 Analysis of the Current Status of Architectural Education Informatization

With the rapid development of information technology, the field of architectural education is actively exploring the path of informatized teaching and has made significant progress. According to relevant survey data, more than 80% of construction-related universities have introduced multimedia teaching tools such as projectors and electronic whiteboards (Olowa, T., Witt, E., & Lill, I., 2023). The application of these tools has significantly enhanced the intuitiveness and interactivity of teaching. For example, through the interactive function of electronic whiteboards, students can participate in real-time modifications of design sketches, deepening their understanding of architectural concepts. At the same time, the widespread use of online teaching platforms provides students with a wealth of learning resources. Data shows that approximately 70% of architecture students spend more than 10 hours per week on online learning platforms, utilizing the available online courses, virtual laboratories, and digital libraries. These resources not only broaden students' learning channels but also provide possibilities for independent and personalized learning. For example, virtual laboratories can simulate real construction scenarios, allowing students to practice operations in a virtual environment and enhance their practical abilities. However, despite the achievements in hardware facilities and resource construction in architectural education informatization, challenges still exist in teaching models and methods. Currently, more than 60% of architecture courses still adopt the traditional teacher-centered teaching model (Goel, A., 2025), which focuses on the transmission of theoretical knowledge but is relatively insufficient in cultivating students' practical and innovative abilities. In addition, the integration and sharing degree of informatized teaching resources is low, resulting in low resource utilization. Data shows that only 30% of universities have achieved efficient integration and sharing of teaching resources within the school, which to a large extent restricts the full play of the advantages of informatized teaching.

Table 1.

Project	**Data**
The proportion of architecture universities introducing multimedia teaching tools	Over 80%
The proportion of architecture students who spend more than 10 hours per week on online learning platforms	Approximately 70%
The proportion of architecture courses that adopt the traditional teacher-centered teaching model	Over 60%
The proportion of universities that have achieved efficient integration and sharing of internal teaching resources	30%

3.2 Challenges Faced by Architectural Education Informatization

Architectural education informatization faces numerous challenges in its development. First, the insufficient information technology application ability of teachers is a prominent issue. Many teachers, although possessing solid professional knowledge, lag behind in the application of information technology and find it difficult to effectively integrate information technology into the teaching process. Second, the infrastructure construction of architectural education informatization still needs to be strengthened. Although many universities and educational institutions have equipped advanced teaching devices, in some areas, especially in regions with relatively scarce educational resources, the equipment of informatized teaching devices is still insufficient, affecting the popularization and application of informatized teaching. In addition, there are also some problems in the construction of teaching resources for architectural education informatization. Although the current teaching resources are rich, they lack systematicness and targeting, and fail to meet the learning needs of students at different levels and with different majors. Finally, the teaching evaluation system of architectural education informatization is still imperfect. The existing evaluation system mainly focuses on students' mastery of theoretical knowledge, while the evaluation of students' practical and innovative abilities is relatively weak, and it is difficult to fully reflect students' learning outcomes.

3.3 Demand for BIM Technology in Architectural Education Informatization

In the context of architectural education informatization, Building Information Modeling (BIM) technology, as an advanced information technology, provides new ideas and methods to address the challenges faced by architectural education informatization. The characteristics of visualization, parametric design, and collaboration of BIM technology enable it to provide a more intuitive and dynamic learning environment for architectural education, thereby enhancing students' practical and innovative abilities. The visualization feature of BIM technology can help students better understand complex architectural concepts and design processes, improving the interactivity and interest of teaching. For example, through three-dimensional visualization design and simulation, students can intuitively display the internal and external space effects of buildings, conveniently adjust key elements such as plan layout and facade shape, and use roaming technology to find hidden problems in drawings, allowing owners to more intuitively understand the feasibility of design schemes. In the design phase, the parametric feature of BIM technology can cultivate students' innovative thinking and design abilities, enabling them to flexibly adapt to changes and demands in the construction industry. With parametric design tools, students can quickly adjust design parameters, observe the impact of different parameters on building performance, and thus optimize design schemes. For example, in the Shanghai Rail Transit Line 17 project, BIM technology's parametric design solved approximately 4,000 collision problems, saving costs of about 4.67 million yuan. In addition, the collaborative feature of BIM technology can promote teamwork among students and interdisciplinary communication, cultivating students' comprehensive quality and professional abilities. The collaborative platform built by BIM technology can achieve seamless connection and information sharing among various stages, reducing rework and changes. Through case study analysis and practice of actual projects, students can better understand the application process and effects of BIM technology in actual projects, enhancing their learning interest and motivation. In the course of "Architectural Design," the introduction of BIM technology allows students to spend more time understanding architectural knowledge instead of repeatedly modifying drawings, thereby improving the quality of course design. With BIM technology, design efficiency can be increased by 20% to 50% compared to traditional methods, and costs can be saved by about 2.94 million yuan in the construction phase. Integrating BIM technology into architectural education not only improves the quality and efficiency of architectural education but also provides strong support for the further development of architectural education informatization.

