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From "Drawing" to "Model": Research on the Reconstruction of Landscape Architecture Teachers' BIM Teaching Competence under the Background of New Engineering Education: A Case Study of Zhaoqing University

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Abstract: The development of new engineering disciplines has imposed new requirements for digitalization and interdisciplinary integration in landscape architecture talent cultivation, with BIM technology proficiency becoming a critical competency for industry transformation. However, current BIM education in landscape architecture programs faces the persistent challenge of "teacher preparation lag" —teachers 'BIM knowledge reserves, technical capabilities, and instructional adaptation skills remain core bottlenecks constraining educational quality. Using Zhaoqing University's landscape architecture program as a case study, this research systematically diagnoses three pedagogical dilemmas through questionnaire surveys, in-depth interviews, and teaching action research: knowledge fragmentation, tool instrumentalization, and formalized teaching approaches. Based on these findings, we propose a teacher development pathway encompassing "cognitive restructuring, competency reconstruction, and instructional redesign," while establishing a tripartite competency enhancement mechanism integrating project immersion, workshop empowerment, and interdisciplinary collaboration. The study reveals that the essence of teachers' BIM instructional competence lies not in software proficiency but in cognitive transformation—recognizing BIM as an "information carrier" rather than a "drawing tool" —alongside corresponding curriculum restructuring capabilities and industry-academia collaboration skills. This research provides actionable frameworks for teacher development in landscape architecture programs at regional universities within the context of new engineering education.

Keywords: New Engineering Education, Landscape Architecture, BIM Teaching, Teacher Development, Industry-Academia-Research Collaboration.

1. Problem Statement

1.1. Challenges of New Engineering Education to Landscape Architecture Education

The "New Engineering Education" initiative represents China's strategic response to the new wave of technological revolution and industrial transformation in engineering education. For landscape architecture programs, the essence of this initiative extends far beyond merely "adding a few digital software courses to the curriculum." It demands three fundamental shifts in professional education: transitioning from "single-discipline specialization" to "interdisciplinary integration," evolving from "drawing representation skills" to "full lifecycle information management capabilities," and shifting from "aesthetics-driven design thinking" to "data-driven systems thinking."

BIM (Building Information Modeling) technology serves as a prime example of this transformation. In industry practice, BIM has expanded from the construction sector to landscape engineering, giving rise to the concept of LIM (Landscape Information Modeling). It is not merely a 3D modeling tool but a comprehensive information management methodology spanning project planning, design, construction, and operation and maintenance. At the Guangzhou International Campus project of South China University of Technology, BIM technology enabled collaborative design across multiple disciplines including architecture, landscape architecture, and municipal engineering. During the design phase alone, 1,733 potential issues were identified and resolved, resulting in cumulative economic savings of 27.58 million yuan. This case demonstrates that landscape architects must acquire proficiency in working within BIM/LIM environments to effectively participate in large-scale, complex project collaborations.

1.2. The Dilemma of "Faculty First"

However, the quality of talent cultivation primarily depends on the faculty's competency reserves. The BIM instruction in landscape architecture programs faces a structural challenge: while students need to master BIM technology, the initial training should be provided by instructors.

The root cause of this dilemma lies in the "intergenerational mismatch" within the teaching workforce. Most core faculty members in landscape architecture programs have received traditional horticultural education, with their professional development centered on manual drawing and blueprint production. Their understanding of digital tools often remains at the level of "CAD replacing drawing boards." When confronted with the information-based workflow paradigm represented by BIM, they find themselves on the same starting line as students—and may even struggle to adapt due to their "experience baggage."

Zhaoqing University serves as a representative case study. Its Landscape Architecture program evolved from the established Landscape Architecture major founded in 1994. Compared to traditional architecture or agricultural/forestry institutions, this program demonstrates a distinct botanical ecological foundation—most faculty members possess backgrounds in botany and ecology, while digital design education remains relatively underdeveloped. Established in 2004, the program laboratory currently houses 180 sets of drafting furniture and over 30 high-end computers, though high-performance workstations and software licenses for BIM education remain insufficient. This disciplinary DNA brings both advantages (solid ecological literacy) and challenges (limited engineering technology expertise).

