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Industry-Education Integration: Modeling Dilemmas and Practical Tensions

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Abstract

The integration of industry and education in vocational education is a key Chinese strategy to tackle structural talent imbalances. Through the lenses of model, relation, and institution theory, this study examines its development and dilemmas. Findings reveal: at the micro level, conflicts between corporate technical secrecy and educational publicity hinder knowledge transfer; at the meso level, vague stakeholder roles and weak incentives lead to superficial collaboration ("enthusiastic schools, cold enterprises"); at the macro level, uniform policies ignore regional industrial disparities. To address these, breakthroughs are essential: an integrated cross-level analytical framework, localized risk-benefit sharing mechanisms, and proactive digital ecosystem development. Ultimately, a layered, synergistic institutional ecosystem is crucial for linking the education, talent, industry, and innovation chains effectively.

Keywords

Vocational Education; Industry-Education Integration; Theoretical Evolution.

1. Origins of the Issue

The deepening of industry-education integration is rooted in the national strategy for systemic reform of the human resource supply side. In 2017, the State Council issued the Several Opinions on Deepening Industry-Education Integration (No. 95(2017)), which for the first time proposed "facilitating the organic linkage of the education chain, talent chain, industry chain, and innovation chain" ("four-chain linkage"). This policy positioned industry-education integration as a core solution to bridge the gap between talent supply and demand, setting the goal of "establishing an integrated education-industry structure within about 10 years." It marked the transition of industry-education integration from localized experiments to a national institutional framework, emphasizing the role of enterprises as key actors and promoting institutionalized school-enterprise collaboration.

Subsequent policies have continued to refine this framework. In 2023, eight departments including the National Development and Reform Commission launched the Implementation Plan for Empowering and Enhancing Industry-Education Integration in Vocational Education (2023–2025), introducing innovative incentives such as "finance + fiscal support + land + credit" and stimulating enterprise participation through tax deductions (30% education surcharge exemption) for certified integration-oriented enterprises. In 2024, the Ministry of Education issued the Notice on Strengthening the Development of City-Based Industry-Education Consortiums, which focuses on industrial parks as carriers, enhances "four cooperations" (co-schooling, co-education, co-employment, co-development), and promotes the "Five Golden" curriculum reforms (golden majors, courses, textbooks, teachers, and bases) with 44 quantitative standards. These efforts shift vocational education from foundational capacity-building to precision services for industries, signaling a phase of comprehensive deepening.

The urgency of these policies stems from the severe mismatch between the rapid growth of emerging industries and the lagging response of traditional vocational education[1]. With

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accelerated technological cycles in fields like AI and green energy, vocational training models struggle to keep pace, leading to three structural imbalances:

1) Skills Mismatch: AI-driven new professions (e.g., "Generative AI System Operators") created 19 new roles in 2024, demanding millions of talents, yet curricula lag behind technological applications[2]. Green energy faces a projected talent gap of nearly one million during the "14th Five-Year Plan" period, with only 100,000 existing practitioners[3][4].

2) Regional Imbalance: Eastern industrial clusters adapt quickly via consortiums, while central and western regions face a "brain drain–industrial hollowing" cycle due to resource constraints[5]. For example, the Changji Agricultural Hi-Tech Zone Consortium in Xinjiang supports three 100-billion-yuan industrial clusters but lacks adequate training resources.

3) Outdated Training Models: Traditional vocational education lacks sufficient practical training, while emerging fields like new energy vehicles and smart manufacturing require "high-skills + high-education" talent, necessitating deeper integration with real production scenarios, such as AI algorithm debugging and battery technology iteration[2].

Thus, this paper will next theoretically analyze the practical dilemmas arising from divergent models of industry-education integration. Research in this field holds strategic value not only for synchronizing educational supply with industrial demand but also for providing sustainable regional development momentum. It supports city-based consortiums in precisely matching regional needs through "professional clusters industrial clusters" mechanisms, improving local talent retention, and advancing the "Five Golden" reforms to align curricula with occupational standards and foster bidirectional teacher mobility. Furthermore, it offers evidence for optimizing policy incentives and enterprise evaluation metrics, constructing a "government-industry-university-society" quadruple helix governance model to resolve the "enthusiastic schools enterprises" dilemma.