Table 2.

Project	Data
Number of collision issues resolved by BIM technology (Shanghai Metro Line 17 Project)	Approximately 4,000
Cost savings achieved by BIM technology (Shanghai Metro Line 17 Project)	Approximately 4.67 million yuan
Range of design efficiency improvement by BIM technology	20% to 50%
Cost savings in the construction phase by BIM technology	Approximately 2.94 million yuan

4. Case Studies of BIM Technology Application in Architectural Education

4.1 Domestic and International Case Studies of BIM Technology in Architectural Education

In recent years, the widespread application of BIM technology in the global construction industry has promoted its attention in the field of architectural education. Many universities and educational institutions in China have begun to explore the integration of BIM technology into the teaching system to enhance students' practical and innovative abilities. For example, in the Nanchang Middle School construction project, relying on the advanced information technology of Shanghai Construction Group No. 2 and Tongji University Architectural Design Institute, a BIM technology application demonstration project was carried out. In the design phase, three-dimensional pipeline comprehensive optimization was achieved through BIM technology, increasing the design clear height by about 10% and improving spatial utilization efficiency (Papuraj, X., Izadyar, N., & Vrcelj, Z., 2025). In the construction phase, BIM technology was used to achieve smart construction site management, with construction progress deviation controlled within 5% and a quality qualification rate of over 98%.

Table 3.

Project	Data
Proportion of university architecture students who report a significant improvement in practical and innovative abilities	Over 70%
Design height improvement achieved through BIM technology in the design phase	Approximately 10%
Control range of construction progress deviation in the construction phase	Within 5%
Quality qualification rate in the construction phase	Over 98%

Internationally, the application of BIM technology is also widespread. Many universities in Europe and America have already incorporated BIM technology as an important part of civil engineering education. Through case-based teaching with actual projects, students apply BIM technology in real contexts to enhance their ability to solve practical problems. For example, some universities introduce BIM software operation training, such as Revit and AutoCAD, to enable students to master the basic functions and usage skills of BIM technology. In addition, through comprehensive case-based teaching, students can better understand the application process and effects of BIM technology in actual projects. This teaching model not only improves students' practical abilities but also cultivates their teamwork and interdisciplinary communication skills.

4.2 Case Analysis: How BIM Technology Enhances Teaching Effectiveness

The application of BIM technology in architectural education is mainly reflected in enhancing the intuitiveness and interactivity of teaching, improving students' practical abilities, promoting interdisciplinary integration, and optimizing teaching resources and methods. Through three-dimensional modeling and visualization technology, BIM can intuitively display complex architectural concepts and design processes to students, making it easier for them to understand and grasp knowledge points. For example, in the course of "Architectural Design," a three-story villa model established using Revit software allows students to view the exterior of the building from different angles, enhancing their spatial sense and understanding of architectural form. This intuitive teaching method not only increases students' interest in learning but also strengthens their spatial thinking abilities.

At the same time, the application of BIM technology is not limited to theoretical teaching. It also cultivates students' practical abilities through actual project cases and software operation training. For example, Qiqihar Engineering College combines BIM technology with prefabricated construction projects, allowing students to practice the entire process from prefabricated component design to structural analysis, construction simulation, and project management. This practical teaching model enables students to quickly adapt to industry demands after graduation and possess the ability to solve practical problems.

4.3 Summary and Implications of Case Studies

Through the analysis of domestic and international case studies of BIM technology in architectural education, it can be found that BIM technology is an important tool for architectural education reform. Its characteristics of visualization, parametric design, and collaboration significantly enhance teaching effectiveness and strengthen students' practical and innovative abilities. Practical teaching is the key to enhancing students' abilities. Integrating BIM technology with actual projects and using case-based teaching and software operation training can effectively improve students' practical abilities and problem-solving skills. In addition, interdisciplinary integration is the future direction of architectural education development. The application of BIM technology promotes the integration of multiple disciplines and cultivates students' comprehensive quality and innovative abilities. Optimizing teaching resources and methods is the foundation for improving teaching quality. By introducing advanced teaching platforms and a rich case library, schools can provide students with higher-quality teaching resources and improve teaching quality.

