Journal of International Education and Development
2025, VOL. 9, NO. 11, 255-260
DOI: 10.47297/wspiedWSP2516-250056.20250911

Exploring Educational Pathways for the Integration of Industry and Education in Private Universities in the Digital-Intelligent Era

Wenxiao Hu

Liaoning University of International Business and Economics, Dalian, Shandong, 116052, China

ABSTRACT

The Digital-Intelligent Era is driving profound industrial transformation, placing new demands on the quality of applied talents. This presents strategic opportunities for private universities to deepen the integration of industry and education, while also posing severe challenges to their traditional educational models, such as insufficient collaboration, outdated content, and superficial technology application. Using private universities in Liaoning Province as the research context, and based on the needs of educational digital transformation and regional industrial development, this paper aims to construct a systematic and innovative pathway for industry-education integrated education. The study proposes that private universities should establish a three-stage synergistic educational mechanism—"Demand Perception - Resource Adaptation - Quality Optimization"—driven by data as the key force, serving as the core guide. On this basis, efforts should focus on developing a modular, project-based curriculum system grounded in dynamic job competency maps, and deeply integrating virtual simulation with real enterprise scenarios to build a new "dual-track virtual-real" practical teaching ecosystem. Finally, it is necessary to design a supporting "Incentive - Certification - Sharing" trinity policy guarantee system to overcome the institutional bottlenecks of deep university-enterprise collaboration. Through the three-dimensional linkage of "Conceptual Innovation - Pathway Reconstruction - Guarantee Support," this research aims to provide a set of solutions with both theoretical foresight and practical operability for private universities to break through the bottlenecks of industry-education integration and achieve connotative development, thereby effectively enhancing the quality of applied talent cultivation and empowering the high-quality development of the regional economy and society.

KEYWORDS

Digital-intelligent era; Private universities; Integration of industry and education

1 Introduction

Currently, the world is undergoing a profound transformation led by intelligent technologies such as big data, artificial intelligence, cloud computing, and the Internet of Things. Human society is rapidly advancing into the "Digital-Intelligent Era." This era's characteristics not only reshape production organization methods, business operation models, and industrial structure layouts but also place unprecedented high standards and new demands on the human resources supporting economic and social development. Cultivating versatile talents equipped with digital literacy, cross-border integration capabilities, innovative thinking, and rapid adaptability has become the core mission and foundation for the survival and development of higher education, especially for private universities tasked with serving the regional economy and focusing on applied talent cultivation. In this context, deepening the integration of industry and education, breaking down the barriers between universities and the industrial sector, and achieving precise alignment and resonance between the talent supply side and the industry demand side are no longer optional questions but imperative ones concerning the future competitiveness of private universities.

At the national level, guiding documents such as "China's Education Modernization 2035" have been successively issued, explicitly emphasizing the strategic direction of deepening the integration of industry and education and leveraging information technology to empower educational model innovation. At the local level, regional development strategies represented by Liaoning Province's "Digital Liaoning, Intelligent Manufacturing Strong Province" initiative place high expectations on universities within the province, especially the more flexible private universities, regarding the reform of talent cultivation models. They are required to respond quickly to the changing demands for talent skill structures driven by regional industrial upgrading. However, in reality, although many private universities have conducted various explorations in industry-education integration, the results often fall short of expectations, and deep-seated contradictions remain prominent, mainly manifested in the following three dimensions:

First, in the dimension of university-enterprise collaboration, relationships are loose, with a significant "stovepipe phenomenon. "Existing cooperation mostly stays at the level of "point-based" collaborations such as short-term projects and shallow internships or field visits, lacking long-term, stable, and institutionalized "chain-based" deep collaboration mechanisms. Due to a lack of sufficient endogenous motivation and clear expected benefits, enterprises have limited enthusiasm and depth in participating in talent cultivation, and the situation of "hot universities, cold enterprises" has not been fundamentally reversed. Differences in target demands, organizational culture, and management models between universities and enterprises constitute invisible barriers to deep integration.

Second, in the dimension of the educational process, the model is rigid and disconnected from industrial evolution.

Traditional curriculum systems are built based on relatively stable disciplinary knowledge logic, with long update cycles that struggle to keep pace with the iteration speed of digital-intelligent technologies and industrial format innovation. Teaching methods still predominantly center on teacher-led knowledge transmission, lacking sufficient cultivation of students' practical abilities, critical thinking, and innovation and entrepreneurship spirit. This leads to a significant "generation gap" and "mismatch" between the knowledge and skill structure possessed by graduates and the actual demands of the market.

