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Integration Practice of BIM and AI-Guided Learning in Mountain Architecture Teaching under the Background of Intelligent Construction

Yajuan Liu*

Chongqing Energy College, Chongqing 402260, China

Author to whom correspondence should be addressed.

Abstract: To further enhance the quality of mountain architecture teaching, strengthen talent cultivation, and precisely meet the demand for new architectural talents driven by the development of intelligent construction, this paper explores the integration of BIM and AI-guided learning in mountain architecture teaching. It first analyzes and interprets the value of integrating BIM and AI-guided learning in mountain architecture teaching, then examines the supporting system for their integration in mountain teaching, and finally proposes practical strategies to address current issues in integrated teaching. These strategies include optimizing teaching platform functionalities, innovating teaching resource provision, improving teaching evaluation systems, and deepening school-enterprise collaboration, thereby effectively promoting deep integration of BIM and AI-guided learning in mountain architecture teaching and providing solid support for talent cultivation in mountain architecture under the context of intelligent construction.

Keywords: Intelligent construction; BIM; AI-guided learning; Mountain architecture teaching; Integration practice

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1. Preface

With the rapid popularization of intelligent construction technologies, the construction industry has embraced new development opportunities, and the demand for compound talents with both digital capabilities and mountain engineering literacy has become increasingly urgent. Mountain architecture, characterized by complex terrain, challenging construction, and unique scenarios, imposes stricter requirements on talent cultivation. Traditional teaching models fail to achieve a deep connection between theory and engineering practice [1]. Therefore, in the current context of intelligent construction, it is necessary to deeply integrate BIM and AI-guided learning into mountain teaching to drive teaching innovation, create a three-dimensional teaching model that combines visualization, personalization, and practicality, and enable students to deeply master digital design, construction, and management skills in mountain architecture, thereby enhancing talent cultivation levels and effectiveness and continuously supplying high-quality talents to the mountain architecture field.

2. Core value of integrating BIM and AI-guided learning in mountain architecture teaching

2.1. Meeting the special needs of mountain architecture teaching

Mountain architecture teaching presents special characteristics such as complex terrain, abstract scenarios, and significant practical challenges, which traditional teaching models cannot intuitively present, resulting in insufficient teaching adaptability [2]. The integration of BIM and AI-guided learning in teaching can precisely meet the special needs of mountain architecture teaching, effectively visualizing terrain relationships and construction challenges in mountain architecture construction. This not only helps students more accurately understand theoretical knowledge regarding mountain architecture site selection and terrain adaptability but also precisely addresses challenges in teaching practice, thereby improving teaching quality and effectiveness.

2.2. Aligning with intelligent construction talent cultivation goals

The integration of BIM and AI-guided learning in mountain architecture teaching deeply aligns with the goals of intelligent construction talent cultivation. In the current era of intelligent construction, the demand for compound talents with digital capabilities and mountain engineering literacy in the mountain architecture field is becoming increasingly urgent. The integration of BIM and AI-guided learning in education can effectively promote the connection between digital technologies and the entire teaching process, enabling students to master skills such as BIM visual modeling and AI-guided learning during their studies, and cultivating their digital thinking and engineering practice abilities. This not only drives precise alignment between teaching and industry needs but also highly aligns with the core goals of intelligent construction talent cultivation, continuously supplying high-quality talents to industry development [3].

3. Supporting system for integrating BIM and AI-guided learning in mountain architecture teaching

3.1. Establishing a digital teaching technology support framework for mountain architecture

The integration of BIM and AI-guided learning in mountain architecture teaching requires establishing a digital teaching technology support framework for mountain architecture to ensure that education and teaching deeply meet the special needs of mountain teaching. In practice, it is necessary to closely revolve around the entire process of mountain architecture teaching and establish a technology application logic that adapts to mountain architecture teaching scenarios, such as integrating BIM and AI-guided learning into various aspects of mountain architecture theory teaching, practical guidance, Q&A sessions, and outcome feedback. This not only achieves deep integration of BIM and AI-guided learning in mountain architecture teaching but also enables innovation and transformation of various teaching links under technology adaptation, meeting students' professional learning needs and promoting quality and efficiency improvements in integrated teaching [4].

3.2. Constructing a "BIM + AI" teaching content adaptation mechanism

Constructing a "BIM + AI" adaptation mechanism helps improve the effectiveness of integrated teaching and ensures deep integration of mountain teaching with BIM and AI-guided learning. In teaching practice, the primary task is to sort out the core content of current mountain architecture teaching and strive to embed BIM and AI throughout the entire teaching process, such as using BIM technology for contour line processing teaching in terrain modeling links and utilizing AI-guided learning for precise knowledge point delivery in Q&A sessions to ensure the adaptability of teaching content to students' learning needs. Additionally, in teaching practice, it is necessary to accurately observe students' learning progress, ability foundations, and professional levels to ensure precise alignment between BIM and AI-guided learning during the integration stage and students' growth needs, thereby improving teaching quality [5].