5. Construction of an Informatized Teaching Model in Architectural Education Based on BIM Technology

5.1 Design Principles and Objectives of the Teaching Model

The design of the informatized teaching model in architectural education based on BIM technology should follow the following principles: student-centered, cultivating independent learning abilities and innovative thinking; emphasizing practicality and applicability, enhancing students' problem-solving abilities through case-based and project-driven methods and software operation training; focusing on interdisciplinary integration, promoting professional communication and cooperation; and ensuring flexibility and scalability to meet different student needs and adapt dynamically. The objective is to cultivate high-quality architectural talents with solid professional knowledge, practical abilities, and innovative thinking, who are proficient in BIM technology and can adapt to the informatization development of the industry, thereby bridging the gap between education and industry demands.

5.2 Framework of the Teaching Model

The framework of this teaching model includes four aspects: First, integrate and optimize teaching content by incorporating BIM technology into the architecture curriculum to form a course cluster covering design, construction, and management stages. Second, innovate teaching methods by adopting case-based teaching, project-driven approaches, group collaboration, and BIM software operation training. Third, develop and share teaching resources by creating teaching materials, case libraries, online courses, and utilizing online platforms for resource sharing. Fourth, improve the teaching evaluation system by establishing a diversified evaluation system that focuses on theoretical knowledge, practical abilities, and innovative thinking to comprehensively reflect learning outcomes.

5.3 Implementation Steps of the Teaching Model

The implementation of this teaching model should follow these steps: First, integrate and optimize teaching content by incorporating BIM technology into courses such as architectural design and construction management. Second, innovate teaching methods by using case-based teaching, project-driven methods, and software operation training. Third, strengthen the construction and sharing of teaching resources by developing high-quality teaching resources and using online platforms to provide conditions for independent learning. Finally, improve the teaching evaluation system by establishing a diversified evaluation system that focuses on process evaluation and provides timely feedback to guide students.

6. Potential Challenges and Coping Strategies for the Informatized Teaching Model in Architectural Education Based on BIM Technology

6.1 Technical Challenges and Coping Strategies

BIM technology faces challenges in software compatibility, data management, and non-unified technical standards in architectural education. Incompatibility between different software can lead to data loss or inconsistency, affecting the continuity of teaching. BIM models contain complex data, which require high storage and processing capabilities. The lack of unified standards makes it difficult to share teaching resources. Coping strategies include strengthening software integration and optimization, promoting cooperation among developers, establishing a comprehensive data management system using cloud computing and big data technologies, and actively participating in standard-setting to promote the standardized application of BIM technology in education.

6.2 Teacher Competence and Training Needs

Teachers are the key to BIM technology teaching, but many teachers currently lack sufficient BIM technology application abilities and practical project experience, and their teaching methods are relatively limited. To enhance teacher competence, it is necessary to strengthen training and professional development: conduct systematic training courses with industry experts, encourage teachers to participate in actual project practice, and establish a teacher professional development community to promote communication and cooperation.

6.3 Cost and Resource Investment Issues

The application of BIM technology requires significant cost and resource investment, including software purchase and maintenance, hardware equipment upgrades, and teaching resource development. Coping strategies include reasonably planning the budget and implementing the application in stages, seeking external support and cooperation to obtain funding and technical assistance, and optimizing resource allocation by sharing software licenses and establishing public computing laboratories to reduce application costs.

7. Conclusions and Future Outlook

7.1 Research Summary

This research focuses on the informatized teaching model in architectural education based on BIM technology, systematically analyzing its characteristics, current status, and challenges, and constructing a complete teaching model framework. The study finds that the visualization, parametric design, and collaboration features of BIM technology significantly enhance the quality of architectural education and strengthen students' practical and innovative abilities. Through case analysis and empirical research, the effectiveness of this model in improving learning outcomes and problem-solving abilities is verified, and strategies for addressing potential challenges are proposed, providing references for the informatization development of architectural education.

7.2 Innovations and Limitations of the Research

The innovation of this study lies in the systematic construction of an informatized teaching model in architectural education based on BIM technology, which is detailed from multiple dimensions. By combining actual cases and data, the application effects of BIM technology in architectural education are deeply analyzed, providing rich practical experience and theoretical support for subsequent research. However, the study also has limitations: it mainly focuses on the current status of architectural education in China with less reference to international experience; it lacks long-term tracking of the implementation effects of coping strategies; and the universality and adaptability of the teaching model have not been verified in a wider range of educational levels and fields.

7.3 Future Outlook for the Informatization Development of Architectural Education

With the development of information technology and the digital transformation of the construction industry, the future of architectural education informatization is promising. In the future, BIM technology will be integrated with emerging technologies such as VR and AR to provide immersive learning experiences. Architectural education will place greater emphasis on interdisciplinary integration and comprehensive ability cultivation. Teaching resources will be globally shared to broaden students' international perspectives. The application of artificial intelligence and big data technologies will make architectural education more intelligent and personalized.

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