

Generative Artificial Intelligence Empowering Classroom Teaching: Innovation and Practice of the Dual-Teacher Collaborative Teaching Model

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Abstract: Against the backdrop of digital transformation in higher education, traditional dual-instructor collaborative teaching faces structural challenges such as insufficient coverage of personalized education, delays in integrating cutting-edge industry content, and slow iteration of teaching resources, making it difficult to meet the training needs for application-oriented and innovative design talent in the new era. To address these teaching challenges, this paper uses generative artificial intelligence (Generative AI, GAI) as a technological enabler to explore innovative pathways for the deep integration of intelligent technologies with collaborative teaching by university and industry instructors. Grounded in policy guidelines and pedagogical realities, the study comprehensively employs literature review, expert interviews, action research, questionnaire surveys, and case studies. Following a three-stage research paradigm of “theoretical construction—pilot implementation—iterative dissemination,” it systematically elucidates the underlying mechanisms, implementation framework, and practical pathways for GAI-enabled dual-instructor classrooms. The research findings indicate that by establishing a three-party closed-loop collaborative teaching model of “full-time faculty + industry mentors” empowered by GAI, and by building a smart teaching platform that integrates intelligent resource generation, dynamic assessment of student learning progress, online dual-teacher collaboration, and multidimensional teaching evaluation, enables the establishment of a three-dimensional comprehensive evaluation system characterized by “complementarity between process and summative assessment, linkage between campus and industry, and integration of intelligent data with human judgment.” This effectively addresses issues such as low efficiency in traditional classroom teaching, weak industry-education integration, and a one-dimensional evaluation system. The study confirms that the deep integration of GAI technology with dual-teacher collaborative teaching overcomes the temporal, spatial constraints, and collaboration barriers of traditional dual-teacher teaching, achieving mutual value enhancement through both technological efficiency gains and practical empowerment. These research findings provide a replicable practical model for the digital teaching reform of applied courses in higher education institutions—particularly private universities—and offer theoretical guidance and practical support for innovative smart teaching in design disciplines and the advancement of industry-education integration in talent development.

Keywords: Generative Artificial Intelligence, Smart Classroom, Dual-Instructor Collaboration, Teaching Model, Digital Education, Design Education

1. Introduction

With the deep integration of digital technologies—such as artificial intelligence and big data—into higher education, educational digitization has become the core driving force behind transforming teaching models in universities and enhancing the quality of talent development. The Ministry of Education continues to promote innovative integration of intelligent technologies into classroom instruction, requiring universities to restructure traditional teaching paradigms, optimize mechanisms for industry-education integration, and refine diversified student evaluation systems to fully align with the educational objectives for cultivating application-oriented, innovative talent in the new era. In the teaching systems of design-related majors, “dual-instructor collaborative teaching”—which relies on a dual-track educational structure of “on-campus theoretical instruction + industry-based practical guidance”—effectively breaks down the barriers between campus instruction and industrial practice. It

serves as the core teaching model for universities to implement industry-education integration and strengthen students' practical and innovative capabilities, and is now widely applied in applied design courses such as packaging design, visual communication, and digital media.

However, collaborative teaching by dual-qualified instructors in higher education institutions currently faces numerous structural shortcomings that hinder further improvements in educational quality. First, under the large-scale classroom instruction model, instructors are burdened with complex teaching responsibilities, making it difficult to address the differentiated learning needs of students at various proficiency levels; as a result, personalized and targeted education struggles to be implemented on a routine basis. Second, the design industry experiences rapid technological iteration and frequent shifts in aesthetic trends. Full-time faculty members, who focus deeply on theoretical instruction, have relatively limited hands-on industry experience, leading to a lag and disconnect between classroom content and cutting-edge industry technologies as well as market job requirements. Finally, traditional teaching resources have long production cycles and slow update rates. Content such as course materials, case studies, and practical training question banks is highly static, making it difficult to adapt to the characteristics of disciplinary development in the era of generative AI—where creativity iterates rapidly and technology is constantly evolving.