4. Existing problems in the integration of BIM and AI-guided learning in mountain architecture teaching

4.1. Insufficient adaptability of BIM and AI technology applications to mountain architecture teaching

The integration of BIM and AI-guided learning in mountain architecture teaching faces challenges related to insufficient adaptability, resulting in suboptimal teaching outcomes and hindering teaching innovation. Mountain architecture teaching is characterized by complex terrain and unique construction challenges, yet the application of BIM and AI technologies often falls short in addressing these specific needs. BIM technology is predominantly utilized for conventional architectural simulations, with limited optimization for special scenarios in mountain architecture, such as contour line processing, slope adaptation, and slope protection. Similarly, AI technology lacks deep integration with teaching content, lacking tailored guidance modules specifically designed for mountain architecture teaching, thereby limiting the full potential of BIM and AI technologies [6].

4.2. Need for improvement in the personalized teaching adaptability of AI-guided learning

The personalized teaching adaptability of AI-guided learning requires enhancement, posing a significant challenge in mountain architecture teaching. This limitation hinders the precise alignment of teaching content with the diverse learning foundations and growth needs of students. In practice, AI-guided learning algorithms have not been sufficiently optimized to meet the unique demands of mountain architecture teaching, resulting in difficulties in accurately identifying students' knowledge weaknesses, such as those related to mountain terrain modeling and BIM. Consequently, this leads to homogenized delivery of learning resources. Furthermore, teaching practices often fail to adequately consider individual student differences, lacking differentiated resource delivery for students with varying levels of foundation, thereby impeding the implementation of personalized teaching approaches and reducing overall teaching quality.

4.3. Insufficient integration of digital teaching resources and technologies in mountain architecture

The insufficient integration of digital teaching resources and technologies in mountain architecture represents a significant challenge in the integration of BIM and AI in teaching. This issue is primarily manifested by the relatively weak reserve of teaching resources and the inability of existing resources to achieve deep integration with BIM and AI technologies, thereby limiting the expansion of diverse teaching scenarios. For instance, existing teaching resources often consist of scattered BIM models and teaching materials, lacking dedicated content tailored to terrain adaptation and slope protection in mountain architecture. Additionally, these resources have not been integrated with AI-guided learning technologies, hindering the establishment of precise resource delivery mechanisms in teaching practices and diminishing the effectiveness of mountain architecture teaching [7].

4.4. Disconnection between the practicality of integrated teaching and actual mountain engineering practices

The disconnection between the practicality of integrated teaching and actual mountain engineering practices poses a problem in the integration of BIM and AI in teaching. This issue is primarily characterized by the predominant use of classroom simulations and virtual operations in integrated teaching, with limited emphasis on strengthening connections with mountain engineering practices, resulting in weak practicality in course teaching. In practical teaching, BIM practical cases often rely on virtual scenarios, failing to incorporate elements such as real mountain construction projects, complex terrain, and construction challenges. Consequently, students struggle to gain practical experience, limiting the improvement of their practical abilities [8]. Meanwhile, insufficient collaboration between schools and enterprises has hindered the establishment of off-campus practical bases, resulting in a scarcity of practical teaching scenarios and difficulties in enhancing teaching quality and effectiveness.

5. Optimization strategies for the integration practice of BIM and AI-guided learning

5.1. Optimize teaching platform functionalities to enhance adaptability to mountain scenarios

Optimizing teaching platform functionalities to enhance adaptability to mountain scenarios is crucial for promoting the integration practice of BIM and AI-guided learning and fostering teaching innovation. Therefore, it is essential to precisely align with the characteristics of complex terrain and diverse scenarios in mountain architecture and make targeted optimizations to teaching platform functionalities. Firstly, promote the optimization of the teaching platform's technological architecture by deeply integrating core functional modules such as BIM modeling, terrain simulation, and AI-guided learning within the platform. This integration should eliminate data barriers between modules and prevent disconnections between modeling and guidance processes. Additionally, the platform should focus on improving the mountain terrain simulation capabilities within the BIM module, ensuring support for practical operations such as contour line import, slope analysis, and terrain cutting. This will enable the simulation of real engineering scenarios in teaching practices, allowing students to intuitively understand the multifaceted impacts of mountain terrain on architectural design and construction. Secondly, enhance the adaptability of the AI-guided learning module to mountain scenarios by conducting AI model training that deeply aligns with mountain architecture teaching objectives. This will drive the optimization of AI algorithms and effectively bridge classroom teaching with mountain scenarios. For instance, in teaching special knowledge related to slope protection and foundation treatment in mountain architecture, AI-guided learning can be utilized to deliver relevant BIM modeling cases and construction videos, assisting students in addressing terrain adaptation challenges during practical operations. This approach not only strengthens the adaptability of teaching content to mountain scenarios but also helps improve students' professional abilities and levels, enabling them to more efficiently complete mountain architecture teaching tasks [9].

