

Research on the Industry-Education Integration Education Mechanism of Modern Industry Colleges in Application-Oriented Undergraduate Universities Empowered by Artificial Intelligence

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Abstract

Artificial intelligence (AI) is driving the industry-education integration of modern industry colleges, shifting it from a "physical-level combination" to a "deep organic integration," which serves as a crucial approach to addressing the mismatch between university talent cultivation and industrial demands. Grounded in interdisciplinary theories, this paper constructs a four-dimensional analytical model of "Technology-Mechanism-Subject-Environment," and takes the modern industry colleges in Jiangsu Province as the research subjects for in-depth discussion. The study finds that while the industry-education integration in Jiangsu's modern industry colleges has established basic characteristics of multi-party collaboration and project-driven models, there are notable shortcomings in the slow intelligent upgrading of subjects, poor articulation of the intelligent education system, regional disparities in digital infrastructure, and the absence of data management mechanisms. Moreover, it faces critical challenges such as superficial technology application, ambiguous delineation of data rights and responsibilities, difficulties in promotion and replication, and an inadequate support and guarantee system. In light of the above situation, this paper proposes improvement strategies from the perspectives of supply-demand alignment, institutional management, regional collaborative empowerment, and safeguard mechanisms, aiming to provide references for the digital-intelligent transformation of industry-education integration reforms in application-oriented undergraduate universities.

Keywords

Empowerment; Modern Industry College; Industry-Education Integration.

1. Analytical Framework and Logical Path of the Industry-Education Integration Education Mechanism Empowered by Artificial Intelligence

The rapid and widespread development of artificial intelligence (AI) technology is constantly breaking down the barriers between traditional education and industrial development. It is gradually transforming the construction of modern industry colleges from a "physical integration" model-characterized by simple spatial overlap and scattered resource accumulation between schools and enterprises-into a new stage of "chemical integration," marked by deep collaboration in talent, technology, data, and resources. Against the backdrop of the swift advancement of AI technology, it continuously blurs the boundaries between traditional education and industrial development, shifting the construction of modern industry colleges from a simple "physical combination" of school-enterprise spatial alliances and resource integration to a "chemical reaction" of deep synergy in talent, technology, data, and resources. Grounded in technology empowerment theory, collaborative governance theory, and modern learning science, this paper conducts an in-depth analysis of how AI, as a key empowering force, integrates into the entire process of talent cultivation in modern industry colleges. Consequently, it constructs a multi-dimensional interactive theoretical analysis model

of "Technology–Mechanism–Subject–Environment," providing a theoretical basis for subsequent empirical research and mechanism improvement.

Addressing the issues in traditional industry-education integration-such as poor information transmission, supply-demand deviations, and slow knowledge updates-is fundamental to AI-driven reforms of the education model in industry colleges. In traditional practice, critical information such as industry frontier trends and job competency standards often suffers from long transmission cycles and significant distortion when reaching university teaching, leading to structural mismatches between talent cultivation and actual industrial needs. In conventional education models, the transmission of market demands for cutting-edge technologies and job competencies to university training programs, curricula, and teaching content is often delayed and weakened, resulting in a structural mismatch between talent supply and industrial development needs. With the in-depth application of AI, big data, and generative large models, modern industry colleges can perceive industrial dynamics in real-time, accurately map job competencies, and dynamically update teaching systems, thereby shifting talent cultivation from "passively adapting to industry" to "actively leading industry."

In terms of demand identification, AI utilizes semantic mining and big data analysis of industry recruitment data, enterprise operation data, and industrial research reports to construct dynamically iterative job competency maps and industrial talent demand maps, providing precise data support for program setup and talent training plan revision. For curriculum reconfiguration, leveraging the bidirectional mapping between knowledge graphs and competency maps breaks through the fixed constraints of traditional disciplinary knowledge, enabling modular, granular deconstruction and reorganization of course content to meet students' personalized and differentiated growth needs. Regarding teaching innovation, technologies such as digital twins, virtual reality, and intelligent teaching assistant systems can migrate the real business scenarios, production processes, and technical systems of leading enterprises into the training classroom at low cost and with high fidelity, effectively addressing the pain points of traditional practical teaching, such as single scenarios, poor hands-on experience, and insufficient authenticity. In terms of resource integration, intelligent algorithms can accurately match key resources between schools and enterprises-such as school-enterprise faculty, training equipment, research projects, and practice platforms-greatly reducing communication costs and cooperation barriers in collaborative education. For evaluation and feedback, whole-process learning analytics technology replaces traditional single summative assessments. Based on the multimodal process data of students solving complex engineering or business problems, it achieves value-added, process-oriented evaluation and long-term feedback, building a comprehensive education evaluation system.