2. Research value and research status

Generative AI offers technical advantages such as multimodal content generation, intelligent learning analytics, personalized learning adaptation, and real-time human-machine interaction. It can efficiently handle repetitive teaching tasks, enabling rapid iteration of teaching resources and improving the quality and efficiency of teaching processes. By deeply integrating GAI technology with the “dual-teacher” collaborative teaching system, we can leverage intelligent technology to address the efficiency shortcomings of traditional classrooms and rely on industry mentors to bridge the gap in practical education, thereby building a new smart classroom ecosystem characterized by “intelligence-empowered, industry-education integration, and precision-oriented education.” Based on this, this paper addresses the pain points in design course instruction and the needs of digital reform by constructing a GAI-enabled dual-teacher collaborative innovative teaching model. Through theoretical analysis, course piloting, and iterative optimization, it establishes a practical and scalable digital teaching paradigm, providing a practical reference for reforming design education and upgrading talent development in higher education institutions.^[1]

2.1. Theoretical Value

The theoretical contributions of this study are primarily reflected in two dimensions. First, it enriches the theoretical framework of intelligent design education by clarifying the logic of adaptation, mechanisms of action, and integration pathways for GAI technology in dual-teacher collaborative classrooms. It resolves the research dilemma of “the disconnect between technology application and dual-teacher education” found in current studies and refines the theoretical framework for AI-empowered design classrooms. Second, it expands the research boundaries of dual-teacher collaborative teaching, breaking through the temporal and spatial limitations and collaborative constraints of traditional in-person dual-teacher instruction. It constructs a new theoretical teaching paradigm characterized by “GAI-powered intelligence + online-offline integration + university-industry collaborative education,” providing new theoretical insights and research support for similar digital teaching reforms and the development of smart design classrooms.^[2]

2.2. Practical Value

The findings of this study possess strong practical applicability and scalability, capable of generating value for teachers, students, and higher education institutions alike. For instructors, the GAI intelligent tool can automatically iterate teaching resources, quantify learning data, and generate personalized tutoring plans, effectively reducing administrative and repetitive teaching burdens while facilitating a shift in the teacher's role from a traditional “knowledge transmitter” to a “course designer, learning facilitator, and innovator.” For students, the new model integrates three-dimensional educational scenarios—theoretical instruction, industry practice, and intelligent tutoring—to comprehensively enhance their professional design capabilities, innovative thinking, and job readiness, thereby strengthening their core competitiveness in the job market.^[3]

For universities, this study has established a standardized, iterable, and replicable intelligent “dual-teacher” teaching solution that effectively addresses industry pain points such as loose university-industry collaboration, low participation by industry mentors, and superficial practical instruction, while promoting the joint development and sharing of teaching resources between universities and industry. It is particularly well-suited to the applied education orientation of private universities, providing a mature, practical model for their digital transformation, design curriculum reform, and the development of industry-education integration systems, with broad disciplinary applicability and promotional value.

2.3. Current State of Domestic and International Research

Currently, the academic community both domestically and internationally has produced a wealth of foundational research findings on the application of GAI in education and the collaborative teaching model involving both teachers and industry mentors. However, systematic and model-based research on the deep integration of these two areas remains in the exploratory stage, and no mature teaching framework or evaluation mechanism has yet been established.

At the domestic research level, existing studies on GAI education mostly focus on single technical application scenarios, concentrating on basic auxiliary functions such as intelligent courseware generation, assignment grading, learning performance statistics, and personalized learning recommendations. Most of these studies remain at the superficial level of “technology-driven workload reduction,” failing to integrate deeply with the school-enterprise dual-teacher collaborative education mechanism and lacking the construction of an intelligent education system from the perspective of industry-education integration. Research on “dual-teacher” collaboration, meanwhile, has largely centered on the field of vocational education, emphasizing the in-person practical instruction provided by industry mentors. Common issues include imperfect collaboration mechanisms, fragmented school-enterprise coordination, and insufficient motivation among mentors to engage in education. Furthermore, the lack of digital empowerment through intelligent technologies results in teaching models that are insufficiently innovative and ill-suited to contemporary needs.

In terms of international research, universities in Europe and the United States have prioritized exploring the application of GAI technology in project-based learning, the cultivation of innovative thinking, and creative design practices, leveraging intelligent technologies to empower students’ independent inquiry and creative output; however, they have not established a systematic framework for collaborative education involving both school and industry instructors. Germany’s dual education system features a mature school-enterprise collaboration framework and has deeply cultivated an industry-education integration model; however, the overall level of digital empowerment remains low. It has failed to leverage generative AI to achieve intelligent iteration of teaching processes and precision-oriented education, resulting in a model that lags behind trends in digital education.