5.2. Innovate teaching resource provision to meet practical needs in mountain architecture

In the context of intelligent construction, the integration of BIM and AI-guided learning in mountain architecture teaching necessitates innovative teaching resource provision to ensure alignment with practical needs. Therefore, teaching should revolve around the demands of mountain architecture education and establish an integrated teaching resource provision framework that combines "BIM + AI". Firstly, diversify the types of teaching resources provided by deeply integrating resources such as BIM model libraries, AI-guided learning courseware, practical cases, and virtual simulation videos in teaching. Additionally, promptly supplement typical case resources in mountain architecture to ensure comprehensive coverage of BIM models for different terrains and architectural types. Core teaching points such as terrain processing, slope protection, and drainage design should be meticulously annotated within these resources to meet the practical teaching needs of mountain architecture. Secondly, strengthen the adaptability of resources to teaching by precisely aligning resource provision with the objectives of intelligent construction talent cultivation. This involves deeply integrating BIM modeling techniques, AI data analysis, and practical norms for mountain engineering into the teaching resource system. Furthermore, resources should be categorized and provided based on the professional learning needs of students with varying foundations and grade levels. For instance, focus on providing foundational resources for terrain modeling to lower-grade students, while emphasizing resources related to comprehensive practical operations and construction simulations in mountain architecture for higher-grade students. This ensures the targeted and effective provision of mountain architecture teaching resources, enhancing the quality of talent cultivation.

5.3. Improve the teaching evaluation system to strengthen the orientation of integrated practice

Improving the teaching evaluation system and strengthening the orientation of integrated practice are instrumental in promoting the integration of BIM and AI into mountain architecture teaching practices and ensuring alignment with educational reform trends in the context of intelligent construction. Therefore, it is essential to establish a comprehensive evaluation framework that combines process-based and summative evaluations. Firstly, drive the optimization of teaching evaluation indicators by comprehensively considering aspects such as BIM modeling capabilities, AI-guided learning application abilities, practical abilities in mountain architecture, and teamwork skills when evaluating mountain architecture teaching. Additionally, refine the scoring criteria for each indicator. For instance, when evaluating BIM modeling capabilities, focus on assessing the accuracy of students' mountain terrain modeling and the adaptability of architectural designs to the terrain during practical operations, reflecting their practical skill levels [10]. Secondly, promote innovation in evaluation methods by paying close attention to students' learning processes and outcomes, and establishing a "process-based + summative" three-dimensional evaluation model. In process-based evaluation, focus on students' performance during BIM practical operations, AI-guided learning, group collaborations, and task progressions in the classroom. Utilize online learning platforms to meticulously record each student's learning trajectory, task progress, and practical performance, reflecting the specifics of their learning processes. Summative evaluation should assess students' abilities to apply BIM technology to advance projects based on comprehensive practical projects in mountain architecture, including indicators such as mountain architectural design, terrain simulation, and construction process planning, to comprehensively evaluate their practical application abilities. After completing evaluations, leverage the evaluation results to drive subsequent teaching mode optimizations, promoting the deep integration of BIM and AI into mountain architecture teaching and enhancing teaching quality and efficiency.

5.4. Deepen school-enterprise collaboration to expand integrated practice scenarios

In the context of intelligent construction, the integration of BIM and AI into mountain architecture teaching requires deepening collaboration between schools and enterprises to expand integrated practice scenarios. Firstly, establish a long-term cooperation mechanism between schools and enterprises. Strengthen collaboration between schools and enterprises related to mountain architecture, such as signing cooperation agreements with mountain architecture enterprises and digital construction enterprises. Clearly define the responsibilities of both parties in advancing talent cultivation. In this collaboration, enterprises provide real mountain construction project cases and BIM modeling projects, along with AI technical support, while schools are responsible for orchestrating curriculum teaching, strengthening technological research and development, and deeply aligning teaching practices with actual engineering projects in enterprises. This approach fosters a three-dimensional talent cultivation framework and effectively promotes the deep integration of BIM and AI in mountain architecture teaching. Secondly, expand integrated practice scenarios by leveraging engineering case resources from enterprises and theoretical teaching resources within schools. Collaborate with enterprises to establish off-campus practical bases and organize students to conduct practical operations at these bases. This allows students to deepen their understanding of BIM and AI technologies in real projects and strengthen their technological application abilities. During practical operations, enterprise mentors and school teachers provide tracking guidance to help students master the construction processes and industry norms of mountain architecture projects, thereby solidifying their professional skill foundations and enabling them to fully adapt to the demand trends for compound talents in the mountain architecture field under the context of intelligent construction.

6. Conclusion

Research has found that in the context of intelligent construction, the integration of BIM and AI-guided learning into mountain architecture teaching holds significant importance and value. It not only precisely meets the unique demands of mountain architecture teaching but also fully aligns with the objectives of intelligent construction talent cultivation. The multiple measures proposed in this paper, including platform functionality optimization, teaching resource provision, evaluation system improvement, and school-enterprise collaboration, contribute to promoting the deep integration of BIM and AI into mountain architecture teaching and driving teaching innovation. In the future, mountain architecture teaching will gradually evolve towards innovative development characterized by deep technological integration and precise scenario adaptation. Subsequent research can explore breakthroughs in areas such as the optimization of personalized algorithms for BIM and AI-guided learning and the construction of digital teaching scenarios for mountain architecture, further enhancing the quality and efficiency of mountain architecture teaching.

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