In the proposed four-dimensional analysis model of "Technology–Mechanism–Subject–Environment," the four key components are intertwined, continuously optimized, and developed synergistically, forming an organically unified whole. In this framework, AI-related technologies are the key drivers of education model innovation; the education model is the crucial platform for achieving school-enterprise collaborative talent cultivation; various educational participants are the active forces driving collaborative co-construction; and the institutional norms and industrial development environment provide the necessary guarantee for the smooth operation of the entire system. These four aspects are not unidirectional but an organically unified whole that interacts and advances together, serving as a crucial theoretical basis for the efficient operation of modern industry colleges in the AI era.

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2. Current Development Status of AI-Empowered Industry-Education Integration in Modern Industry Colleges of Application-Oriented Undergraduate Universities

2.1. A Multi-Stakeholder Collaborative Governance System Has been Initially Established, Yet the Intelligent Roles and Functions of Various Subjects Remain Ineffectively Reshaped Section Headings

As a pioneer province in the construction of modern industry colleges in China, Jiangsu has approved the establishment of 50 provincial-level key industry colleges (including 10 national-level ones). Across the province, industry colleges have generally adopted a dean responsibility system under the leadership of a council, forming a diversified governance pattern guided by the government, led by universities, and deeply participated in by leading enterprises. The basic framework for school-enterprise collaborative education has largely taken shape. However, with the deep penetration of AI into the education sector, the role definition and operational methods of multiple stakeholders in the education field have not yet achieved a comprehensive intelligent transformation.

University faculty still cling to the traditional disciplinary mindset in their teaching philosophy. Most merely use generative AI as an auxiliary tool for making courseware, retrieving literature, and compiling question banks, without delving into the practical application processes of enterprise-level AI such as dataset cleaning, prompt engineering, and model fine-tuning. Consequently, they lack capabilities in industry-oriented digital teaching. While enterprise mentors possess frontline practical experience, they lack the systematic pedagogical transformation ability to effectively translate complex algorithmic principles and intelligent production technologies into standardized, implementable teaching content and training systems. Meanwhile, the focus of local governments and industry associations in collaborative governance remains on building school-enterprise cooperation platforms. They have yet to establish a regulatory, arbitration, and service system that aligns with AI-driven educational models, leaving them ill-equipped to address emerging issues such as data compliance, algorithmic ethics, and intelligent teaching risks.

2.2. A Project-Based Education Closed-Loop Has Initially Established a Smooth Operational Mechanism, but Weaknesses Persist in the Process of Full-Chain Intelligent Articulation

The key industry colleges in Jiangsu are currently building a project-based education system characterized by "enterprises posing questions, teachers and students solving them, and the market testing them." Institutions such as Nanjing University of Aeronautics and Astronautics and Changzhou University have achieved certain results, and a complete chain for school-enterprise project-based education has been preliminarily realized. However, from the perspective of AI's comprehensive support for industrial talent cultivation, there are still issues regarding poor intelligent articulation across various stages of talent cultivation and misalignment with market demands.

In the demand identification phase, university program adjustments and curriculum updates still rely on traditional methods such as annual enterprise symposiums and periodic program

evaluations. There is a lack of capabilities for dynamic demand perception based on industrial big data, causing the talent cultivation system to lag behind the pace of industrial technology iteration. During teaching implementation, many virtual simulation platforms only possess visual demonstration functions and have not achieved underlying data interoperability with the actual production systems and intelligent operation and maintenance platforms of partner enterprises. Student training largely relies on simplified "teaching edition" scenarios, preventing them from accessing the real intelligent production logic and business processes of enterprises, resulting in subpar training outcomes.

2.3. There Are Significant Hierarchical Differences in Hardware Infrastructure Support, and the Rule System for Data Governance Is Still Incomplete

The intelligent hardware support of various industry colleges in Jiangsu exhibits significant hierarchical differences, influenced by the uneven development of the regional economy. Universities in Southern Jiangsu, leveraging their dual advantages of location and industry, have partnered with industry leaders such as Huawei and ChinaSoft International to build intelligent computing centers and smart training platforms, achieving high levels of computing power guarantees and intelligent hardware configuration. In contrast, application-oriented undergraduate universities in Central and Northern Jiangsu face obvious shortcomings in computing resources, intelligent equipment configuration, and digital platform construction—such as insufficient computing power supply, a lack of intelligent hardware, and slow development of digital teaching platforms—making it difficult to meet the hardware and technical requirements for high-demand teaching activities like AI training and large model fine-tuning.

