Practical Exploration of AI-Integrated Reform in Architectural Education at Local Application-Oriented Universities

Yongtian Zhang[1], Pengyu Chen[2,*]
[1]*College of Civil and Architectural Engineering, Liuzhou Institute of Technology, Liuzhou, Guangxi, China*
[2]*College School of Design and Art, Liuzhou Institute of Technology, Liuzhou, Guangxi, China*
**Corresponding Author*

Abstract: With the continuous innovation of AI technology transforming the construction industry, local application-oriented universities are facing new challenges in cultivating innovative talents who possess both technical adaptability and humanistic literacy. This study takes the Architecture program of Liuzhou Institute of Technology as a practical case and proposes an educational reform philosophy centered on "human-machine collaboration with literacy as the foundation." It constructs an AI-integrated practical pathway characterized by "three-dimensional integration and dual-track driving." Through measures such as curriculum system restructuring, mentor system empowerment, and regionalized project practice, the research explores an AI-integrated architectural education reform solution tailored for local application-oriented universities.

Keywords: Architectural Education; Human-Machine Collaboration; Local Application-Oriented Universities; AI Integration

1. Introduction

In today's digital age, the emergence of artificial intelligence (AI) is exerting an unprecedented and far-reaching influence on the developmental trajectories of virtually every industry. Concurrently, global climate change, the rapid expansion of the information society, and the growing embrace of sustainable development are profoundly redefining both the substance and direction of architectural education. Emerging technologies—such as AI, big data, virtual construction, and digital cities—are sparking a cognitive revolution within the architectural discipline, driving design paradigms toward digital transformation, guiding the building sector toward "dual-carbon"-oriented green architecture, and fostering a holistic, systematic approach to the conservation of historical and cultural heritage. These transformations are reconfiguring the emerging social and professional demands placed on the architectural field, requiring future practitioners to cultivate resilience in the face of uncertainty and to develop design-decision capabilities grounded in interdisciplinary integration[1].

Once regarded as remote from creative and design professionals, "artificial intelligence" has now begun to permeate these very communities, architectural design included[2]. In an era of human-machine symbiosis, architects must integrate innovations in tools, platforms, modes of thought, and production processes into broader objectives of industry shaping, cultural expression, and ecological sustainability[3]. With AI evolving at breakneck speed, regional application-oriented universities face the novel challenge of cultivating innovative talent that is both technologically adaptive and humanistically grounded[4]. Architectural education must therefore be re-examined and new methods and theories explored. Hence, probing the deep integration of AI and architectural education to propel the transformation and innovation of traditional pedagogies is not only an imperative of the times but also a vital pathway for regional application-oriented universities to elevate educational quality and cultivate high-caliber architectural professionals. Taking the architecture program of Liuzhou Institute of Technology as its case study, this research investigates practical pathways for AI-infused reform in architectural education under the concept of human-machine collaboration, offering valuable insights for similar institutions undertaking educational reform.

2. Theoretical Foundations for AI Integration in Architectural Education

2.1 Applications of Artificial Intelligence in Architecture

The rapid evolution of artificial intelligence has led to its ever-broader and deeper penetration throughout the building sector. From planning and design to construction management and facility optimization, AI is driving the industry toward greater intelligence, automation, and sustainability[5]. In architectural design, powered by advanced machine-learning algorithms, AI tools can rapidly generate a wide array of design options, fine-tune them to precise user requirements, dramatically boost efficiency, and spark new creative possibilities. During construction, computer-vision systems provide real-time site monitoring, while intelligent robots take on high-risk tasks, enhancing both quality and safety. In the operational phase, smart management platforms continuously monitor building systems and analyze data, enabling automated energy management and predictive maintenance, thereby significantly reducing operating costs.

