

A literature review on improving the course design of Building Information Modeling (BIM) courses in construction majors for higher vocational colleges in China

1. Introduction

1.1 Background

Building Information Modeling (BIM) has become an essential technology in the construction industry, revolutionizing project management, design coordination, and construction processes (Tran, and Nguyen, 2024). With the continuous iteration and evolution of “BIM+” technologies—such as BIM + construction management, BIM + artificial intelligence, and BIM + carbon neutrality—the industry is placing higher demands on BIM technical talent.

Higher vocational colleges in China play a crucial role in preparing students for careers in the construction industry. In recent years, policies such as the *Vocational Education Law*, the “20 Measures for Vocational Education” and *National Vocational Education Reform Implementation Plan* have prompted updates in China's higher vocational education system. These initiatives underscore that higher vocational education is a distinct category from general higher education, shift the focus of talent cultivation from technical skills to developing high-skilled professionals, and promote robust school-enterprise cooperation and production-education integration (Ministry of Education of the People’s Republic of China, 2019).

In construction-related disciplines, the introduction of the “1+X” certificate system has allowed students to acquire additional technical credentials, including the 1+X BIM Certificate, alongside their academic qualifications. However, the relationship between BIM courses and BIM certification has been a subject of extensive scholarly debate. While some researchers view the certification as a useful indicator of technical competence, others point out the challenges in aligning course curricula

with the evolving standards of the industry. Moreover, integrating and balancing theoretical knowledge with practical skills in actual teaching settings remains a persistent challenge (Shen, Huang and Zhang, 2023). This discussion reflects the broader complexities involved in modernizing vocational education to meet contemporary industry requirements.

However, the current course design of BIM education in vocational colleges faces several challenges. Many programs struggle with outdated curricula, insufficient integration of real-world industry practices, and a lack of qualified instructors with hands-on BIM experience. Additionally, the fast-evolving nature of BIM technology requires continuous updates to course content, teaching methods, and assessment strategies to align with industry needs (Besné et al., 2021). The existing literature suggests that effective BIM education should incorporate interactive learning, project-based training, and collaborations with industry stakeholders to enhance students' practical competencies.

Despite ongoing efforts to improve BIM education, there is still a gap in research regarding the optimization of course design specifically for higher vocational colleges in China. This literature review aims to explore existing studies on BIM course design, identify key challenges, and propose strategies for improving curriculum development, teaching methodologies, and industry alignment. By addressing these issues, vocational colleges can better equip students with the skills needed to thrive in the construction sector.

1.2 Key search terms and process of review

The review process employed a systematic search strategy to gather scholarly works relevant to BIM course design in higher vocational education. This process began by defining research questions and selecting comprehensive databases, including Scopus, IEEE Xplore, Google Scholar, and institutional digital libraries. Key search

terms such as “BIM (Building Information Modeling) technology,” “Higher vocational education,” “Digital pedagogy,” and “Course effectiveness” were used, both individually and in combination, to capture a wide array of literature. Articles were screened based on their relevance to BIM integration and digital pedagogy in vocational contexts, publication date, and academic rigor. The selected studies were then analysed to extract insights regarding methodological approaches, integration challenges, and the balance between theoretical and practical instruction, ensuring a robust examination of current trends and identifying potential areas for improvement in BIM curriculum development and higher vocational education development.

1.3 Research aims/objectives and draft research questions

1.3.1 Research aims

The primary aim of this research is to explore and evaluate the current state of BIM course design in higher vocational education in China, focusing on the integration of BIM technology, digital pedagogy, and the effectiveness of the courses in preparing students for the evolving demands of the construction industry.

1.3.2 Objectives

- a. To review the current literature on BIM technology integration in higher vocational education and its impact on curriculum development.
- b. To evaluate the effectiveness of existing BIM courses in equipping students with the practical and theoretical knowledge required by the construction industry.
- c. To examine the role of digital pedagogy in enhancing the teaching and learning of BIM within vocational settings.