2. Literature Search

This study conducted a literature search and visualization analysis using the China National Knowledge Infrastructure (CNKI) database with "industry-education integration" as the key keyword, aiming to reveal the evolution and academic focus of research on industry-education integration in vocational education.

As shown in Figure 1, the annual distribution of publications indicates that after the first domestic article in this field was published in 2007, the number of publications grew slowly between 2007 and 2017. Following the release of the State Council's Several Opinions on Deepening Industry-Education Integration in 2017, research interest increased markedly, entering a phase of rapid growth. This trend clearly reflects the rising academic attention to the application value of industry-education integration in vocational education under policy impetus and highlights the guiding role of institutional supply in shaping research agendas.

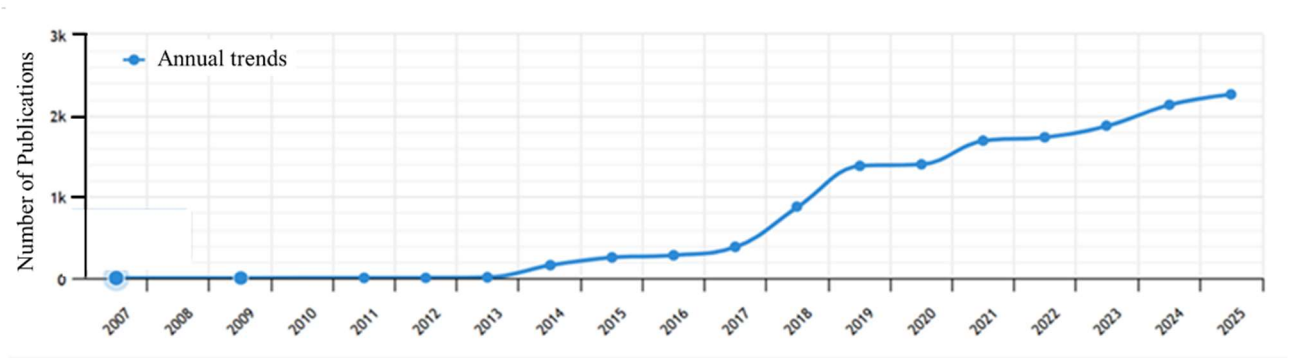

Figure 1. Annual Trends in Industry-Education Integration Research

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As shown in Figure 2, "industry-education integration" emerges as the dominant research focus, with significantly more publications than related themes such as "vocational education," "higher vocational institutions," and "school-enterprise cooperation." This pattern closely aligns with the evolution of national strategy: the 2017 policy elevated industry-education integration to a national institutional framework, while subsequent initiatives like the 2024 "city-based industry-education consortiums" and the "Five Golden" curriculum reforms have further reinforced its central role, driving the transition from conceptual advocacy to institutional practice.