2.2 Characteristics and Objectives of Architectural Education

Architectural education is inherently integrative, practice-oriented, and innovation-driven. Students must master robust theoretical knowledge in areas such as building structures, architectural history, construction technology, and fundamental design principles, while simultaneously developing practical competencies that include model-making, architectural drawing, and construction-site management. In terms of learning outcomes, China's current architectural programs show significant shortcomings in keeping curricula up to date, cultivating conceptual design ability, and imparting current building-technology knowledge[6]. Only by prioritizing the cultivation of creative thinking can architectural education keep pace with evolving client demands and technological advances. For regional application-oriented universities, the goal is to produce professionally grounded, practically skilled, and innovation-minded graduates who can swiftly adapt to the needs of the construction industry and thereby serve local economic development.

2.3 Human–Machine Collaboration Concept

Human–machine collaboration describes the cooperative and complementary relationship between humans and machines when they jointly accomplish a task. In architectural education, this concept emphasizes the organic integration of students and AI tools. On one hand, AI provides abundant learning resources and efficient assistive instruments, helping students better understand and apply knowledge. On the other hand, students must develop the ability to work with AI—leveraging its strengths to solve real-world problems while preserving human creativity and critical thinking. This approach enhances instructional efficiency and cultivates students' integrated competencies, preparing them to thrive in future professional settings that demand human–machine teamwork. In the era of intelligence, the sole human agent is evolving into a hybrid human–machine agent; collaboration between humans and machines has become the new normal of societal development. Consequently, educational models must proactively innovate, strengthening transdisciplinary integration and advancing human–machine collaboration[7].

2.4 Competency-based Educational Philosophy

In AI-integrated architectural education, a competency-based philosophy is essential. It centers on three core literacies: information literacy, innovation literacy, and professional literacy. Information literacy denotes the ability to locate, critically evaluate, and effectively apply knowledge from the vast expanse of AI-generated information. Innovation literacy calls for students to demonstrate creative thinking in architectural design and problem-solving, translating AI-assisted insights into viable, real-world solutions. Professional literacy emphasizes ethical awareness, responsibility, and professional integrity in practice, ensuring students understand human–machine collaborative settings and use technology judiciously. As education in information and digital literacy advances, AI literacy is emerging as a new frontier, equipping students to comprehend, deploy, and critically reflect on artificial-intelligence technologies, thereby enhancing their competitiveness in the digital age[8].

2.5 Theoretical Foundations from Educational Technology

In the integration of AI into architectural education, theories of educational technology provide the scaffolding for instructional design, methods, and assessment. By leveraging AI, personalized learning pathways are generated; through data analytics, the entire teaching process is continuously optimized to safeguard educational quality. Constructing an autonomous knowledge system of educational technology with Chinese characteristics is essential for building a strong education nation and advancing Chinese-style modernization. Conventional pedagogy risks a widening gap between theory and practice in the age of intelligence; the applied lens of educational technology effectively narrows this gap and propels reform in architectural education[9].

3. Overview of the Architecture Program at Liuzhou Institute of Technology

3.1 Overview

Liuzhou Institute of Technology is a full-time private undergraduate university sponsored by the Liuzhou Municipal Party Committee and Municipal Government and wholly funded by state-owned enterprises of the city. The architecture program—flagship and distinctive—was selected as the second cohort of key-construction majors among private universities in Guangxi and is recognized as a provincial-level first-class undergraduate program. It is designed to cultivate high-caliber application-oriented graduates who meet the needs of regional socioeconomic development and the ongoing industrial upgrade of the construction sector. The program runs a five-year curriculum and currently enrolls approximately 200 students.

3.2 Key Challenges

3.2.1 The curriculum and its content lag behind the demands of the times

The current curriculum remains largely traditional; its content is updated slowly, failing to keep pace with societal change and, in particular, the rapid advances in AI. Courses dedicated to AI tool applications are distinctly scarce, leaving students' demand for cutting-edge skills unmet. Moreover, faculty AI literacy still needs improvement, which in turn constrains both content renewal and the overall quality of instruction.