- d. To identify the challenges and gaps in the current BIM course design and suggest potential improvements in course structure, teaching methods, and industry alignment.
- e. To investigate the relationship between BIM certification (such as the "1+X" certificate system) and the actual learning outcomes for students in vocational education.

By addressing these objectives, the study aims to provide insights into how higher vocational colleges can improve their BIM courses to better prepare students for successful careers in the construction sector.

1.3.3 Research question

How can the design of the BIM courses in construction majors be improved for higher vocational colleges in China?

Sub-questions:

How is BIM technology currently integrated into the course design of higher vocational education programs in China?

What are the key challenges faced by higher vocational colleges in designing and implementing BIM courses, and how can these challenges be addressed?

How does the BIM certification, such as the "1+X" certificate system, impact the learning outcomes and career preparedness of students in vocational education?

What are the gaps in the current BIM curriculum design, and what improvements can be made to align it more closely with industry needs and emerging technologies??

1.4 Summary of Section 1

This research examines the integration of BIM (Building Information Modeling) technology in higher vocational education in China, particularly within construction majors. It highlights recent policy updates, such as the *Vocational Education Law* and the *"1+X" certificate system*, which focus on developing high-skilled professionals and promoting school-enterprise cooperation. Despite the growing importance of BIM courses and certifications, there are ongoing challenges in balancing theoretical knowledge with practical skills in course design. The review aims to explore the effectiveness of current BIM courses, the role of digital pedagogy, and the impact of BIM certification on student outcomes. Key research questions include the integration of BIM technology in vocational courses, the role of digital pedagogy, and the effectiveness of BIM education in meeting industry demands.

2. Literature Review

2.1 Introduction

This literature review aims to critically examine existing research on BIM course design in higher vocational education, with a focus on the integration of BIM technology, the effectiveness of current teaching methods, and the challenges faced in course development. By exploring key issues such as digital pedagogy, course effectiveness, and the impact of BIM certification, this review provides a comprehensive overview of the current state of BIM education and offers insights into potential areas for improvement.

2.2 Key definitions/theories

2.2.1 Building Information Modeling (BIM)

BIM is a digital representation of physical and functional characteristics of a building or infrastructure project (Tahir et al., 2018). BIM involves the use of software tools to create 3D models (Eastman et al., 2008), enhance collaboration, and manage information throughout a project's lifecycle.

2.2.2 Building Information Modeling (BIM) courses

Building Information Modeling (BIM) courses refer to structured, multi-module educational programs that integrate BIM technology into different aspects of construction-related education. These courses are not isolated, instead, they are embedded within traditional subjects and aligned with practical applications using specialised BIM software and platforms (Zhang, 2023).

2.2.3 Higher Vocational Education

Higher Vocational Education is a level of post-secondary education in China focused on developing students' practical skills and technical expertise for specific careers. It is distinct from general education and aims to prepare students for direct employment in specialized fields, such as construction, engineering, and technology (Yu, Yan and Jin, 2025).

2.2.4 Digital Pedagogy

Digital Pedagogy is the integration of digital tools, technologies, and methods into the teaching and learning process. It involves the use of digital platforms, resources, and strategies to enhance students' learning experiences and outcomes (Chatterjee et al., 2023).

2.2.5 Course Effectiveness

Course Effectiveness refers to the degree to which a course meets its intended learning objectives and provides students with the knowledge and skills required by the industry. Course effectiveness is often evaluated based on student performance, feedback, and alignment with industry standards (Wong et al., 2025).

2.2.6 1+X Certificate System

1+X Certificate System is a certification system in China that allows students to earn additional industry-recognized credentials alongside their formal academic qualifications. The "1" refers to the primary vocational qualification, while the "X" represents various supplementary certificates, such as the BIM certificate, aimed at enhancing students' employability (Zhao, and Selvaratnam, 2024).

2.2.7 School-Enterprise Cooperation

School-Enterprise Cooperation refers to a collaborative model between educational institutions and industry partners, aimed at aligning curriculum design with industry needs. This cooperation ensures that students receive practical, hands-on experience and are better prepared for the workforce upon graduation (Zhou and Xu, 2023).