Third, in the dimension of technology empowerment, applications are superficial and fail to penetrate the entire process. Although some private universities have introduced digital tools such as online teaching platforms and virtual simulation training software, these applications are often scattered, isolated "information silos." They fail to organically embed digital-intelligent technology into the entire process from talent demand analysis, curriculum design, and teaching implementation to learning evaluation and quality monitoring. The value of data as a new factor of production has not been fully exploited, and data-driven decision optimization and personalized education mechanisms are far from being formed.

In summary, exploring and constructing a new educational pathway for industry-education integration that conforms to the characteristics of the Digital-Intelligent Era, follows educational principles, and suits the institutional mechanisms of private universities holds extremely important theoretical value and practical urgency. This study aims to systematically analyze the root causes of the aforementioned dilemmas and attempt to construct a systematic framework with advanced concepts, clear pathways, and strong guarantees, hoping to provide reference for the reform practices of private universities in Liaoning Province and even nationwide.

2 Conceptual Innovation: Building a Data-Driven Three-Stage Synergistic Education Mechanism

To solve the deep-seated dilemmas of industry-education integration in private universities, the primary task is a fundamental innovation in educational philosophy. It is necessary to abandon the previous static, linear, supply-side (university) -centered traditional thinking and shift towards building an ecosystem with data as the core element, possessing dynamic response and continuous optimization capabilities. The "Demand Perception - Resource Adaptation - Quality Optimization" three-stage driving mechanism proposed in this study is the core embodiment of this conceptual innovation, constituting the "brain" and "central nervous system" of the digital-intelligent education model.

2.1 Demand Perception Layer – Achieving Precise Anchoring from "Experience Judgment" to "Data-Driven"

Accurately and dynamically perceiving internal and external demands is the fundamental prerequisite for ensuring the correct direction of education. In the traditional model, the setting of talent cultivation goals mostly relies on market research conducted every few years, limited expert opinions, and past experiences, suffering from serious lag and one-sidedness. The digital-intelligent education model requires the establishment of a real-time, multi-dimensional, and precise demand perception system.

First, perform data-driven capture and analysis of external industrial demands.

Use big data technologies such as web crawlers and API interfaces to automate continuous data collection from mainstream recruitment websites, authoritative industry reports, technical white papers from leading enterprises, and government industrial policy documents.

Second, refine the fine-grained profiling and insight into internal learner characteristics.

Build a learner digital profile system integrating students' academic grades, online learning behavior data (such as video viewing duration, assignment completion, forum participation), library resource usage records, experimental and practical training operation data, and scientific career aptitude assessment results during their time at university. Through multi-dimensional data analysis, precisely identify each student's knowledge structure weaknesses, ability strengths, learning style preferences, and potential career development directions, laying a solid foundation for truly "teaching students according to their aptitude" and personalized growth path planning. Form a closed loop for tracking and feedback on alumni career development trajectories.

Third, establish a normalized mechanism for tracking graduate career development.

Systematically collect information on alumni employment quality (starting salary, job-match rate), career progression speed, feedback on job competency, and evaluations of the effectiveness of university curricula through regular questionnaire surveys, alumni interviews, and social media data analysis. This "downstream" feedback data is the most powerful evidence for testing and calibrating the "upstream" design of talent cultivation programs, enabling effective closed-loop feedback and driving the continuous optimization of cultivation objectives.

2.2 Resource Adaptation Layer – Achieving Intelligent Matching from "Standard Allocation" to "Personalized Customization"

Based on the precise perception of demand, how to efficiently allocate the most suitable educational resources to the students who need them most is key to improving educational efficiency. This requires a complete shift from the past "one-size-fits-all," fixed resource supply model to a highly flexible, customizable intelligent adaptation model.

First, perform modular deconstruction and tag-based management of course resources.

Using the dynamic job competency map as a blueprint, "deconstruct and reconstruct" the traditional disciplinary curriculum system, forming clusters of modular courses with smaller granularity and higher flexibility. Each course module corresponds to one or a set of core competency points, forming "knowledge units" that can be recognized and invoked by the system.

Second, intelligently generate algorithm-based personalized learning paths.