3.2.2 The capstone design studio is increasingly disconnected from real-world industry needs

Current capstone-design courses diverge markedly from the real employment needs of graduates. Design III–V, for example, assigns museums, exhibition halls, and high-rise hotels—projects that appear prestigious and representative, yet are rarely encountered by graduates of regional application-oriented universities operating in an era of stock renewal. In practice, these graduates more often work on urban-regeneration schemes such as aging neighborhood renovations or standardized industrial buildings, project types largely absent from the curriculum. Moreover, instruction tends to overemphasize traditional design elements—functional zoning, circulation, and formal expression—while underplaying factors crucial in actual practice: social and cultural context, technical feasibility, and economic cost. Studio briefs are typically idealized scenarios devoid of real constraints; students undertake little genuine site investigation or field analysis. Consequently, graduates struggle to adapt quickly to professional practice.

3.2.3 Insufficient depth and breadth in architectural technology courses

Architectural technology courses fall short in both depth and breadth. Instructors typically offer only superficial coverage of construction, structure, materials, and building physics, with little connection to real-world practice. The content is poorly aligned with current societal needs and fails to reflect either the present state or the cutting-edge developments of building technology in actual projects.

4. The "Three-Dimensional Integration and Dual-Track Drive" AI Integration Practice Path

The main content of the exploration of the AI integration practice path of the architecture major in Liuzhou University of Technology is "three-dimensional integration and dual-track drive". Among them, "three-dimensional integration" includes the technical dimension, the quality dimension and the regional dimension. The concept of "dual-track drive" refers to the vertical empowerment of the mentor system and the horizontal integration of the project system (as shown in Figure 1).

4.1 Technical Dimension: Deep Integration of AI Tools with Professional Courses

4.1.1 In the talent cultivation plans of architecture over the past two years, the curriculum system has been comprehensively restructured. Based on the original curriculum, new cutting-edge courses such as "Introduction to Artificial Intelligence A", "Internet of Things Technology and Application", "Industrial Building Design", and "Theory and Practice of Urban Renewal" have been added. At the same time, incorporate the application ability of AI tools into the talent cultivation goals. The course syllabus has been redesigned based on the secondary indicators of the training objectives and graduation requirements, precisely aligning with the skill requirements of occupational positions, and organically integrating AI tools with professional courses such as architectural design.

4.1.2 Innovation in teaching methods: In teaching, case-based teaching methods and project-driven approaches are employed, and AI tools are incorporated into actual architectural design cases, enabling students to learn the skills of using AI tools through practice. Through project practice, students can better understand the application value of AI tools in architectural design, and enhance their learning enthusiasm and innovation ability.

4.1.3 Construction of Practical Platforms The school actively builds a practical platform for AI-assisted design and conducts in-depth school-enterprise cooperation with Huawei Technologies Co., LTD., providing students with a wealth of AI tools and high-quality resources. Students can conduct architectural design experiments on this platform and use AI tools to generate, optimize and evaluate schemes. By leveraging the practical platform, students can combine theoretical knowledge with practical operations, thereby enhancing their professional skills and practical abilities.