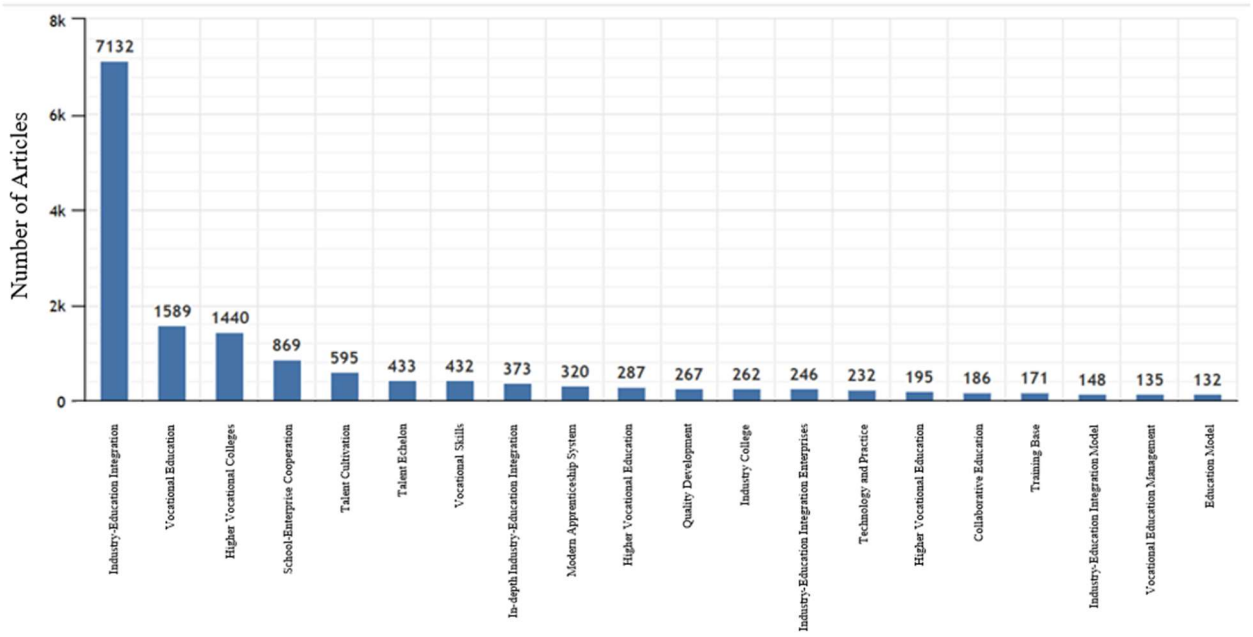

Figure 2. Publication Volume in Industry-Education Integration Research

From a practical perspective, industry-education integration focuses on core issues such as multi-stakeholder governance (government-industry-education-society), incentive and risk-sharing mechanisms for enterprises, and innovative resource integration models. It serves as a key mechanism for aligning vocational education with industrial demands. The growing research interest fundamentally reflects the dynamic interaction between the distinctive features of vocational education and the patterns of industrial transformation, highlighting the strategic role of industry-education integration in resolving structural contradictions between educational supply and industrial demand.

3. Theoretical Evolution and Conceptual Models of Industry-Education Integration

3.1. Theoretical Evolution of Industry-Education Integration

3.1.1. International Theoretical Evolution

Early theoretical foundations of industry-education integration are widely traced to Karl Marx's[7] concept of "integration of labor and education" in Germany, Herman Schneider's "cooperative education" theory in the U.S., and John Dewey's "learning by doing" philosophy. In 1912, Joseph Schumpeter[8], in his Theory of Economic Development, synthesized earlier ideas and systematically proposed the "five types of innovation," identifying industry-education integration as a crucial form of innovation in education. This theory gained global influence and significantly promoted economic development.

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In 1987, British scholar Christopher Freeman[9], in his study of Japanese experience, emphasized that industry-education integration should be regarded as a national strategy with government playing a key role. Subsequently, the "Triple Helix Model" by Etzkowitz and Leydesdorff[6] further advanced this perspective by highlighting the interactive relationships among government, industry, and universities, urging higher education institutions to integrate talent cultivation, management models, and operational philosophies into real-world enterprise processes.

3.1.2. Domestic Theoretical Evolution in China

The formation of industry-education integration theory in China partly originated from the interpretation and development of Marxist classical theory. Marx emphasized the comprehensive nature of human productive activities and identified education as key to intellectual reproduction.Building on this, Sun Shanxue[10] argued that vocational education spans both "means of subsistence production" and "social relations production," representing a significant theoretical deepening of Marxist thought. Subsequently, "industry-education integration" gained broad academic and policy adoption, evolving from singular school-enterprise cooperation into a synergistic developmental paradigm between industrial and educational systems. Scholars have developed multiple theoretical interpretations, including model theory, relation theory, and institution theory.

3.2. Development of Theoretical Models

3.2.1. Model Theory: Micro-Level Technical Integration in Education

Model theory offers a practical framework by focusing on the "how" of integration, emphasizing the deep alignment of educational processes and content with industry needs. It highlights two key pathways[11]: First, breaking barriers between education and production through alternating study and work or project-based teaching, integrating real enterprise workflows and scenarios into instruction[12],[13]. Second, dynamically updating educational content by transforming industrial technologies, techniques, and standards into curricula, training, and assessments[14]. The ultimate goal is to internalize industrial excellence into student competencies, fostering technical thinking, standardized behaviors, and cultural awareness, thereby supplying high-quality skilled talent.

3.2.2. Relation Theory: Meso-Level Organizational Collaboration

Relation theory represents a paradigm shift beyond the traditional "school-enterprise duality," defining integration as a collaborative network of multiple stakeholders based on resource embedding and value co-creation[15]. Its innovations span three dimensions: expanding stakeholders to include government, industry associations, research institutes, and communities, forming a "education-industry-society" quadruple helix ecosystem[16]; coupling relational governance (e.g., industrial colleges, apprenticeships) with contractual agreements to clarify rights and responsibilities; and leveraging resource integration for multiplicative effects[17]. The theory underscores integration as an institutional restructuring of production relations, requiring a shift from loose coupling to institutional coupling, from physical resource stacking to chemical innovation reactions, and from project-driven to legally sustained governance.

