
Research on Theoretical Construction and Model Innovation of School-enterprise Collaborative Education in Environmental Design Major from the Perspective of Industry-Education Integration

Junhua Yu, Wei Guo

Hainan Vocational University of Science and Technology, Haikou 571126, Hainan, China

**Author to whom correspondence should be addressed.*

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Abstract: Against the backdrop of China's urban-rural systematic transformation, rural revitalization and urban renewal, environmental design education is plagued by the disconnection between theoretical teaching and industrial practice, outdated curricula, and superficial school-enterprise cooperation. From the perspective of industry-education integration, this study combs the theoretical basis of school-enterprise collaborative education for environmental design, constructs the "Four Chains Integration" logical framework, and dissects practical dilemmas in cooperation mechanism, motivation mechanism and regional resource allocation. It puts forward a tripartite collaborative education model integrating "value orientation, path integration and platform support", clarifies the implementation paths and guarantee mechanisms such as curriculum restructuring and governance innovation, and verifies the model's effectiveness through the Lingnan Cultural Space Design Studio case. This research provides a theoretical and practical reference for cultivating applied environmental design talents and realizing the deep integration of education and industry.

Keywords: Industry-Education Integration; Environmental Design; School-Enterprise Collaborative Education; Four Chains Integration; Applied Talent Cultivation

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1. Introduction

China's urban and rural development is currently undergoing systemic transformation, shifting from scale expansion to quality enhancement and from material construction to deepened humanistic care. The comprehensive implementation of rural revitalization strategies, nationwide urban renewal initiatives, and thriving cultural-tourism integration industries have expanded practical opportunities in environmental design while raising talent cultivation standards: designers must not only master spatial morphology and technical expression but also possess profound cultural understanding, conscious ecological responsibility, acute digital technology application skills, and empathy for diverse social needs. However, current environmental design education in universities still exhibits widespread disconnect between theoretical instruction

and industrial practice. Outdated curriculum frameworks inadequately address cutting-edge topics like BIM collaborative design processes, low-carbon eco-material systems, and accessibility design standards, with slow updates. Practical training remains limited to virtual simulations, leaving students ill-prepared for real-world challenges including site constraints, user diversity demands, construction feasibility, and cost control. School-enterprise collaborations often remain superficial at contract signing, campus accreditation, and short-term internships, lacking comprehensive institutional mechanisms to support talent development across all educational stages. Policy documents such as the National Vocational Education Reform Implementation Plan and Guidelines on Deepening Industry-Education Integration explicitly identify industry-academia collaboration as a core solution to structural mismatches between educational supply and industrial needs, emphasizing the establishment of dual-competency education models, shared training resources, and organic alignment between educational ecosystems and industrial value chains^[1]. Environmental design, as a quintessential applied and interdisciplinary discipline, relies heavily on real-world immersion and industry practice interaction to shape knowledge generation logic and competency development. Industry-education integration here transcends mere optimization of teaching methods or expansion of resource channels—it fundamentally reshapes educational philosophies, training frameworks, and evaluation systems. Grounded in the intrinsic characteristics and developmental needs of environmental design programs, this study breaks away from traditional “resource supplementation” collaborative paradigms to explore a new school-enterprise co-education model featuring aligned objectives, integrated processes, shared responsibilities, and reciprocal outcomes. The initiative aims to provide a systematic solution for applied design talent cultivation that combines theoretical rigor, practical applicability, and regional adaptability, thereby achieving organic integration between higher education’s educational mission and its role in serving regional socioeconomic development and cultural innovation.

2. Theoretical Foundations and Logical Framework of School-Enterprise Collaborative Education

As an educational reform paradigm guided by national strategic orientation, industry-academia integration has evolved from a tool-oriented rationality focused on resource alignment between schools and enterprises, to an organic fusion and value co-creation that achieves consensus on educational objectives, collaborative knowledge production, and symbiotic talent development. Its core lies in dismantling organizational and institutional barriers between academia and industry, facilitating efficient, orderly, and sustainable circular interactions among knowledge flows, technological exchanges, information sharing, and talent mobility to enhance value creation. The collaborative education theory emphasizes that educational outcomes depend on the depth of goal alignment among stakeholders, complementary resource endowments, and the synergy and continuity of interactive processes. Within this framework, universities leverage systematic theoretical frameworks, research innovation potential, and educational environments, while enterprises provide authentic project scenarios, cutting-edge technical standards, market insights, and industry expertise. Students achieve knowledge internalization, skill development, and competency enhancement through immersive practices guided by “learning by doing, innovating through learning, and gaining insights through creation.” This tripartite collaboration establishes an educational ecosystem characterized by value co-creation and shared responsibility^[2].