It should be noted that the standardized governance system for data resources—the core production factor for AI development—has not yet been established. Due to concerns regarding trade secret protection and data compliance, enterprises often only provide simulated data and historical information that are lagging and lightweight, and are reluctant to open up real-time production data. Consequently, the data used in teaching is deficient in authenticity and timeliness. Furthermore, the intellectual property rights for the research and development of algorithmic models and the construction of datasets during student training remain unclear. There are also no standardized institutional arrangements for calculating working hours and distributing benefits for enterprise mentors and university faculty participating in AI teaching projects. These issues exacerbate the phenomenon of data silos, making it difficult to fully realize the value of data elements in education and innovation.

3. Core Obstacles to AI-Empowered Industry-Education Integration in Modern Industry Colleges

At present, although the modern industry colleges established by application-oriented undergraduate universities in Jiangsu Province have completed preliminary work such as the configuration of basic hardware facilities and the construction of school-enterprise collaboration mechanisms in their AI-driven reforms, deep-seated transformations have yet to be achieved in technology application, institutional innovation, and talent cultivation models. The main problem lies in the profound contradictions among educational laws, industrial development laws, and algorithmic logic, which can be summarized into four specific aspects.

3.1. Superficial Technology Empowerment and Insufficient Restructuring of Core Educational Mechanisms

Many industry colleges remain at the auxiliary periphery in applying AI technologies, and the mechanism innovation in core talent cultivation links has not been deepened, resulting in a significant disconnect in empowerment. In terms of application scenarios, AI is mostly used for

administrative and teaching assistance tasks such as attendance management, courseware production, and question bank compilation, while it is notably lacking in critical educational links such as semantic matching of industrial demands, construction of teaching knowledge graphs, and generation of student competency evidence. Both teachers and students frequently rely on generative AI to complete course assignments and project proposals, yet they have not mastered the underlying logic, operational mechanisms, and threshold-setting principles of intelligent algorithms, reducing technology application to a mere formality. Furthermore, the "black box" nature of algorithms conflicts with the educational demand for interpretability, a conflict that remains unresolved.

3.2. Imbalance of Data Rights, Responsibilities, and Interests, Leaving Market-Oriented Governance Rules Hanging in the Air

Data is a crucial production factor driving industry-education integration through AI. However, current industry colleges are deficient in building a data governance system, and the imbalance in the distribution of rights, responsibilities, and interests is evident, posing a significant obstacle to deep school-enterprise collaboration. First, data ownership is ambiguously defined. Existing policies and institutional regulations do not clearly stipulate the ownership, usage rights, and benefit rights of new resources such as enterprise training data, student model parameters, and school-enterprise joint datasets, leaving school-enterprise cooperation without an institutional basis. Second, there is insufficient motivation for data sharing. Due to corporate concerns over confidentiality and compliance risk control, enterprises strictly limit the opening of high-value real-time data, resulting in low-quality teaching data. Third, the benefit distribution mechanism is inadequate. The intellectual property rights of the achievements generated by teachers and students participating in intelligent project R&D, dataset optimization, and algorithm iteration are unclear. There are no unified standards for the performance evaluation and profit sharing of school-enterprise personnel participating in digital-intelligent teaching reforms. Consequently, the internal motivation for multi-subject collaborative education is weak, and cooperative relationships rely on personal connections rather than institutionalized, long-term guarantees.^[1]

3.3. Lack of Resilience in Education Models, with Deficiencies in Regional Adaptability and Scalability

The current construction of industry colleges is characterized by a distinct geographical dependence and reliance on leading enterprises, raising concerns about the sustainability and regional replicability of the education model. On the one hand, the risk of relying on a single enterprise is prominent. Local industry colleges represented by the JD Modern Industry College at Suqian University are highly dependent on resource inputs from cooperative leading enterprises. Any strategic adjustment of the enterprise or change in the cooperative relationship will directly affect the stable operation of the college's education system. This issue is common among industry colleges in Southern Jiangsu built around tech giants. On the other hand, differing regional industrial characteristics pose challenges to model adaptation. In Jiangsu Province, Southern Jiangsu focuses on intelligent manufacturing, Central Jiangsu is dominated by biomedicine, and Northern Jiangsu emphasizes modern agriculture. This clear differentiation in industrial structures makes it difficult to directly apply the mature digital industry-education integration models of Southern Jiangsu to universities in Central and Northern Jiangsu. Blind replication would lead to problems such as mismatched data resources, disconnected job competency frameworks, and a misalignment between the teaching system and regional industrial demands. Additionally, most industry colleges lack the ability to standardize and modularize their mechanisms, making it difficult to form a replicable and adaptable construction paradigm, which limits the overall effectiveness of industry-education integration across the province.