3.2.3. Institution Theory: Macro-Level Systemic Restructuring

From an institutional perspective, industry-education integration is a multi-level, systematic framework. It focuses on mechanism innovation for regional economic development, emphasizing dynamic synergy among operational models, curriculum restructuring, and resource optimization[18]. It also aims to improve cross-sectoral governance between education and industry, including collaborative planning, talent supply-demand alignment, and refined policy design. Crucially, it elevates integration to a national strategic level, framing it as a

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"socialized knowledge production institution," highlighting its role in modernizing national governance[19]. The institution theory contribution lies in addressing the fundamental questions of "why integrate" and "for whom," providing a theoretical basis for policy and practice.

4. Multi-Perspective Examination of Practical Dilemmas in Industry-Education Integration

4.1. Model Theory: Inefficiency in Micro-Level Technical Transfer

From the perspective of model theory, the micro-level implementation of industry-education integration often suffers from superficial and alienated technical knowledge transfer, significantly limiting the depth and educational quality of integration. Although practices frequently emphasize "aligning production processes with teaching processes" and "transforming technical elements into educational content," they encounter substantial barriers when accessing core enterprise technologies-such as AI algorithms or precision manufacturing know-how-which are seldom openly shared[2]. Key factors include corporate secrecy protecting competitive advantage and the high cost of adapting advanced technologies for teaching. Empirical studies indicate that few school-enterprise cooperation projects achieve meaningful transfer of core technologies, with most interactions limited to equipment donation, production line visits, or basic skills training, resulting in insufficient depth and currency in knowledge transfer[20].

Moreover, an alarming "alienation" of educational goals has emerged. Driven by the imperative to "serve industry," some vocational institutions excessively emphasize short-term employment metrics, drastically reducing general and theoretical education in favor of maximal practical skill training[12]. This imbalance produces graduates skilled in specific equipment operation but lacking systemic understanding of underlying principles, hindering their career mobility and locking them into operational roles rather than enabling advancement to R&D or management positions. This reflects a fundamental tension between the public-good mission of education-emphasizing holistic development and knowledge accessibility-and the profit-driven logic of industry, which prioritizes competitive advantage through technological exclusivity[1]. This value misalignment causes micro-level integration, especially in core technical transfer, to often become nominal rather than substantive.

4.2. Relation Theory: Superficiality in Meso-Level Organizational Collaboration

Relation theory frames industry-education integration as an "organizational innovation for multi-stakeholder collaborative education," yet in practice, it reveals governance deficits such as "ambiguous roles and responsibilities" and "insufficient motivational drivers," leading to ineffective collaboration networks[15]. Within the multi-actor network (schools, enterprises, government, society), role boundaries are poorly defined: government interventions often blur the line between policy support and administrative overreach; enterprises prioritize short-term gains over sustained talent development engagement, creating an imbalance between their input costs and benefits; and schools struggle between educational autonomy and resource dependency, risking the subordination of educational values to corporate interests[16]. This ambiguity results in a governance vacuum with weak accountability.

The root issue is the absence of systematic mechanisms for interest distribution and risk sharing among stakeholders[21]. Effective collaboration requires a dynamic balance of rights, responsibilities, and benefits underpinned by contractual frameworks. Currently, resource exchanges lack market-based valuation-enterprise contributions of equipment, technology, and expertise are not adequately quantified or compensated[14]. Similarly, a culture and system

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of shared risk is missing, leaving schools, enterprises, and students to individually bear the risks of knowledge obsolescence, production disruption, and skills mismatch[22].

4.3. Institution Theory: Lag in Macro-Level Institutional Innovation

From an institutional perspective, industry-education integration is conceived as a "societal-level institutional arrangement," yet it exhibits structural flaws such as "overly generalized design" and "lack of regional adaptability," indicating institutional innovation lags behind diverse local needs[23]. National policies provide broad principles but lack operational specifics. For example, incentives for integration-oriented enterprises suffer from inconsistent certification processes and oversight, leading to regional disparities in implementation where few firms ultimately qualify[24]. Similarly, the Construction Standards for City-Based Industry-Education Consortiums outline directional goals like "four cooperations" and "five golden reforms," but omit critical details such as evaluation metrics, resource allocation standards, and cross-departmental responsibility mechanisms, resulting in symbolic engagement rather than sustainable operation[25].