A synthesis of existing research findings reveals two core shortcomings in current studies: first, the integration of GAI technology and the collaborative education model involving both school and industry instructors remains fragmented, lacking a deeply integrated collaborative mechanism and a unified teaching framework; second, existing research largely remains at the level of theoretical speculation, lacking practical models and evaluation systems that are implementable, quantifiable, and iterable. Based on these research gaps, this paper conducts innovative research on GAI-enabled “dual-teacher” collaborative teaching models, which possess clear academic and practical value.

3. Research Design and Implementation System

This paper adopts a three-stage closed-loop research framework of “theoretical construction—pilot implementation—optimization and dissemination,” which involves iterative refinement at each stage to ensure the research’s systematic, scientific, and practical nature.

3.1. Three-Stage Progressive Research Framework

First, the theoretical construction stage. By systematically reviewing core literature on AI education, dual-teacher collaborative teaching, and smart classroom development, we solidify the theoretical foundation of the research. Through tiered interviews with educational technology experts, senior industry designers, key technical personnel from enterprises, and frontline university instructors, we identified pain points in current dual-teacher instruction, challenges in technology integration, and

industry talent requirements. We clarified the roles and boundaries of responsibilities among the three parties—GAI, on-campus faculty, and industry mentors—and preliminarily established a framework for the intelligent dual-teacher collaborative teaching model.^[4]

Second, the Course Pilot Phase. Core design courses were selected for small-class teaching pilots. A dedicated intelligent teaching resource repository and an online collaborative interaction platform were established to implement a comprehensive dual-teacher collaborative teaching mechanism covering pre-class, in-class, and post-class activities. Classroom teaching data, student learning behavior data, and feedback on dual-teacher instruction were continuously collected to dynamically assess the model's strengths and existing issues, thereby iteratively optimizing teaching workflows, the resource system, and platform functional modules.

Third, the Optimization and Rollout Phase. We will systematically summarize the teaching experiences gained from the pilot, refine the detailed implementation guidelines, resource development standards, and evaluation criteria, and formulate a standardized teaching plan. The optimized new model will be rolled out to teaching scenarios across multiple disciplines and courses to validate its universality and adaptability, ultimately resulting in a comprehensive research outcome that integrates a theoretical framework, practical model, platform system, and evaluation system.

3.2. Core Research Methods

To ensure that research conclusions are rigorous and reliable and that practical implementation is feasible, this study comprehensively employs five categories of standardized academic research methods to provide all-around support for the research process, as show in Figure 1.

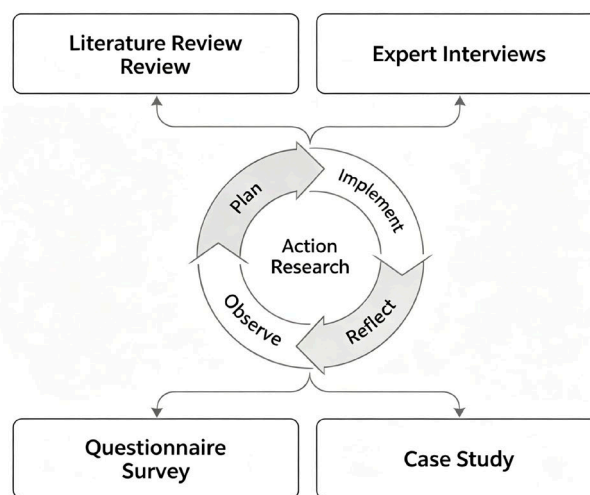


Figure 1 Research framework illustrating the mixed methods of literature review, expert interviews, cyclic action research, questionnaire survey, and case study.

1) Literature Review: Systematically search core literature from the past five years in the fields of AI education, dual-teacher collaborative education, smart classrooms, and educational digitization; analyze the current state of domestic and international research, theoretical foundations, and cutting-edge developments; and clarify the innovative entry points and overall research framework of this study.

2) Expert Interviews: We engaged experts in educational technology research, representatives from design industry enterprises, and frontline university instructors through a tiered approach to accurately assess industry competency requirements, classroom teaching challenges, and pain points in dual-teacher collaboration, thereby providing a practical basis for model innovation, resource development, and mechanism optimization.