The interdisciplinary nature and educational principles of environmental design programs provide a natural foundation for school-enterprise collaborative talent development. Integrating perspectives from art studies, architecture, ecology, sociology, and psychology, these programs emphasize “local relevance” and “humanistic values” in design outcomes—spatial creation must deeply align with regional historical contexts, natural landscapes, community structures, and users’ authentic, diverse, and evolving needs. Teaching methods detached from real-world site contexts, user feedback, and construction validation struggle to cultivate design professionals with complex systems thinking and practical problem-solving capabilities. Industry-education integration systematically transforms contemporary issues of social significance—such as micro-updates for traditional villages in rural revitalization, community space development in urban renewal, and cultural space revitalization in tourism industries—into teaching projects and research topics. This approach reverts

education to its essence of “problem-oriented, demand-driven” methodology, aligning seamlessly with design education’s cognitive logic and developmental path of “contextual immersion, practical reflection, and iterative optimization.”

Based on theoretical analysis and professional characteristics, this paper proposes a “Four Chains Integration” logical framework: using industrial chain demands and development trends to precisely guide content updates, methodological innovations, and evaluation optimization in the education chain; leveraging high-quality interdisciplinary graduates from the talent chain to effectively support continuous breakthroughs in the innovation chain at the conceptual, technological, and model levels; utilizing cutting-edge achievements, technical solutions, and standard specifications generated by the innovation chain to feed back into industrial chain transformation and upgrading; and positioning the education chain as a foundational and pivotal link to achieve organic integration and dynamic coupling among the four chains, thereby constructing a sustainable educational ecosystem characterized by bidirectional empowerment, cyclical promotion, and symbiotic prosperity between schools and enterprises. This framework organically integrates national macro-strategies, industry micro-dynamics, and professional meso-regulations into a three-dimensional framework, providing clear theoretical coordinates, action logic, and value orientation for collaborative education. It ensures that educational practices are deeply rooted in the practical realities of China while also prospectively guiding the direction of industrial development^[3].

3. Practical Challenges in School-Enterprise Collaborative Education for Environmental Design Majors

A systemic review of current school-enterprise collaborative education practices reveals that multiple structural and institutional challenges collectively constrain substantive improvements in educational efficacy and sustainable development. At the cooperation mechanism level, most initiatives remain confined to superficial and ceremonial forms such as framework agreement signing, base accreditation, and phased internships. Enterprises struggle to achieve substantive, end-to-end participation in talent cultivation program revisions, collaborative core curriculum development, deep teaching process integration, and diversified academic assessment systems. The curriculum content framework lags behind industry technological advancements, failing to promptly incorporate cutting-edge developments like advanced parametric design tool applications, sustainable material database construction and retrieval systems, and intelligent spatial human-computer interaction technologies. This results in significant “time gaps” and “skill gaps” between students’ knowledge competencies and job requirements, ultimately undermining the relevance and adaptability of talent cultivation programs.

The core motivation mechanism exhibits deep-seated structural imbalances. University evaluation and incentive systems still prioritize traditional metrics such as academic paper publications and vertical research project applications, while insufficient recognition and incentives for faculty engagement in collaborative teaching and real-world project guidance weaken their intrinsic motivation for sustained participation. As rational market entities, enterprises focus on input-output ratios and short-term benefits, showing limited willingness and resource allocation to long-term talent cultivation processes with weak tangible returns—particularly evident among numerous small and medium-sized enterprises (SMEs) that generally lack attractive policy incentives (e.g., tax reductions, project priority support) and accessible participation channels. Meanwhile, some university faculty have long been detached from frontline industrial practices, requiring enhanced engineering implementation and project management capabilities. Although corporate mentors possess practical experience, they often lack pedagogical theoretical literacy and classroom management skills, creating a dual competency gap characterized by “unresolved industry perceptions among university faculty and inadequate teaching methodologies among corporate mentors,” which constrains the quality and depth of collaborative guidance^[4].

The uneven distribution of regional resource endowments further exacerbates implementation challenges and equity issues in collaborative education. Eastern coastal regions and economically developed areas boast robust industrial

foundations and clusters of high-quality design enterprises, with mature school-enterprise cooperation ecosystems featuring diverse models. In contrast, central and western regions along with local universities face practical constraints including limited partnerships, low-tier collaborations, and weak industrial support systems, making it difficult to effectively adopt advanced regional experiences. This results in structural mismatches between talent cultivation quality and regional development needs, intensifying regional imbalances in higher education resources. These challenges indicate that current school-enterprise collaborative education practices have yet to achieve qualitative transformation from “physical integration” at the resource and project levels to “chemical fusion” at conceptual, institutional, and cultural levels. There is an urgent need for theoretical innovation and institutional restructuring to reshape the core logic of school-enterprise cooperation, effectively stimulating and sustaining the intrinsic motivation and collaborative willingness of multiple stakeholders.