2.2.8 Production-Education Integration

Production-Education Integration is a concept that emphasises the integration of educational programs with real-world industry practices. It aims to bridge the gap between academic learning and industry requirements, ensuring that students gain practical, applicable skills (Yu, Yan and Jin, 2025).

2.3 Key theme 1: Integration of BIM Technology in Curriculum

Design

A central theme in the literature is the extent to which BIM technology is integrated into higher vocational education courses. Scholars debate how BIM can be effectively incorporated into existing curricula and whether current teaching methods adequately reflect industry standards and technological advancements.

Several scholars emphasise the growing importance of integrating BIM technology into architectural and construction education, yet they also highlight distinct challenges and perspectives. Badrinath et al. (2016) and Smith & Tardif (2019) both stress that incorporating BIM is essential for aligning education with industry needs, recognizing BIM as a necessary skill set for future professionals. Jin et al. (2018) further expands this view by describing BIM-based curricula as comprehensive, combining technical skills with theoretical foundations and offering exposure to project management, cost estimation, and facility management. Murillo (2024) reinforces this, emphasizing the multifaceted nature of BIM education, which prepares students for complex modern practices. However, Ahn and Kim (2016) and Matejovska et al. (2017) provide a more critical perspective, pointing out the significant curricular changes and institutional challenges required to successfully integrate BIM into traditional education systems. The synthesis of these views shows a consensus on BIM's necessity in education, but also reveals tension between the ambition to comprehensively integrate BIM and the practical difficulties of curriculum reform, resource allocation, and faculty readiness.

This gap between the recognised importance of BIM education and the challenges of its implementation is particularly evident in the context of Chinese higher vocational colleges. While much of the existing literature focuses on university level education, vocational institutions face unique constraints, including limited teaching resources, a strong emphasis on certification driven training, and a need for greater alignment with industry requirements. My research on improving the course design of BIM

courses in construction majors for higher vocational colleges in China aims to bridge this gap by exploring how BIM curricula can be structured to balance theoretical knowledge, practical application, and industry relevance. By analysing current teaching practices, identifying barriers to effective BIM education, and proposing a more integrated course framework, this study seeks to contribute to both academic discussions and practical reforms in vocational BIM education.

2.4 Key theme 2: Effectiveness of BIM Education

Despite the increasing emphasis on integrating BIM into vocational and higher education curricula, there remains a noticeable gap in the literature concerning the clear measurement and evaluation of its effectiveness. One major reason for this scarcity is the inherent complexity in defining what constitutes ‘effectiveness’ in BIM education.

As Liu et al. (2025) demonstrate, assessing the current effectiveness of BIM education in construction management programs is a necessary yet challenging task. Their study, grounded in Bandura's Social Cognitive Theory, illustrates that direct impacts from both theoretical and practical educational environments on perceived educational effectiveness are not statistically significant. Instead, these factors influence outcomes indirectly by fostering students’ professional self-efficacy. The study highlights that decision-making self-efficacy values more than coping self-efficacy, suggesting that empowering students with confidence in applying BIM knowledge is critical for job readiness. These findings underscore that traditional evaluation metrics, such as curriculum completeness or technical instruction quality, may be insufficient on their own.

Furthermore, beyond the BIM-specific domain, broader literature on engineering and vocational education effectiveness remains similarly limited. Bouffard et al. (2000) reviewed program evaluations across vocational education, employment training, and correctional work programs, finding evidence of effectiveness in improving employment outcomes, yet their analysis also exposed a widespread lack of rigorous methodological evaluation, making it difficult to generalise findings. This

methodological shortfall is mirrored in the Chinese context, where while some official reports on vocational education effectiveness exist, they often fail to isolate the specific pedagogical innovation like BIM education.

For researchers aiming to evaluate the effectiveness of BIM education in Chinese higher vocational colleges, this brings challenges like establishing indicators best define effectiveness (whether skills application, industry adaptability, or student self-efficacy) and developing reliable evaluation frameworks that can provide actionable investigation on course design and policy development.