3) Action Research Method: Using the semester as an iterative cycle and following a cyclical optimization mechanism of “plan—implement—observe—reflect,” this method involves continuously adjusting teaching plans, optimizing collaboration processes, and updating teaching resources in real-world teaching scenarios to achieve dynamic iteration and upgrading of the teaching model.

4) Questionnaire Survey Method: Upon completion of the pilot teaching cycle, specialized

questionnaires are administered to pilot students, on-campus instructors, and industry mentors to quantitatively analyze teaching satisfaction, model suitability, and educational outcomes, thereby providing data support for model optimization.

5) Case Study Method: Typical teaching cases—such as GAI-based personalized tutoring, dual-instructor collaborative practical instruction, and creative applications of intelligent resources—will be selected to conduct in-depth analyses of the new model’s application advantages, practical implementation points, and optimization directions, thereby distilling practical experiences suitable for broader adoption.

3.3. Feasibility Analysis

This study possesses sufficient feasibility for implementation across four dimensions: policy, technology, practice, and team. At the policy level, the state is vigorously promoting the digital transformation of education and reforms in industry-education integration, encouraging the deep integration and innovation of intelligent technologies with classroom teaching, thereby providing solid policy support for this study. At the technical level, generative AI technology is currently mature and stable; functions such as multimodal content generation, intelligent learning progress analysis, and real-time human-computer interaction are highly suited to design-oriented classroom teaching scenarios, offering low implementation costs and strong adaptability. At the practical level, the project team has long been deeply engaged in the reform of design education and industry-academia collaboration at universities. It can collaborate with multiple institutions and design firms to conduct pilot teaching programs, ensuring the successful implementation of practical initiatives. At the team level, project members have clearly defined roles covering core work modules such as teaching research, technology application, industry-academia coordination, and data analysis, enabling them to efficiently complete the entire process of project research, practical iteration, and the transformation of research outcomes.

4. Innovation in Teaching Models and System Construction

Addressing core issues in traditional dual-teacher instruction—such as ambiguous responsibilities, loose collaboration, and fragmented processes—this paper constructs a GAI-empowered, dual-teacher collaborative, integrated closed-loop teaching model. It clarifies the core responsibilities of the three key parties—GAI intelligent tools, full-time faculty, and industry mentors—to create a full-chain, closed-loop educational system encompassing “pre-class preparation—in-class implementation—post-class extension.”

4.1. Model Innovation: A Three-Party Collaborative, Full-Process Closed-Loop Teaching System

In the pre-class phase, on-campus instructors use GAI to design lesson plans, update resources, assess student learning needs, and optimize instructional design, while industry mentors simultaneously provide cutting-edge industry case studies, job competency standards, and new industry technologies. The three parties collaborate to complete pre-class instructional preparations. During the in-class phase, GAI handles auxiliary tasks such as real-time classroom interaction, personalized Q&A, dynamic monitoring of student progress, and classroom data collection. On-campus faculty lead theoretical instruction, classroom management, and the implementation of instructional design, while industry mentors deeply integrate into classroom teaching through live online sessions, case analysis, and hands-on demonstrations. In the post-class phase, GAI intelligently pushes tiered assignments, supplementary resources, and personalized learning plans, while automatically generating learning progress analysis reports. On-campus instructors and industry mentors jointly conduct assignment reviews, project guidance, and competency evaluations, thereby achieving a closed-loop implementation of the entire teaching process.

4.2. Technological Innovation: GAI Dual-Instructor Collaborative Smart Teaching Platform

Leveraging generative AI technology, the GAI Dual-Instructor Collaborative Smart Teaching Platform—tailored for design-oriented education—has been developed. It integrates four core functional modules to enable digital and intelligent management throughout the entire teaching process. First, the Intelligent Resource Generation Module rapidly iterates teaching resources such as courseware, design case studies, practical training question banks, and creative materials, addressing the issues of static resources and delayed updates in traditional teaching. Second, the Intelligent

Learning Analysis Module automatically collects behavioral data—such as classroom learning, homework completion, and creative output—to precisely identify knowledge gaps and skill deficiencies, generating personalized diagnostic reports. Third, the Online Teacher-Student Interaction Module establishes regular online communication channels between schools, enterprises, and students, breaking down spatial and temporal barriers to enable real-time collaboration and efficient coordination between teachers and students. Fourth, the Multidimensional Teaching Evaluation module integrates process-based learning data, final outcome data, and industry practice evaluation data to ensure that teaching effectiveness is quantifiable, traceable, and assessable.^[5]