4. Innovative Construction of School-Enterprise Collaborative Talent Cultivation Model

To address practical challenges, this study establishes a tripartite collaborative education model integrating “value orientation—path integration—platform support” between schools and enterprises, driving systematic breakthroughs in educational practice.

Establish three core value pillars: cultural heritage preservation, green and low-carbon practices, and digital intelligence integration. Cultural heritage preservation focuses on exploring regional cultural narratives, intangible cultural heritage, and community memories, infusing them with historical and humanistic significance to strengthen cultural confidence and design ethics. Green and low-carbon initiatives incorporate ecological design principles, sustainable material selection, and life cycle assessment methodologies, fostering awareness and practical capabilities in carbon neutrality and carbon peaking goals. Digital intelligence enhancement leverages advanced technologies such as BIM, VR/AR, and parametric tools to precisely meet the demands of industrial digital transformation.

The implementation strategy emphasizes three key integrations: First, combining theoretical instruction with project-based practice by transforming real-world corporate projects (such as community age-friendly renovations and revitalization of intangible cultural heritage workshops) into teaching cases to facilitate knowledge-to-capability conversion. Second, establishing collaborative mentorship between academic and industry experts—university instructors focus on theoretical frameworks and cultural exploration, while corporate mentors emphasize business analysis, technical guidance, and user needs assessment to create synergistic synergy. Third, aligning curriculum evaluation with industry standards by incorporating corporate assessments, user feedback, project outcomes, and skill certifications into the evaluation system to enhance the alignment between talent development and industrial demands.

The platform establishes three-tiered support systems: On-campus “Creative Workshops” provide foundational support for concept development and model creation; School-enterprise co-built “Industry Practice Centers” undertake regional projects and deliver end-to-end practical training; Rural community “Mobile Design Stations” organize service-oriented design practices to cultivate social responsibility awareness, localized problem-solving skills, and cross-cultural communication competencies. Simultaneously, the “Environmental Design Collaborative Cloud Platform” integrates virtual simulation, project management, and competency profiling functions to expand blended learning scenarios, support data-driven personalized growth, and establish a closed-loop educational ecosystem encompassing “demand-teaching-capability-feedback.”

5. Implementation Path and Guarantee Mechanism for Model Implementation

To ensure the effective implementation and sustainable operation of innovative models, it is essential to establish systematic

implementation strategies and institutional safeguards. Curriculum restructuring serves as the core pivot: efforts should focus on breaking down disciplinary barriers and course silos to build a modular curriculum system with clear hierarchies and seamless connections. The foundational module emphasizes core competencies such as design expression, spatial composition, and software operation. Core modules utilize real-world corporate projects (e.g., community pocket park renovations, rural cultural hall development) as platforms, where students complete full-cycle training in group settings—from site surveys and requirement interviews to proposal comparisons and outcome optimization. Extension modules introduce interdisciplinary courses like “Design + Environmental Psychology,” “Design + Ecological Restoration,” and “Design + Digital Twin Technology” to expand knowledge boundaries and foster innovative perspectives. Graduation projects strictly adhere to the “real-world problem-solving” principle, with 100% topic alignment with corporate needs or public welfare initiatives. Proposals undergo multi-faceted evaluations by industry experts, user representatives, and sectoral reviewers to enhance practical application value and social impact.

Innovative governance mechanisms serve as the cornerstone for sustainable operations. By collaborating with universities, leading enterprises, industry associations, and local governments, we established the “Environmental Design Industry-Education Integration Development Alliance,” implementing regular joint meetings and collaborative decision-making frameworks. This initiative focuses on developing talent cultivation standards, co-building practical training resource libraries, jointly applying for research projects, and conducting coordinated quality diagnosis and improvement initiatives. A dedicated university-enterprise cooperation fund has been established to provide policy incentives—including project partnerships, priority talent recruitment, and recognition awards—to outstanding contributors. We are also exploring a “design achievement monetization feedback mechanism,” where selected student projects (such as adopted solutions or award-winning works) allocate a portion of their revenue to innovation funds or educational resource development according to predefined ratios, creating a self-sustaining “input-output-reinvestment” cycle.