1.3. Research Question

Against this backdrop, this study takes the Landscape Architecture program at Zhaoqing University as a case study to address the following core question: How can landscape architecture faculty at local universities bridge the competency gap between "traditional blueprint-based teaching" and "BIM information-based teaching" in the context of new engineering education? Specifically, the research aims to answer:

(1) What practical challenges do teachers encounter in BIM-based teaching?

(2) What are the underlying causes of these dilemmas?

(3) What are the effective pathways and mechanisms for enhancing teachers' professional competencies?

2. Conceptual Clarification and Analytical Framework

2.1. From BIM to LIM: The "Information Turn" in Landscape Architecture

The essence of BIM lies in the 'I' (Information)—information. It is not merely software but a methodology that integrates geometric data, material specifications, cost estimates, and temporal parameters into a 3D digital model, enabling seamless data flow across design, construction, and operation phases.

For landscape architecture programs, the BIM concept must be localized as LIM (Landscape Information Modeling). Unlike architectural BIM, LIM deals with more complex information types: topographic data, soil characteristics, hydrological data, and plant information (including growth cycles and maintenance requirements). These datasets exhibit greater dynamism and regional specificity, imposing higher demands on the model's information-carrying capacity.

This implies that landscape architecture educators must not only understand "how to model," but also comprehend "the sources of information within models, their organization, target audiences for communication, and methods of updating." This cognitive shift constitutes the first threshold for faculty competency development.

2.2. Three-dimensional Model of Teacher Competency Structure

Building upon Shulman's "Subject Teaching Knowledge" (PCK) theory and the TPACK framework, this study deconstructs landscape architecture teachers' BIM teaching competencies into three dimensions:

Table 1. Three-dimensional Model of Teacher Competency Structure

dimension	Connotation	Key issues
technological know-how (TK)	Operational capabilities of BIM/LIM software, hardware environment configuration, and data management	Know how to use tools
Integrative Knowledge (TPK)	The ability to match BIM tools with specific teaching content and design appropriate teaching activities	What to teach with tools
Situation Knowledge (PCK)	Understanding students' cognitive difficulties, designing project scenarios, and transforming industry practices into teaching resources	How to help students truly understand

This framework suggests that teacher competency development cannot be achieved through "software training" alone, but requires coordinated advancement across three dimensions: technical operation, instructional design, and industry cognition.

3. Research Design and Methods

3.1. Case Selection

This study selected the Landscape Architecture program at Zhaoqing University as a case study based on the following considerations: (1) The program was established relatively late (2018), placing it in a "window period" for curriculum system development with relatively low resistance to reform; (2) Supported by the School of Life Sciences, its faculty structure reflects typical characteristics of local universities; (3) Researchers were able to conduct field-based action research to obtain primary data.

3.2. Data Collection

The study adopted a mixed methods approach:

Questionnaire survey: Questionnaires were distributed to all full-time faculty members of the program (N=18), with 16 valid responses collected. The questionnaire covered four dimensions: BIM cognitive level (5 items), technical proficiency (8 items), teaching integration degree (6 items), and developmental needs (4 items).

In-depth interviews: Six teachers were selected for semi-structured interviews (including one department head, three core faculty members, and two young teachers), with each interview lasting 40-60 minutes, focusing on authentic teaching challenges and needs.

Teaching Observation: Conducted longitudinal observations of the teaching processes for two courses, "Landscape Architecture Engineering" and "Computer-Aided Design," documenting classroom interactions, student feedback, and instructional challenges.

Action research: As 'participatory observers', the researchers participated in the design and implementation of two BIM teaching workshops, documenting teachers' engagement status, learning difficulties, and reflective content.

4. Research Findings: Triple Dilemma and Its Causes

4.1. Knowledge Dilemma: The Discontinuity from "Knowing" to "Applying"

The survey revealed that 81.3% of teachers had 'heard of' BIM technology, but only 18.8% could accurately articulate the core differences between BIM and CAD (information delivery versus collaborative sharing). Most teachers perceived BIM as '3D CAD' or 'more advanced modeling software.'