3.4. Insufficient Support from the Safeguard System, with Deficiencies in Both Computing Power Resources and Institutional Supply

The uneven distribution of computing power resources and the insufficient supply of institutional safeguards have become the main external obstacles to the implementation of AI technology in educational practice. Jiangsu's computing power resources are highly concentrated in hardware, mainly in key universities in Southern Jiangsu cities such as Nanjing and Suzhou. Application-oriented undergraduate universities in Central and Northern Jiangsu are severely lacking in computing power resources, making it difficult to support high-end teaching scenarios such as large model training, algorithm optimization, and intelligent simulation training, thereby widening the regional gap in digital-intelligent education capabilities. In terms of policy, the provincial level has not yet formulated supporting policies for data sharing in industry colleges, privacy protection, algorithmic ethics, and intelligent teaching management, leaving universities without clear guidance when carrying out digital-intelligent teaching reforms. Furthermore, the current personnel evaluation and professional title review mechanisms in universities have not been aligned with the direction of industry-education integration reform. The efforts made by teachers in intelligent teaching innovation, school-enterprise data cooperation, and AI curriculum development are often difficult to translate into tangible advantages in professional title evaluation and performance assessment. This greatly reduces teachers' motivation to engage in digital-intelligent education reform, creating a clear disconnect between the safeguard system and the reform objectives.^[2]

4. Optimization Paths for the AI-Empowered Industry-Education Integration Education Mechanism in Modern Industry Colleges

Currently, structural issues such as superficial technology integration, disordered data governance, insufficient model adaptation capabilities, and lagging safeguard system construction urgently need to be addressed. Therefore, based on the specific circumstances of industry-education collaborative development in Jiangsu Province, this paper constructs a trinity optimization framework of "Technology Integration-Institutional Innovation-Ecological Reshaping" from four aspects: supply-demand alignment, institutional norms, regional radiation, and safeguard mechanisms. Through this framework, it aims to promote the industry-education integration of modern industry colleges to break through the simple physical superposition and truly achieve deep chemical integration, thereby improving the quality and efficiency of education.

4.1. Build an Industry-Education Collaborative Adaptation System to Promote Deep Integration of Technology Empowerment in Key Educational Links

To break through the superficial dilemma of technology empowerment, the key is to construct a connection mechanism between industrial technology logic and education and teaching logic, and promote the fundamental reshaping of AI in the core chain of talent cultivation. First, establish a dynamic industrial demand perception system. Relying on natural language processing and big data mining technologies, conduct semantic analysis on industry standards, enterprise technical documents, and job recruitment data to extract core job competency indicators in real-time, and build a dynamically iterative industrial competency map to provide data support for program adjustment, curriculum reform, and talent positioning. Second, construct a dynamic learning system and evaluation mechanism by introducing AI technology to achieve adaptive adjustment of personalized learning paths, and combine it with blockchain technology to ensure data authenticity and privacy. Third, formulate AI interpretability teaching norms. Incorporate algorithm principles, model logic, and decision-making mechanisms into the teaching system, and use methods such as visual analysis, feature

interpretation, and case deconstruction to break through the dilemma of "black box" algorithm teaching. This will encourage students to move from "tool use" to "mechanism mastery and innovative application," achieving deep coupling between technology empowerment and competency cultivation.^[3]

4.2. Optimize the Data Contract Management Framework to Construct an Effective Mechanism for Market-Oriented Allocation of Factors