My research, focusing on improving the course design of BIM education in construction majors for higher vocational colleges in China, is therefore situated in an under-researched and methodologically complex field, demanding the construction of new evaluation models and multi-dimensional assessment tools that can meaningfully measure both educational outcomes and industry-readiness in this rapidly evolving discipline.

2.5 Key theme 3: Role of Digital Pedagogy in BIM Education

The use of digital pedagogy—incorporating digital tools, resources, and methods into teaching—is another debated topic. Scholars examine how digital pedagogy can enhance BIM education and improve student engagement and learning outcomes in vocational settings.

Scholars emphasise the evolving complexity of BIM pedagogy and the necessity of adopting innovative, structured, and diverse teaching approaches. Teizer et al. (2013) highlight the need for integrating modern pedagogical methods and technological tools to better prepare students for industry challenges. MacDonald's (2012) IMAC framework — encompassing illustration, manipulation, application, and collaboration — offers a structured model for this integration, providing educators with clear phases for implementing BIM in curricula, as also endorsed by Smith & Tardif (2019). Solnosky and Parfitt (2015) add that the diversity in teaching methodologies reflects the flexibility required to adapt BIM education to different institutional contexts and learning outcomes. Soemardi and Erwin (2017) bring focus to BIM's

role in construction safety education, while Ahn et al. (2020) show how traditional lectures, when enhanced by 3D simulation tools, can significantly improve safety training effectiveness. Synthesising these perspectives reveals agreement on the need for structured yet flexible approaches with interactive, technology-driven methods. The key challenge lies in balancing standardisation, as represented by the IMAC framework, with adaptation to different content areas such as safety and practical application, suggesting that BIM education must remain both systematic and dynamic to be effective.

This challenge is particularly relevant in the context of BIM education in Chinese higher vocational colleges, where course design must balance standardisation with adaptability to industry needs. While structured frameworks like IMAC provide valuable guidance, the application of such models may not fully address the diverse demands of higher vocational education, where students require both technical proficiency and broader professional competencies. My research aims to explore how BIM course design in construction majors can integrate these pedagogical insights while addressing the specific challenges of vocational training, such as the emphasis on certification, faculty expertise, and integration of project-based learning. By examining existing teaching practices and proposing a more flexible yet comprehensive BIM curriculum, this study will contribute to improving the effectiveness and industry relevance of BIM education in Chinese vocational colleges.

2.6 Key theme 4: BIM Certification and Its Impact

The relationship between BIM certification (such as the "1+X" certificate) and student success is a recurring theme. Researchers question whether these certifications effectively measure student competency and how they contribute to student employability and career readiness.

However, many Chinese scholars, particularly those from vocational colleges participating in the 1+X BIM certification pilot programs, have reported encouraging

outcomes regarding student cultivation and curriculum innovation. For instance, Liu (2021) describes how Binzhou Polytechnic has integrated BIM certification standards into its talent training program, building a comprehensive platform that links certification and course content through a “module + synthesis, level promotion” model, leading to improved training levels for BIM-skilled talent. Such positive evaluations are frequently highlighted in Chinese literature. However, based on practical teaching experience, there is a need for more in-depth, empirical research to evaluate the actual learning outcomes and long-term competency development of vocational students beyond short-term certification achievements.

Additionally, some scholars appear to overemphasise the role of certification. Wu, Jiang, and Wang (2023) suggest that the primary goal of the BIM technology course is to prepare students for certification exams and ensure they obtain certificates of competence. While certification can be a motivating tool and practical benchmark, I argue that the core goal of BIM courses should be cultivating broader student literacy — including critical thinking, problem-solving abilities, and the capacity to apply BIM tools in diverse, real-world construction scenarios — rather than narrowly focusing on passing certification exams. This distinction underscores the need for my research on improving BIM course design in construction majors for higher vocational colleges in China, aiming to balance certification with deeper pedagogical goals that foster both technical skills and professional competencies.