This cognitive bias leads to selective distortion in the selection of teaching content. During the interview, one teacher admitted:

"I am aware of the importance of BIM, but I myself am learning and teaching simultaneously. To be honest, I can only teach students how to operate the software, while I lack confidence in explaining the rationale behind such practices or the utilization of information post-completion." (T-03)

This superficial understanding has reduced BIM education to mere textbook recitation of software operation manuals. Students learn to click buttons but fail to develop "informational thinking" —they lack knowledge about the attributes (species, specifications, pricing, maintenance cycles) that should accompany trees in models, nor do they understand how this information is applied during construction drawing generation and quantity surveying processes.

4.2. Tool Dilemma: The "Impossible Triangle" in Software Selection

The software ecosystem related to BIM/LIM is complex, with no single software solution capable of covering the entire workflow. Teachers face a "trilemma" in software selection: it is difficult to achieve a balance among three key factors—ease of learning, professional expertise, and interoperability (Table 2).

Table 2. Characteristics of various software

Software type	Featured products	superiority	limit
General Modeling	SketchUp	Easy to learn, ecologically rich	Weak information carrying capacity and non-genuine BIM
specialty BIM	Revit + Plugins	Complete information and industry standards	Steep learning curve, weak landscape module
Terrain information	Civil 3D / GIS	Strong terrain processing capability	Poor integration with design software

A young teacher described this dilemma:

SketchUp is easy for beginners to learn, but the models created with it are practically useless beyond visual reference—they cannot generate construction drawings or quantify engineering quantities. Revit does address these issues, yet in a 16-week semester curriculum, software operation instruction alone consumes most of the time. How can design thinking be effectively cultivated under such constraints?

The root cause of this dilemma lies in teachers' lack of curriculum integration awareness. Different courses serve distinct purposes—lower grades can use SketchUp to develop spatial concepts, while upper grades employ Revit to address information management challenges. However, current practices often result in fragmented teaching approaches without vertical integration, forcing students to repeatedly switch between software tools without achieving true mastery.

4.3. Evaluation Dilemma: "Formalized" BIM Teaching

The more insidious dilemma lies in the evaluation mechanism. Current BIM education assessments still rely on "rendering quality" as the benchmark—students can earn high scores simply by submitting well-rendered visualizations or aesthetically designed drawings. This evaluation orientation reduces BIM to a "higher-level performance tool" rather than a "methodological approach for information management."

One interviewee pointed out incisively:

The student spent two weeks constructing an impressive model, yet remained completely uninformed when asked whether the street slope compliance met accessibility standards or whether the earthwork balance was reasonable. Our teaching objective is to cultivate 'model builders,' not 'landscape architects.'

The root cause of this issue lies in teachers' lack of established criteria for assessing "information quality." Traditional drawing instruction evaluates based on "visual expressiveness," whereas BIM teaching should prioritize "information completeness" and "data interoperability." Key considerations include: Can this model generate accurate bill of quantities? Can it align with other professional models? Is it directly applicable to construction teams? Without industry-specific practical experience, educators struggle to develop such evaluation standards.

4.4. Cause Analysis: Why is it the "Triple Dilemma"?

The aforementioned triple dilemmas do not exist in isolation but rather reinforce each other, forming a closed loop.

The superficial reasons include resource shortages: low hardware configurations, expensive software licenses, and limited training opportunities. The equipment in the Landscape Architecture Laboratory of Zhaoqing University primarily meets the requirements for drafting courses, with a severe shortage of high-performance workstations capable of running large-scale software such as Revit.

The intermediate-level reason lies in institutional deficiencies: teachers' BIM competencies have not been incorporated into professional title evaluation and performance assessment systems, resulting in "no difference between learning and non-learning" and a lack of intrinsic motivation. At the institutional level, there is no clear BIM teaching plan, leading to fragmented efforts among individual teachers.