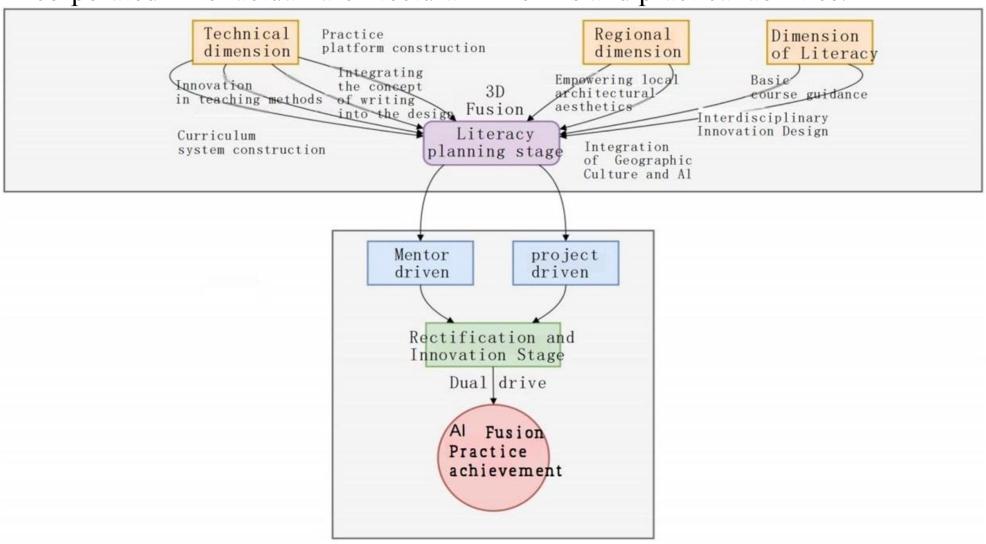

Figure 1. Model Diagram of "3D Fusion and Dual Track Drive"

4.2 Competency Dimension: The Balance of Humanistic Core on Technological

Application In the AI integration reform practice of the Architecture major at Liuzhou Institute of Technology, emphasis is placed on integrating humanistic literacy throughout the teaching process. By leveraging courses such as architectural history and historical building conservation, students are guided to deeply understand the connotations of regional culture, ensuring that the application of AI tools always revolves around humanistic values and avoiding the blind use of technology. At the same time, it is necessary to clarify the auxiliary role of AI in architectural creation, guide students to think about the balance between technology and humanity, prevent the neglect of the essence of design due to excessive reliance on technology, and ensure that architectural design is both tech-savvy and humanistic. In project practice, students need to integrate humanistic concepts into the design of AI solutions. Under the guidance of their mentors and through team discussions, they should constantly improve their plans, making technology and humanities complement each other and enhancing the overall quality of the design.

4.3 Regional Dimension: Technology Domestication Driven by Local Scenarios

In the AI integration reform practice of the Architecture major at Liuzhou Institute of Technology, the exploration of the regional dimension mainly focuses on technology domestication driven by local scenarios. Deeply explore the regional culture, natural environment and architectural traditions of Liuzhou and its surrounding areas, organically integrate these local elements with AI technology, and enable AI tools to better meet the local architectural needs. In teaching, teachers guide students to take local architectural projects as practical objects, utilize AI to carry out scheme design and optimization work, and at the same time attach importance to respecting and inheriting regional characteristics, ensuring that the application of technology is in line with local realities, and promoting the innovative development of local architectural education and practice.

4.4 Vertical Empowerment through Mentorship System: The "Three-Stage Engine" for Ability Advancement

4.4.1 Quality foundation stage (grades 1-2)

During the grades 1-2, instructors should guide students through basic courses to help them build a solid professional knowledge system, cultivate their architectural aesthetics and design thinking, lay a solid professional foundation, and guide them to initially come into contact with AI tools to stimulate their interest in human-machine collaboration. Lay a solid foundation for subsequent learning.

4.4.2 Human-machine collaboration stage (grades 3-4)

In grades 3-4, students enter the human-machine collaboration stage. Mentors guide students to apply AI technology in architectural design practice, training their ability to analyze data, generate solutions and optimize with AI. Through project practice, students' ability to solve complex problems is enhanced. Prompt students to shift from traditional design thinking to human-machine collaborative design thinking.

4.4.3 Integration and innovation stage (grade 5)

During the integration and innovation stage in Grade 5, mentors guide students to conduct interdisciplinary research, encouraging them to combine regional culture with the cutting-edge of technology to create innovative designs. This helps cultivate students' ability to comprehensively apply knowledge for innovation, facilitating their transition from knowledge acquisition to innovative practice and laying a foundation for their future career development.