Institutional innovation should be used to resolve the issues of ambiguous data ownership and imbalanced benefit distribution, thereby building a new legalized and contractual data governance environment. First, strengthen the top-level design of provincial institutions. Formulate the Interim Measures for the Administration of Data Assets in Modern Industry Colleges of Jiangsu Province to clarify the ownership, usage, and benefit rules for new elements such as school-enterprise training data, algorithm models, and annotated datasets. Establish the core principle of "whoever invests, contributes, and benefits," implement a data rights confirmation registration and benefit filing system, and build a three-party intellectual property sharing model of "student attribution, school holding, and enterprise priority conversion." Second, build a secure and controllable data collaboration platform. Set up a dedicated data governance committee for industry colleges, introduce blockchain and privacy computing technologies, and create a multi-party secure computing platform to achieve the goal of making data "available but invisible, controllable and traceable." This will solve the problems of low teaching data quality and poor real-time performance while ensuring corporate trade secrets and data security. Third, optimize the multi-party incentive and evaluation mechanism. Incorporate AI curriculum development, intelligent training guidance, dataset optimization, and school-enterprise data collaboration into the scope of teacher and student workload recognition, performance assessment, and merit evaluation. Clarify the standards for recognizing the teaching hours of enterprise mentors and the proportion of achievement benefit distribution, so as to effectively stimulate the collaborative motivation of multiple subjects including schools, enterprises, governments, and industry associations.

4.3. Build a Hierarchical Promotion System to Enhance the Sustainable Development Capability and Extensive Application Value of the Education Model

In response to the regional differences in industrial layout within Jiangsu Province, a modular construction framework centered on "unified core standards and adapted regional characteristics" should be built to effectively solve problems such as over-reliance on leading enterprises and insufficient adaptation of regional models. First, compile a provincial standardized construction component library. Relying on benchmark industry colleges such as those in Southern Jiangsu (integrated circuits), Central Jiangsu (biomedicine), and Northern Jiangsu (modern agriculture), extract replicable and scalable governance models, data standards, curriculum systems, and teacher collaboration mechanisms to form generalized and modular institutional components and teaching resource packages, stripping away core corporate business secrets while retaining universal operational logic. Second, carry out regional adaptation transformation projects. Promote the sinking of high-quality digital-intelligent industry-education resources from Southern Jiangsu to Central and Northern Jiangsu. Universities in each region should locally modify the standardized components based on local industrial characteristics, deeply adapt the general intelligent training system to the regional leading industries, and build differentiated and characteristic education models. Third, build a multi-party collaborative anti-risk mechanism. Break the situation of relying on a single enterprise, and promote the establishment of normalized cooperation between industry colleges and regional industrial clusters and multiple industry-leading enterprises, broaden

resource acquisition channels, and improve the stability and sustainability of the education model.^[4]

4.4. Build a Collaborative Safeguard Alliance to Solidify Both Computing Power and Institutional Foundations

First, strengthen the overall allocation of regional resources, address the shortcomings of computing power infrastructure, and improve the institutional safeguard system to provide comprehensive support for AI-empowered industry-education integration. First, promote the inclusive and balanced distribution of computing power resources. The Provincial Department of Education should make overall plans, relying on the province's high-level application-oriented undergraduate construction projects, to layout regional industry-education integration intelligent computing centers in Southern, Central, and Northern Jiangsu. Implement a "computing power voucher" subsidy mechanism to open computing power resources to application-oriented undergraduate universities in the region for free or at a low cost, focusing on solving the hardware bottlenecks of large model training and intelligent simulation teaching in universities in Central and Northern Jiangsu, and narrowing the regional gap in digital-intelligent education. Second, improve the multi-departmental policy coordination system. Integrate policy resources from departments such as education, industry and information technology, science and technology, and human resources and social security, and incorporate the achievements of AI-empowered industry-education integration into the university running quality assessment and the evaluation index system for high-level university construction. Third, deepen the reform of the teacher evaluation system. Establish a professional title review channel for the "Industry-Education Integration Special Project" to provide policy preference to teachers who deeply cultivate intelligent teaching reform and school-enterprise collaborative innovation. At the same time, establish a provincial special fund for industry-education integration to focus on supporting core projects such as data governance, intelligent teaching platform construction, and standard system development, thereby building a multi-dimensional collaborative safeguard system of funds, institutions, talents, and computing power to promote the high-quality and sustainable development of industry-education integration in modern industry colleges.

5. Conclusion

This study finds that the empowering effect of artificial intelligence on industry-education integration hinges on a shift from tool application to mechanism reconfiguration. In response to such practical problems as the superficial integration of technology, ambiguous data ownership, and the absence of sustainable mechanisms, the study proposes using data-driven approaches to optimize demand identification, curriculum restructuring, and resource matching, and using intelligent collaboration to improve multi-stakeholder governance and whole-process evaluation. Taking into account the regional disparities within Jiangsu Province, it further develops a practical pathway characterized by the "intelligent transformation of industry-education resources" plus the "intelligent enhancement of the education process."

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