The root cause lies in cognitive bias: reducing BIM to a mere "technical issue" rather than a paradigm shift. When schools attempt to address BIM-related teaching challenges, their immediate response is to "purchase software, install computers, and send teachers for training," instead of engaging in systemic reflection: Does our curriculum framework require restructuring? Should evaluation criteria be revised? Is it necessary to establish collaborative mechanisms with industry enterprises?

This "technological determinism" mindset overlooks the essence of BIM education as a "pedagogical paradigm shift"—it demands that teachers transform their understanding of "design," redefine the role of "drawings," and adopt a new attitude toward "information." Such changes cannot be achieved through a few training sessions.

5. Path Exploration and Practice

5.1. Cognitive Reconstruction: From "Drawing Tools" to "Information Carriers"

The first step in capability enhancement is cognitive transformation. The research team initiated a semester-long "BIM Teaching Salon" series of seminars within the professional field, focusing on three core issues:

What is BIM? This guide helps educators differentiate between 'BIM software' and 'BIM methodology,' emphasizing that 'information' constitutes the essence of BIM.

-What can BIM achieve for landscape architecture? Demonstrate specific application cases of BIM in earthwork calculation, plant information management, construction simulation, and post-construction operation and maintenance.

In BIM education, what is the role of the teacher? It is essential to clarify that the teacher is not merely a "software operation demonstrator," but rather a "guide for information thinking" and a "designer of project scenarios."

During the seminar, we introduced a pivotal case study: A project utilized BIM models to directly generate planting construction drawings, automatically annotating each tree's specifications, root ball dimensions, and support methods while synchronizing with the model's seedling database—any modification to a single tree triggers immediate updates across all drawings. This case enabled numerous educators to intuitively grasp the fundamental distinction between "information models" and "drawing models."

5.2. Capability Restructuring: A Tripartite Framework of "Project Embedding—Workshop Empowerment—Interdisciplinary Collaboration"

Based on cognitive transformation, the study established a tripartite competency enhancement mechanism:

(1) Project Embedding

The enhancement of teaching capabilities must be grounded in real-world projects. We partnered with Shenzhen Ruoyou Education Company, deploying several core faculty members as "technical consultants" to participate in their international university-industry collaboration initiative. The entire process utilized BIM workflows—from site data collection and conceptual modeling to construction drawing production. Through hands-on learning, teachers mastered the complete workflow within three months, covering everything from SketchUp modeling and Revit data integration to drawing output and quantity surveying (Fig. 1).