Recent policy experiments, such as regional cultivation databases for integration-oriented enterprises and tailored curricula in central and western provinces, aim to address these issues. However, they face tensions between institutional rigidity and regional flexibility: local pilots lack room for experimentation under top-down policies, and interregional cooperation mechanisms between eastern and western China remain under-institutionalized, preventing efficient resource and technology transfer[26][27]. The institution theory perspective thus calls for a "layered and collaborative" institutional ecosystem-combining central-level foundational policies with greater local autonomy for institutional experimentation, dynamically adapted based on regional industry-education alignment indices-to bridge the gap between macro-level systems and micro-level practice.

5. Conclusion

The tripartite conceptual framework-model theory, relation theory, and institution theory-systematically deconstructs the essence of industry-education integration, reflecting an evolving scholarly understanding: from a "technical transfer tool" to a "collaborative governance form" and further to a "systemic institutional arrangement." This progression aligns with both the dynamic demands of industrial upgrading and the repositioning of vocational education from "internal educational reform" to a "socio-systemic project." Model theory anchors micro-level technical integration, relation theory expands meso-level organizational collaboration, and institution theory elevates macro-level systemic governance. Together, they form a nested and mutually reinforcing theoretical framework.

Future research should be grounded in the context of "Chinese modernization" and advance in three directions:

1) Theoretical Integration Across Perspectives: Develop an integrated analytical framework connecting micro-level technical embedding, meso-level organizational collaboration, and macro-level institutional support to address fragmented implementation.

2) Localized Mechanism Innovation: Design multi-stakeholder contractual mechanisms for "risk-sharing and benefit-sharing" within China's governance context, where government leads and the market complements, to incentivize deeper enterprise participation and rebalance the "enthusiastic schools–enterprises" dynamic.

3) Responsiveness to Digital Transformation: Embrace technologies like AI and the metaverse that are reshaping industries, and explore new integration mechanisms such as digital twin training platforms and smart ecosystems to advance from physical collaboration to digital symbiosis, meeting the talent demands of advanced productivity.

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Breakthroughs in theoretical depth, mechanistic precision, and technological responsiveness are essential to organically link the education, talent, industry, and innovation chains, thereby injecting sustained momentum into high-quality vocational education in the new era.

References

[1] Wang Yanan and Wang Bin: Why "Substantial in Form but Weak in Reality": An Analysis of the Crux of the Entity Reform of Industry-Education Integration in Vocational Education, Education Research Monthly, Vol. 2025 (2025) No.4, p.95-103.

[2] Zhu Hongping, Zhu Ruizhe, Ye Hongwu et al.: Dilemmas and Breakthroughs in Developing Digital Resources for Vocational Education: Model Reconstruction Leveraging the Advantages of AI Technology, Journal of Distance Education, Vol. 43 (2025) No.3, p.64-72.

[3] Yue Wei, Li Wenjuan and Chen Junyuan: The Connotation, Composition and Development Path of Green Skills in International Vocational Education, Comparative Education Review, Vol. 46 (2024) No.8, p.7-19.

[4] Zhu Dequan and Shen Jiale: The Economic Logic of Vocational Education Serving Rural Revitalization: Neo-Endogenous Dynamics and Mechanisms, Education and Economy, Vol. 38 (2022) No.3, p.25-34.

[5] Song Yafeng, Wang Shibin and Pan Haisheng: A Spatial Econometric Study on the Efficiency of Regional Resource Allocation in Higher Vocational Education, Research in Higher Education of Engineering, Vol. 2019 (2019) No.1, p.144-151.

[6] H. Etzkowitz: The Triple Helix: Innovation in Academia, Industry and Government - Selected Writings of Henry Etzkowitz (Trans. Chen Jin, Tsinghua University Press, China 2016).

[7] K. Marx: Economic and Philosophic Manuscripts of 1844 (People's Publishing House, China 2000).

[8] J.A. Schumpeter: The Theory of Economic Development (China Commerce Publishing House, China 2009).