4.5 Horizontal Integration of Project System

In the AI integration reform of the Architecture major at Liuzhou Institute of Technology, the project-based horizontal integration adopts a project driven teaching mode, allowing students to participate in real projects in a team form, use AI tools for data analysis, scheme optimization, and visual presentation, and enhance practical abilities; Building a platform for interdisciplinary collaboration, introducing teachers from multiple disciplines to guide, promoting knowledge integration and innovation, and broadening students' horizons. Strengthen school enterprise cooperation, introduce practical projects from enterprises, enable students to apply AI technology in real work scenarios, enhance their professional competence and employment competitiveness, and achieve seamless integration between schools and enterprises.

5. Conclusion

In the exploration of AI integration reform in the architecture major of Liuzhou Institute of Technology, the practical path of "three-dimensional integration and dual track drive" has been preliminarily constructed and applied. We leverage innovative technological applications, comprehensive cultivation of literacy, and integration of regional characteristics to create a forward-looking architectural education model that meets local needs. At the same time, the dual track drive of vertical empowerment through mentorship and horizontal integration through project-based approaches provides students with comprehensive learning support and practical opportunities.

At present, the reform is in a critical stage of promotion, and various measures are being carried out in an orderly manner. Although its specific effectiveness still requires further observation and evaluation, preliminary data has shown positive signals. Taking the employment rate and graduation rate as examples, the employment rate for the 2023 cohort is 43.33%, with a graduation rate of less than 90%; By the year 2025, the employment rate has significantly increased to 91.07%, and the graduation rate has also reached 98.18%.

Looking ahead to the future, we will continue to explore and improve the reform practices of integrating architectural education and AI in local applied universities. We are committed to summarizing and providing valuable experiences and examples to help more local private university students achieve high-quality growth and development goals.

Fund Project

Key Project of Vocational Education in Liuzhou Education Science Planning for 2024, "Application and Research of AIGC Technology in Architectural Design Courses of Applied Universities" (Project Number: 2024ZJB001); 2024 Guangxi Education Science Planning Project "Application of AIGC Technology and Exploration of Project based Teaching Mode in Rural Art Education Workshop" (Project No. 2025C627); The Ministry of Education's Supply and Demand Matchmaking Employment and Education Project "Diversified Skill Empowerment of Liuzhou Institute of Technology: Comprehensive Enhancement of Employment Competitiveness for Civil Engineering Majors" (Project No. 2024083183435),

References

[1] Wang Jianguo. Thoughts and recommendations on the reform and development of architectural education in China. Architecture, 2025, (06): 55-56.
[2] He Wan-yu, Yang Liang-song. Exploring generative artificial intelligence in architectural design: A case study of XKool AI Cloud. Architectural Journal, 2023, (10): 36-41.
[3] Yuan Feng, Xu Xinhui. From Experiment to Evidence: An Architectural Intelligence Laboratory Guided by Design-Science Thinking. Time + Architecture, 2022(4): 6-15.
[4] Min Jiajian, Yu Borou, Zhang Xin. Design pedagogy in the age of generative artificial intelligence: the “AI-Generated Imagery” course at Tsinghua University. Architectural Journal, 2023, (10): 42-49.
[5] Fan Jinlong, Ouyang Dong, Chen Jing. Discussion on the application of artificial intelligence technology in the field of architecture. Electric Age, 2024, (07): 16-24.
[6] Tian Yong. Research on the Training Model of Chinese Architectural Education Based on Effective Objectives. Tianjin: Tianjin University, 2014.
[7] Yang Zongkai, Wang Jun, Wu Di, et al. The impact of ChatGPT/generative artificial intelligence on education and countermeasures. Journal of East China Normal University (Educational Sciences), 2023, 41(7): 26–35.
[8] Cai Yingchun, Zhang Jingbei, Yu Chenlin, et al. Artificial-intelligence literacy in the digital-intelligence era: connotation, framework, and implementation pathways. Journal of Library Science in China, 2024, 50(4): 71-84.
[9] Sun Lihui, Shen Wanli. Building an indigenous knowledge system for educational technology toward a leading education nation. Modern Educational Technology, 2025, 35(1): 6-14.