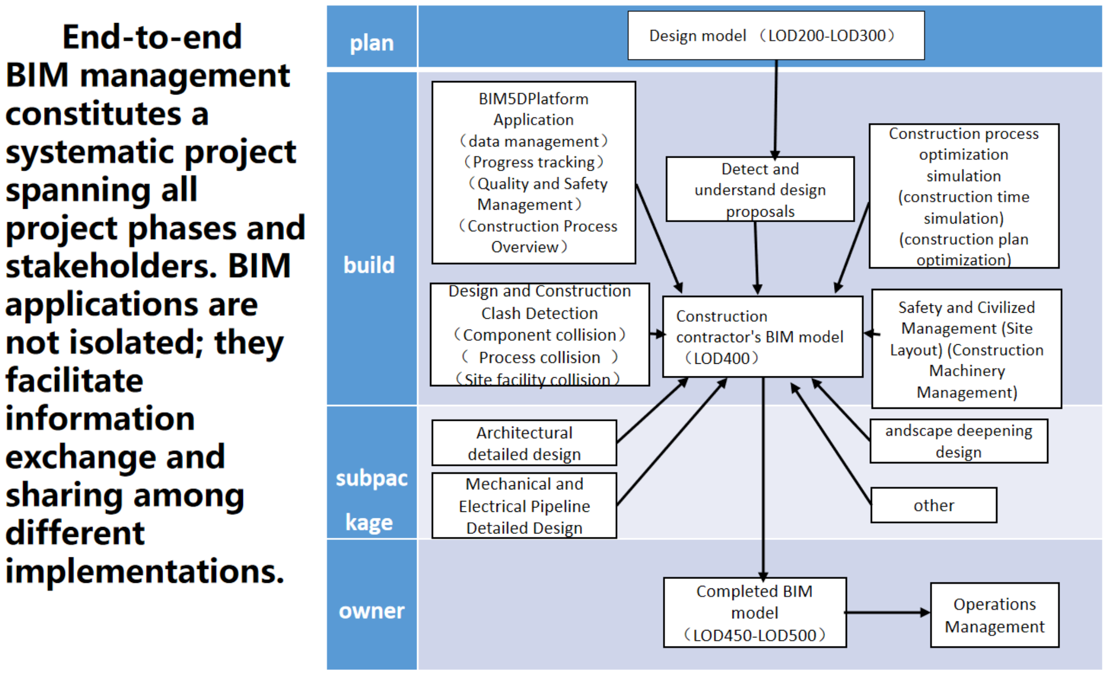

Figure 1. BIM Application Throughout the Entire Process

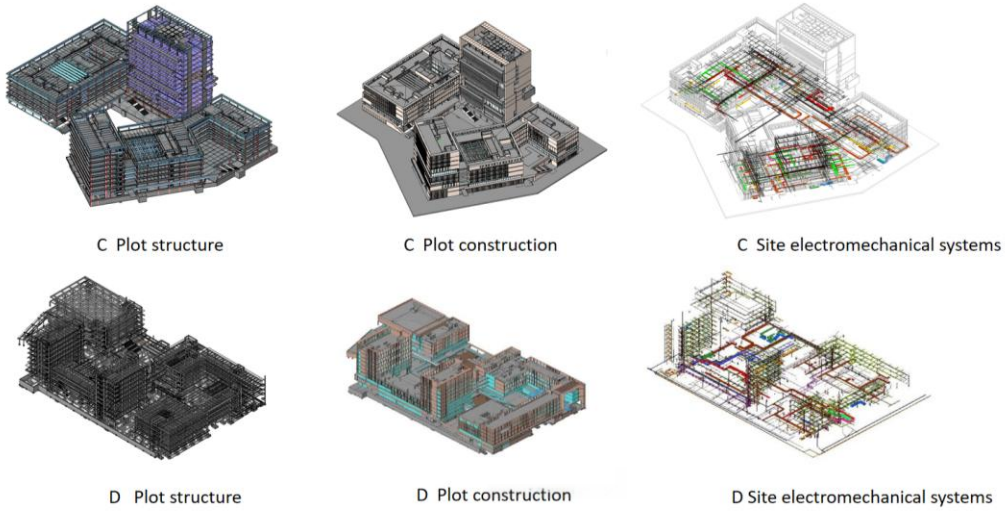

Figure 2. BIM Application and Model Creation in Design Phase

(2) Workshop Empowerment

To address the widespread concern among teachers about the steep learning curve of Revit, Shenzhen Nuoyou Company has developed a "step-by-step" workshop:

Table 3. BIM Phase-specific Tasks

stage	content	duration	output-input ratio
Entry-level stage	Revit interface, basic modeling (walls, terrain, vegetation)	2 days	Small courtyard model
lifting stage	Group creation, parameter settings, and information attachment	2 days	Family of Landscape Artworks with Information Content
Integration phase	Drawing output, quantity surveying, and collaboration with other professional models	1 day	Complete construction drawing kit

The workshop emphasized the principle of 'learn-to-use immediately' —each participating teacher was required to select a course module they teach, design a teaching activity incorporating BIM elements, and conduct a 'teaching demonstration' on the final day of the workshop, where the final project renderings were showcased in class (Figure 3).