4.3. Evaluation Innovation: A Three-Dimensional Comprehensive Evaluation System

To address the shortcomings of traditional design teaching evaluations—which prioritize results over process, theory over practice, and rely on subjective, one-dimensional assessments—this paper constructs a three-dimensional comprehensive evaluation system tailored to intelligent dual-teacher instruction. First, it combines formative and summative assessments, covering a full range of indicators—including classroom performance, daily assignments, creative practice, and end-of-term evaluations—to avoid the one-sided pitfalls of “one exam determining the grade.” Second, it integrates on-campus and industry evaluations, balancing theoretical assessments with industry-specific competency evaluations to align with the talent development standards of the design industry. Third, the system combines GAI-driven data evaluation with human-based comprehensive assessment. It uses intelligent data to quantify learning outcomes, while the collaborative judgment of dual-teacher instructors supplements qualitative creative evaluations, thereby ensuring evaluation results are scientific, comprehensive, and precise—and aligned with the creative education characteristics of design majors, as show in Figure 2.

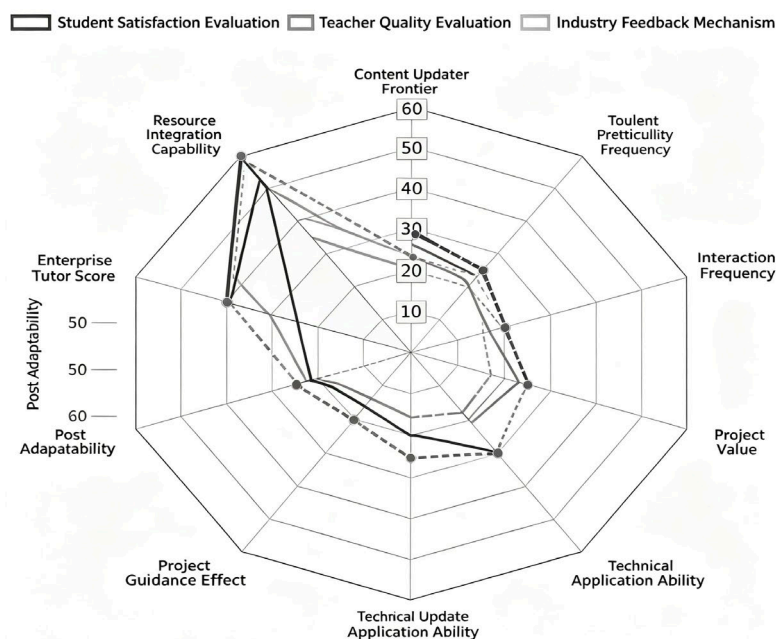


Figure 2 Radar chart of evaluation results for student satisfaction evaluation, teacher quality evaluation and industry feedback mechanism.

5. Conclusions

Against the backdrop of digital transformation in education and addressing the pain points in teaching design courses at universities, this paper conducts innovative and practical research on the “dual-teacher” collaborative teaching model empowered by generative artificial intelligence (GAI). The study demonstrates that generative AI technology can effectively address issues such as the slow iteration of traditional classroom teaching resources, insufficient personalized education, and excessive administrative burdens on instructors. The dual-instructor collaborative teaching model can precisely address the disconnect between classroom instruction and industry practice, as well as the weakness in

practice-based education. The deep integration of these two approaches achieves mutual value enhancement through both the efficiency gains provided by intelligent technology and the empowerment of industry-education collaboration.

The three-party closed-loop teaching model, intelligent teaching platform, and three-dimensional comprehensive evaluation system developed in this study refine the theoretical framework and practical pathways for dual-teacher collaborative teaching in design programs in the intelligent era, addressing the shortcomings of existing research—namely, insufficient integration and weak practical applicability. This model is highly suited to teaching scenarios for design-related and other applied courses in higher education institutions. With strong versatility and replicability, it provides a high-quality practical example for digital teaching reform, the development of industry-education integration systems, and innovation in smart design classrooms—particularly at private universities. Furthermore, incentive mechanisms and long-term collaboration frameworks for both university and industry instructors can be further refined to fully mobilize the enthusiasm of industry mentors for education, promote the routine and in-depth implementation of the GAI-empowered dual-instructor collaborative teaching model, and continuously support the digital transformation and high-quality development of higher design education.

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