2.7 Key theme 5: Challenges of Integrating BIM in Curricula

One of the primary debates is the challenge of Integrating BIM in Curricula. Literature explores challenges in the integration of BIM education, both in university settings and in higher vocational colleges, which are relevant to improving BIM course design in construction majors in China. Underwood and Ayoade (2015) point out the disconnect between disciplines and the lack of consistency in BIM maturity, policy awareness, and the alignment of people, processes, and technology in UK universities. Similarly, Ahn and Kim (2016), Matejovska et al. (2017), and Murillo (2024) underscore the difficulties universities face in keeping up with rapid design

innovation and the shortage of qualified BIM educators. Ku and Taiebat (2011) and Uddin and Khanzode (2014) emphasize that more instructional time and deeper design experience are necessary to help students master BIM complexities.

These university-level issues resonate with findings in Chinese vocational education contexts. Zhang (2023) identifies that in engineering cost major, BIM education is still underdeveloped, often limited to standalone software operation courses or superficial integration into select subjects. The absence of BIM in the overall talent training program, along with fragmented teaching content, hinders the development of interdisciplinary and applied competencies. This synthesis reveals a common global challenge: while BIM is recognised as essential, both universities and vocational colleges struggle with curriculum integration, educator preparedness, and interdisciplinary alignment. These insights directly inform my research on improving BIM course design in higher vocational colleges in China, highlighting the need for systematic integration of BIM into talent training programs, development of interdisciplinary teaching strategies, and better alignment with industry practice to overcome these gaps.

2.8 Key theme 6: Industry Alignment and School-Enterprise Cooperation in Vocational Colleges in China

In Chinese vocational education policy, the concepts of production–education integration, school–enterprise cooperation, and work–study combination are often used interchangeably to describe collaborative efforts between educational institutions and industry. While these frameworks are designed to enhance talent cultivation, Chinese scholars have identified persistent challenges in their practical implementation. Zhou and Xu (2023) highlight several key issues: enterprise participation remains insufficient, with many companies lacking motivation to engage deeply in vocational education; coordination between schools and enterprises is weak, resulting in fragmented cooperation; disparities in school–enterprise collaboration exist across different vocational institutions; and historical policy

legacies, such as the stripping of non-productive functions from state-owned enterprises in the 1990s, have led enterprises to prioritize profit and efficiency over talent development and social responsibility (Xu, 2018). These challenges reveal structural obstacles that hinder meaningful cooperation. However, much of the current discussion remains at a macro-policy level. To truly understand and improve the implementation of school–enterprise cooperation, especially in relation to practical fields like BIM course design in construction majors, more empirical research is needed. Specifically, studies that capture teachers’ and students’ firsthand experiences, perceptions, and difficulties in navigating these cooperative arrangements will be critical for informing more targeted and practical reforms.

2.9 Key theme 7: 1+X Certification System and Its Role in Vocational Education

The 1+X certification system is another key theme, with debates surrounding its effectiveness in complementing vocational education. Researchers explore how this system enhances students' qualifications and whether it leads to better industry integration and career outcomes for graduates.

The “1+X” certificate system in China represents a structured approach to linking academic education with vocational skill development, where “1” refers to the academic diploma and “X” represents additional skill certificates that complement and expand professional competencies. Chinese scholars largely agree that these two components are interconnected, with academic education serving as the foundation and vocational certification enhancing practical application. Tang (2019) emphasizes this integration through four key principles: curriculum integration, standards alignment, synchronized implementation, and integrated assessment. However, despite its strong theoretical foundation, several challenges have been identified that affect its practical effectiveness, including low social recognition of “X” certificates, insufficient teaching resources, and

poor alignment with the national credit bank system. Zhang (2022) offers macro-level solutions, such as enhancing coordination between institutions, refining quality assurance mechanisms, accelerating teaching resource development, and strengthening credit bank integration. While these strategies address systemic issues, there is a growing need for more micro-level, empirical research focusing on student experiences and teacher perceptions in the actual implementation process. This body of work will be valuable in informing more targeted reforms and in ensuring that the “1+X” system not only functions as a policy framework but also effectively supports meaningful competency development in vocational education, an area directly relevant to improving the design of BIM courses in construction majors in Chinese higher vocational colleges.