Figure 3. 3D-printed BIM project scheme sandbox model

(3) Interdisciplinary collaboration

The essence of BIM lies in "collaboration," and enhancing teachers' capabilities also requires interdisciplinary interaction. We established a "BIM Teaching Community" with the School of Civil Engineering at partner institutions, inviting faculty members from the School of Civil Engineering to share their experiences in BIM curriculum development and organizing joint lesson planning sessions. A landscape architecture instructor reflected after participating in collaborative teaching: "I used to think BIM was merely an' architect's tool' with little relevance to landscape design. However, after attending lectures by civil engineering professors, I realized that earthwork projects, hard paving systems, and landscape architecture fundamentally follow the same principles as architectural design—both require precise geometric data and material specifications. It's just that we previously approached these concepts too abstractly." (Table 4)

Table 4. BIM Teaching Reform Roadmap for Landscape Architecture Program

BIM Teaching Reform Roadmap for Landscape Architecture Major at Zhaoqing University			
stage I	stage II	phase III	Phase IV
Diagnostic phase	Pilot phase	Promotion phase	Deepening Phase
Teacher Needs Survey Hardware and Software Evaluation Curriculum System Review	Selecting key personnel for training Workshop Pilot Interdisciplinary Communication	Course Cluster Development resource package development Establishment of evaluation criteria	School-enterprise collaborative curriculum Participate in BIM Competition Teaching Achievement Summary

5.3. Teaching Restructuring: From "Software Courses" to "Project-Based Courses"

The ultimate focus of competency enhancement lies in course instruction. The research team has restructured the "Landscape Architecture Engineering" curriculum:

Before the reform: Courses were delivered in knowledge modules (earthwork engineering, water feature engineering, garden path engineering...), with BIM introduced briefly as an "appendix" during the final two weeks.

Post-reform: A real-world small-scale courtyard project serves as the core framework throughout the curriculum. Each engineering module requires students to complete corresponding modeling and information integration in BIM models. Upon course completion, students deliver not just "blueprints," but a fully functional BIM model capable of generating construction drawings, producing bill of quantities, and performing basic construction simulations.

This restructuring imposes higher demands on educators: teachers must anticipate potential modeling challenges students may encounter at each instructional stage and prepare scaffolded teaching resources (video tutorials, Q&A collections, and demonstration models). To address this, the teaching team spent an entire semester developing the "BIM Engineering Teaching Resource Package," which includes 12 instructional videos, 8 demonstration models, and a comprehensive Q&A index (Table 5).

Table 5. BIM Teaching Curriculum Integration Framework (Taking Landscape Architecture Engineering as an Example)

BIM Teaching Curriculum Integration Framework (Taking Landscape Architecture Engineering as an Example) Project Focus: Courtyard Landscape Engineering					
Weeks 1-2	Weeks 3-5	Weeks 6-8	Weeks 9-12	Weeks 13-15	Week 16
Field research information acquisition	Earthwork engineering terrain modeling	Hard paving Information attachment	planting design Plant Family Library	GIS leading-in terrain processing	Results Report Model Review
	earthwork calculation slope analysis	construction simulation collision detection	Automatically generate seedling forms	Volume of work Statistical Output	

6. Conclusion and Discussion

6.1. Core Findings

Using the Landscape Architecture program at Zhaoqing University as a case study, this research systematically examines the BIM practices of Shenzhen Ruoyou Company and China Construction Fourth Engineering Bureau, shedding light on the challenges and solutions for teachers' BIM teaching capabilities in the context of new engineering education. The findings reveal:

First, the challenges faced by teachers in BIM-based teaching are structural rather than individual. The three interlocking dilemmas—fragmented knowledge, instrumentalized tools, and formalized teaching methods—stem from reducing BIM to a technical issue while overlooking its essence as a paradigm shift in education.

Secondly, the core of teacher competency development lies not in proficiency in 'software operations,' but in the cognitive restructuring from 'drawing thinking' to 'information thinking.' Teachers unfamiliar with Revit can conduct BIM instruction through team collaboration, but those with a 'CAD mindset' will never cultivate genuine BIM capabilities.

Third, the tripartite mechanism of "project embedding—workshop empowerment—interdisciplinary collaboration" has proven effective. The key to this mechanism lies in upgrading "technical training" to "capacity building within teaching contexts" —while learning BIM, teachers also acquire the skills to teach BIM.

6.2. Practical Implications

The findings of this study provide the following implications for landscape architecture programs in local universities:

For individual teachers: The enhancement of BIM capabilities requires "immersive" project practice rather than fragmented software learning. It is recommended that teachers actively participate in a complete BIM project (even a small-scale one) to develop information-based thinking through hands-on experience.