The faculty and evaluation systems are undergoing synchronized reforms. The “Dual-Teacher Bidirectional Mobility” program has been implemented: Professional instructors are regularly assigned to corporate internships and real-world projects to enhance industry insights, while certified technical experts from enterprises serve as industry mentors through teaching training programs, deeply integrating into instructional processes and project guidance. The teacher evaluation framework has been restructured to incorporate collaborative education achievements (such as guiding industry projects, resolving technical challenges, developing school-enterprise curricula, and creating modular teaching materials) into performance assessments, promotion criteria, and excellence awards, thereby motivating intrinsic faculty engagement. Student evaluation systems are shifting away from the “score-centric” and “single-exam-determining” approaches, establishing a comprehensive process-oriented evaluation system that integrates multi-source perspectives. This system synthesizes multidimensional evidence including peer mentor ratings, corporate mentor evaluations, user satisfaction feedback, and industry certification credentials to holistically assess students’ professional competencies, teamwork skills, vocational ethics, and social responsibility awareness.

6. Case Studies and Effectiveness Validation

Using the “Lingnan Cultural Space Design Studio” established through collaboration between an environmental design program at a South China university, local government cultural tourism departments, and regional tourism enterprises as a case study, this research validates the practical efficacy of school-enterprise collaborative education models. Focusing on preserving and revitalizing traditional villages under rural revitalization initiatives, faculty-student teams conducted fieldwork in an ancient village in northern Guangdong under dual mentorship. University instructors guided students in analyzing local archives, interpreting settlement patterns, and understanding clan culture, while corporate mentors employed drone photography and 3D scanning technologies for data collection, proposing functional optimization recommendations aligned with regional planning. Through in-depth interviews, participatory observations, and workshops, students accurately captured villagers’ diverse spatial needs regarding ancestral hall squares, vacant historic houses, and

village entrance nodes.

Based on field research, the team proposed three innovative solutions: “Micro-renovation of ancestral hall squares,” “Transforming vacant old houses into rural reading rooms and cultural hubs,” and “Creating scenic focal points at village entrances.” These initiatives strictly adhered to the principles of “preserving original aesthetics with minimal intervention” while preserving traditional architectural styles. Local materials such as bamboo, wood, and rammed earth were selected to reduce construction costs and environmental impact. The spatial layouts were designed to align with villagers’ daily routines and festive celebrations. Visualizations including hand-drawn renderings and VR tours were employed to communicate the proposals, which underwent multiple rounds of feedback refinement before gaining unanimous approval from local authorities, village committees, and residents. The “Rural Reading Rooms” project has now been operationalized, serving as multifunctional spaces for community reading, children’s activities, and visitor experiences, significantly enhancing social cohesion and cultural tourism appeal.

The initiative has demonstrated remarkable outcomes: students’ professional competencies and design ethics awareness have improved in tandem; enterprises have received culturally adaptive and commercially viable creative solutions that reduce upfront costs; villages have achieved organic integration of cultural preservation, community development, and tourism growth. Guided by the principle of “rooted in local context, teacher-student collaboration, school-enterprise joint research, and shared outcomes,” this case study systematically showcases the multidimensional value of collaborative education models in enhancing educational quality, empowering industries, and revitalizing rural areas. It provides replicable and transferable paradigm references for similar institutions to implement industry-education integration practices tailored to regional characteristics.

7. Conclusion and Prospects

The collaborative education model developed in this study integrates industry-academia partnerships with environmental design discipline principles, leveraging theoretical innovation to guide practical implementation. By fostering value consensus to consolidate collaborative efforts and restructuring mechanisms to overcome systemic barriers, it embodies the educational essence of “integrating knowledge with practice and serving society.” Empirical evidence demonstrates that this model significantly enhances students’ comprehensive design capabilities and professional adaptability, elevating school-enterprise collaboration from resource exchange to value co-creation and ecosystem co-construction. It provides substantial support for regional cultural preservation, human settlement optimization, and community sustainable development.

Future efforts must focus on three key areas: First, addressing regional resource disparities by exploring innovative models such as “enclave training programs,” “cloud-based collaboration,” and “cross-regional coordination” to facilitate the sharing of high-quality educational resources and industrial opportunities, thereby advancing educational equity and regional coordination. Second, integrating technologies like AIGC, XR, and digital twins into teaching practices to create immersive virtual-real interaction scenarios and data-driven learning environments that systematically cultivate students’ digital literacy and adaptability in the intelligent era. Third, transforming empirically validated teaching cases, collaborative standards, and assessment tools into industry benchmarks to strengthen higher education’s influence in shaping industrial standards and developmental directions.

The fundamental mission of environmental design education lies in cultivating outstanding builders who possess superb skills, a sense of patriotism, reverence for nature, deep humanistic roots, and social care. Only by continuously promoting the deep integration of educational logic and industrial logic, and building a new collaborative education ecosystem rooted in China’s land and responsive to the challenges of our times, can we consistently produce versatile talents with professional competence, humanistic sentiment, and global vision. This will contribute solid and warm educational strength to painting a beautiful picture of China where humans and nature coexist harmoniously and material and spiritual development are balanced.

Disclosure statement

The author declares no conflict of interest.

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