2.10 Summary of Section 2

In recent years, the integration of Building Information Modeling (BIM) into engineering education has been an increasingly important area of focus for international scholars. The rapid advancement of digital technologies and evolving industry needs have made BIM an essential skill for students pursuing careers in architecture, engineering, and construction (AEC) sector. This literature review has explored global scholar discussions on the integration of BIM into higher education curricula, the pedagogical challenges faced, the role of China’s “1+X” certification system, and the practical issues surrounding school-enterprise cooperation in higher vocational education. These studies reveal both the progress made and the continuing obstacles that shape the delivery and effectiveness of BIM education in Chinese higher vocational colleges.

Internationally, scholars like Badrinath et al. (2016), Smith & Tardif (2019), Jin et al. (2018), and Murillo (2024) have provided solid foundations for understanding why BIM integration is critical. Their studies emphasise that BIM education equips students with a comprehensive skill set, including project management, 3D modeling,

energy analysis, cost estimation, scheduling, and facility management. Badrinath et al. (2016) highlight the importance of adapting curricula to the rapidly changing demands of architectural and construction practice, while Smith & Tardif (2019) and Jin et al. (2018) emphasise that BIM-based curricula should be holistic, connecting digital tools with fundamental design principles. Murillo (2024) also identifies faculty shortages and difficulty in keeping up with design and technology advances as significant challenges. The consensus from these studies is that although the necessity of BIM integration is clear, translating this into effective curricula requires substantial curricular innovation, faculty development, and ongoing alignment with industry expectations.

Similarly, pedagogical approaches to BIM education have been studied extensively. Teizer et al. (2013) emphasise the importance of innovative teaching methods and technology integration, while MacDonald's (2012) IMAC framework (illustration, manipulation, application, collaboration) provides a structured pedagogical model that supports skill development. Solnosky & Parfitt (2015) highlight the diversity of teaching approaches in BIM education, showing that educators are still experimenting with how best to balance theory and practice. Soemardi and Erwin (2017) further emphasise the potential of BIM in teaching construction safety, a critical area for industry readiness. Ahn et al. (2020) build on this by demonstrating that traditional lectures combined with 3D simulations can enhance safety training effectiveness. In sum, scholars agree that BIM teaching requires dynamic instructional models that integrate technology and simulation while also fostering collaborative learning environments.

The challenges facing BIM education are well-documented. Underwood and Ayoade (2015) point out that, in the UK, BIM maturity levels and policy awareness among students remain low despite the presence of BIM components in the curriculum. This reflects a disconnect between disciplines and between education and practice. Similarly, Ahn and Kim (2016) and Matejovska et al. (2017) highlight barriers such as rapid technological change and the shortage of qualified instructors, issues echoed

by Murillo (2024). Ku and Taiebat (2011), as well as Uddin and Khanzode (2014), emphasise the need for educational administrators to allocate more time and resources for students to fully grasp BIM complexities. In the context of Chinese higher vocational colleges, Zhang (2023) identifies similar challenges in the engineering cost major. Although some courses integrate BIM elements or offer separate BIM software operation training, the full integration of BIM into talent training programs remains lacking. This partial integration results in fragmented learning experiences where students may learn BIM software operations but fail to connect these skills with broader engineering and management principles.

Adding another layer to this landscape is the “1+X” certification policy in China, which aims to link formal academic qualifications with skill certifications. The system emphasizes that “1” (the academic diploma) is the foundation, while “X” (vocational skill certificates) serves as its complement, expanding students’ competencies. Tang (2019) provides a conceptual framework for the “1+X” system, highlighting curriculum integration, alignment of vocational and teaching standards, synchronised implementation, and integrated assessment. However, scholars also note several challenges. Social recognition of “X” certificates remains low, teaching resources are insufficient, and there is a lack of integration with the national “credit bank” system (Zhang, 2022). Zhang suggests macro-level solutions such as enhancing coordination, refining quality assurance mechanisms, and accelerating the development of teaching resources. Despite these high-level strategies, more empirical research is needed to explore how students and teachers experience the “1+X” system in practice.