At the departmental level: BIM teaching reform requires support from a "curriculum ecosystem" rather than isolated efforts in individual courses. It is recommended to establish a "BIM course cluster," integrating BIM competency development across multiple courses to form a progressive chain of "modeling fundamentals—professional applications—comprehensive practice."

At the institutional level: Enhancing teachers' BIM competencies requires systemic support rather than "campaign-style training." It is recommended to incorporate BIM competencies into the teacher development evaluation system, establish a cross-departmental BIM teaching community, and allocate resources for the construction of a BIM training center.

6.3. Research Limitations and Prospects

This study has the following limitations: First, the case study is limited in scope, and whether the findings can be generalized to other types of institutions (e.g., agricultural and forestry colleges, or architecture schools) requires further validation; Second, the study period was relatively short (1.5 years), and the long-term effects of faculty competency enhancement have not been tracked; Third, a student-centered evaluation system for BIM teaching effectiveness has not yet been established.

Future research may focus on the following directions: (1) Conduct comparative case studies to reveal the impact of genes from different disciplines (agriculture and forestry vs. architecture vs. arts) on BIM teaching; (2) Track the long-term effects of teacher competency enhancement on student learning outcomes; (3) Develop BIM teaching competency assessment tools tailored for landscape architecture programs.

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References

[1] Yunnan Forestry. Reform of CDIO Teaching Model for Landscape Architecture Design Course under the Background of New Engineering Education [J]. Yunnan Forestry, 2025(4):92-94.

[2] Zaoqing University. Introduction to the Experimental Teaching Demonstration Center for Landscape Architecture Specialty [EB/OL]. (2024-09-12). https://betdc.zqu.edu.cn/info/1079/1035.htm.

[3] Hebei Academy of Fine Arts. Sino-Korean Cooperative Education Program in Landscape Architecture: LIM Landscape Planning Studio Course [EB/OL]. (2024-10-24). https://gjjy.hbafa.edu.cn/info/1011/1674.htm.

[4] Guangdong Provincial Department of Housing and Urban-Rural Development. The 4th Guangdong BIM Application Competition: BIM Forward Design and Intelligent Construction Management [EB/OL]. http://zfcxjst.gd.gov.cn/zwzt/jskjcx/kccg/BIM/content/post_4742868.html.

[5] School of Life Sciences, Zhaoqing University [EB/OL]. Baidu Encyclopedia. https://wapbaike.baidu.com/item/Zhaoqing University School of Life Sciences/13006686.

[6] Xiamen University Jia Geng College. Outstanding Teaching Cases of New Engineering Education in Fujian Province Announced [EB/OL]. (2025-12-29). https://www.jgxy.xmu.edu.cn/info/84j9v65n.html.

[7] School of Architecture and Urban Planning, Chongqing Jiaotong University. Department of Landscape Architecture Holds Special Teaching and Research Activity on "Transformation and Upgrading of Traditional Majors" [EB/OL]. (2025-05-29). http://aup.cqjtu.edu.cn/info/1002/7152.htm.

[8] College of Agriculture and Biology, Liaocheng University. Achievement Overview [EB/OL]. (2025-09-03). https://nyyswxy.lcu.edu.cn/xqylcjrhszfn/xqcgjj/624214.htm.

[9] Zhang Tianlong, Lu Ping, Zhao Jinsong & Li Bing. (2022). Integrated BIM-based practical teaching reform for prefabricated buildings based on OBE-CDIO. Civil Engineering Construction Information Technology, 14(02), 28-33. https://doi.org/10.16670/j.cnki.cn11-5823/tu.2022.02.04.

[10] Yao Jian, Chen Zhihua, Ma Rong, Shan Tingting, Ding Hu & Qiao Yixin. (2023). Exploring Practical Teaching of Prefabricated Buildings Based on BIM Technology: A Case Study of Applied Undergraduate Engineering Management Programs. Higher Education Journal, 9(28), 114-118+123. https://doi.org/10.19980/j.CN23-1593/G4.2023.28.027.