[9] C. Freeman: Technology Policy and Economic Performance: Lessons from Japan (Trans. Zhang Yuxuan, Southeast University Press, China 2008).

[10] Sun Shanxue: Thoughts and Suggestions on Improving the Vocational Education College Entrance Examination System, China Higher Education Research, Vol. 2020 (2020) No.3, p.92-97.

[11] Liu Bin, Zou Jiquan and Liu Xiaomei: The Logical Starting Point and Ideal State of Industry-Education Integration in Vocational Education, China Higher Education Research, Vol. 2017 (2017) No.11, p.106-110.

[12] He Yangyong: Institutional Reflection on Combining Work with Learning and School-Enterprise Cooperation in Higher Vocational Education, China Higher Education Research, Vol. 2009 (2009) No.2, p.70-72.

[13] Luo Yingzi, Zhang Zhiyuan and Chen Erdong: Conceptual Perspective, Type Distinction and Conceptual Evolution of Combining Work with Learning - Also on Its Enabling Effect on Professional Degree Graduate Education, Tsinghua Journal of Education, Vol. 46 (2025) No.1, p.55-67.

[14] Cao Keyan: Deepening Industry-Education Integration in Vocational Education: From the Dual Perspectives of Technology and Education, Education Research Monthly, Vol. 2025 (2025) No.3, p.38-44.

[15] Chen Nianyou, Zhou Changqing and Wu Zhuping: The Connotation and Realization Approaches of Industry-Education Integration, China University Science & Technology, Vol. 2014 (2014) No.8, p.40-42.

[16] Qiu Hui and Fan Qian: The Dynamic Mechanism and Strategy for Promoting Deep Industry-Education Integration, Heilongjiang Researches on Higher Education, Vol. 2016 (2016) No.12, p.102-105.

[17] Xie Xiaozhen: Research on the Mechanism of "Industry-Education Integration" and Its Path for Institutional Design, Research in Higher Education of Engineering, Vol. 2019 (2019) No.5, p.81-87.

ISSN: 2692-7608 DOI: 10.6981/FEM.202510_6(10).0009

[18] He Xingyue et al.: The Paradigm of Industry-Education Integration in Modern Higher Vocational Education (Zhejiang University Press, China 2018).

[19] Cai J.M., Xia L. and Yu G.J.: Connotation Cognition and Mechanism Innovation of Industry-Education Integration in Application-Oriented Universities, China University Science & Technology, Vol. 2019 (2019) No.4, p.4-7.

[20] Ma Wanli: Dilemmas and Pathways for Cultivating High-Level Talent in Key Core Technology Fields: From the Perspective of School-Enterprise Symbiosis, China Higher Education Research, Vol. 2023 (2023) No.7, p.53-60.

[21] Ji Chengjun and Fan Fengfu: Changing the Problem of "Enthusiastic Schools but Cold Enterprises" in Cooperative Talent Training, China Higher Education, Vol. 2011 (2011) No.12, p.56-57.

[22] Zhuang Xizhen: Internal Contradictions and Solutions for Industry-Education Integration, China Higher Education Research, Vol. 2018 (2018) No.9, p.81-86.

[23] Hu Changsong and Zhang Junping: Industry-Education Integration in Higher Vocational Education: Essence, Models and Pathways - From the Perspective of Knowledge Production Mode, China Higher Education Research, Vol. 2019 (2019) No.4, p.92-97.

[24] Li Yuan: Multiple Institutional Logics in the Construction of Mixed-Ownership Industry Colleges in Higher Vocational Institutions, Education Research Monthly, Vol. 2021 (2021) No.6, p.33-38.

[25] Kuang Ying and Han Lin: Development Opportunities, Practical Challenges and Breakthrough Paths for Constructing City-Based Industry-Education Consortiums, Modern Education Management, Vol. 2025 (2025) No.4, p.111-119.

[26] Hu Shunyi and Ouyang Yuliang: A Comparative Study of Provincial Industry-Education Integration Pilot Policies in China, Vocational Education, Vol. 22 (2023) No.32, p.3-9.

[27] Yin Yuhui, Jin Jin and Zong Cheng: Current Situation, Dilemmas and Promotion Strategies for Building Industry-Education Integration Communities: A Research Report Based on Reform and Innovation in Vocational Education, Vocational & Technical Education Forum, Vol. 40 (2025) No.1, p.31-38.