Some scholars in China have reported positive outcomes regarding the implementation of the “1+X” system for BIM education. For instance, Liu (2021) describes how Binzhou Polytechnic has integrated BIM certificate assessment standards into its talent cultivation program, creating a comprehensive training platform that improves the skill levels of building engineering students. However, the literature also reveals a tendency among some scholars to overemphasise the

importance of certification itself. Wu, Jiang, and Wang (2023), for example, argue that the goal of BIM courses is to enable students to obtain BIM skill certificates. Yet, from my perspective, the ultimate aim might be to cultivate students' digital literacy and professional competencies, with certification serving only as a supporting outcome rather than the end goal.

Finally, the concepts of production–education integration, school–enterprise cooperation, and work–study combination play critical roles in vocational education policy in China. While these policies are designed to improve closer ties between schools and industry, Zhou and Xu (2023) point out that significant challenges persist. Enterprise participation remains low, coordination is insufficient, and historical reforms have led to a business-first mindset in many enterprises (Xu, 2018). These challenges hinder meaningful cooperation and limit the effectiveness of vocational training. While policy recommendations are in place, including improving coordination and refining evaluation systems, more research is needed to understand the practical experiences of teachers and students working within these cooperative frameworks.

In conclusion, the existing literature provides a comprehensive but still developing picture of BIM education in higher vocational colleges, both internationally and in China. Globally, scholars emphasise the importance of integrated, technology-driven curricula and innovative pedagogy, while also recognising challenges in faculty training and curriculum reform. Chinese scholars have focused on integrating BIM into vocational curricula through mechanisms such as the “1+X” certification system. Although pilot projects and case studies report positive outcomes, challenges remain regarding resource availability, curriculum integration, overemphasis on certification, and weak school-enterprise cooperation. Furthermore, there is a notable gap in micro-level research that captures the day-to-day experiences of teachers and students engaging with BIM education under these complex policy frameworks. This gap signals a clear need for further investigation, and it directly informs the author’s research aim of improving the course design of BIM courses in construction majors

for higher vocational colleges in China. By addressing these challenges, future reforms can better align vocational BIM education with both industry needs and educational quality standards.

3. Conclusion

While existing literature emphasises the growing importance of BIM education in both university and vocational contexts, several significant gaps remain. Methodologically, studies such as those by Liu et al. (2025) and Bouffard et al. (2000) reveal a lack of rigorous, systematic frameworks for evaluating the effectiveness of BIM and vocational education programs. Much of the research relies on surveys or descriptive evaluations without triangulation of data or longitudinal tracking of student outcomes. Theoretically, although Social Cognitive Theory has been applied to understanding the role of self-efficacy in BIM education, there remains no comprehensive model linking curriculum design, industry needs, and student development pathways in the vocational education context. Practically, scholars such as Zhang (2023) and Wu et al. (2023) identify that in Chinese vocational colleges, BIM teaching is still at an early stage, often limited to software operation without integration into broader talent cultivation programs, and with excessive focus on certification rather than holistic competence development.

These gaps directly relate to my research project, which aims to improve the course design of Building Information Modeling (BIM) courses in construction majors for higher vocational colleges in China. My study will address methodological gaps by

combining qualitative interviews with teachers and students, curriculum analysis, and pilot testing of redesigned course structures, allowing for a multi-dimensional evaluation of effectiveness. Theoretically, my project will propose a localised conceptual framework for BIM education in vocational colleges, synthesising SCT with principles of applied vocational pedagogy and industry alignment. Practically, I will focus on balancing course design to move beyond certification-centered outcomes toward improving student literacy, critical thinking, and project-based learning skills. The next steps include conducting field interviews at selected vocational colleges, analysing current curriculum documents, and engaging with industry partners to ensure course relevance. Ultimately, future plans involve piloting the redesigned BIM curriculum at a institution and contributing practical guidance for BIM education in higher vocational colleges in China.

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