Develop an intelligent recommendation algorithm engine to accurately match students' personal competency profiles (from the demand perception layer) with the modular course library. The system can generate a highly personalized, dynamically adjusted "learning path map" or "course package" for each student. Within this framework, students have full autonomy to choose, combining different course modules like a "custom menu" based on their interests, strengths, and career plans, constructing a unique and optimized knowledge-ability structure.

Third, enable on-demand scheduling and seamless connection of virtual-real integrated practical training resources.

Build a smart practical training management center integrating virtual simulation training platforms, real enterprise project case libraries, online collaboration tools, etc. The platform can intelligently recommend and dispatch the most suitable practical training resources based on teaching progress, student ability levels, and training objectives. For example, students can first practice high-risk or high-cost operations in a virtual environment, and after mastering them, enter real enterprise scenarios for practical application, achieving seamless switching and complementary reinforcement between "virtual simulation and real practice."

2.3 Quality Optimization Layer – Achieving Closed-Loop Optimization from "Result Evaluation" to "Whole-Process Diagnosis"

Quality is the lifeline of industry-education integration. The digital-intelligent education model requires the establishment of a dynamic quality monitoring and continuous improvement system based on data, covering the entire talent cultivation lifecycle, forming a "monitoring-diagnosis-feedback-intervention-optimization" closed loop.

First, collect whole-process, multi-modal learning data.

Use learning management systems, IoT sensors, video analytics, and other technologies to unobtrusively or with low interference collect multi-modal data generated by students in various stages such as modular learning, virtual training, project practice, group discussions, and enterprise internships.

Second, construct a multi-dimensional, comprehensive quality assessment model.

Break the single evaluation mode of final exam scores and build a comprehensive evaluation index system integrating knowledge mastery, skill application, literacy development, and innovation capability. Strengthen process evaluation, and introduce enterprise mentors, project clients, etc., as important evaluation subjects, incorporating external indicators such as enterprise satisfaction and project completion quality into the core assessment scope, achieving diversification of evaluation subjects and objectification of evaluation results.

Third, implement data-driven real-time diagnosis and precise intervention.

Use educational data mining and learning analytics technologies to perform real-time analysis on the collected massive learning data, automatically identifying abnormal patterns or risk points in the learning process (such as universal learning difficulties in a particular course module, weak mastery of specific skill points, academic early warnings for individual students, etc.). The system can automatically generate visual diagnostic reports and send personalized intervention suggestions to teachers, mentors, and even the students themselves, thus achieving a shift from "post-event remediation" to "in-process warning and real-time intervention."

3 Pathway Reconstruction: Developing a Modular Curriculum and Virtual-real Integrated Practical Training System Based on Dynamic Job Competency Maps

Advanced concepts require solid practical pathways for support. Among these, the curriculum and teaching system, as the core carrier of educational activities, is the top priority for reform. This study proposes that, guided by dynamic job competency maps, the curriculum system should be systematically reconstructed, and virtual and real practical training scenarios should be deeply integrated to create a new educational ecosystem integrating "learning-training-innovation."

3.1 Dynamic Job Competency Map – The "Compass" and "Benchmark" for Curriculum Reconstruction

The accuracy and dynamism of the job competency map are the foundation for the success of the entire system. Its construction and maintenance are systematic projects requiring continuous investment.

First, data aggregation and intelligent construction.

Comprehensively use multi-source data and introduce Natural Language Processing (NLP) and machine learning algorithms to achieve automatic parsing and map generation from massive job information, improving efficiency and coverage.

Second, expert verification and iterative updating.

Establish an expert committee composed of industry enterprise technical experts, human resource managers, and senior professional teachers to regularly conduct manual review, calibration, and confirmation of the automatically generated maps, ensuring their authority and practicality. Simultaneously, establish a quarterly or semi-annual regular update mechanism for the maps to ensure they always reflect the latest industry dynamics.

3.2 Modular Curriculum System – Shifting the Focus from "Disciplinary Logic" to "Competency Logic"

Based on an authoritative and dynamic competency map, thoroughly reconstruct the existing curriculum system to form modular course clusters centered on competency cultivation.

First, the Basic Competency Module Cluster: Solidifying the foundation for sustainable development.

This cluster aims to cultivate students' general literacy, digital-intelligent fundamentals, and professional basic knowledge. The key innovation lies in integrating digital-intelligent literacy into basic courses. Teaching adopts a combination of "focused theory + virtual simulation," using virtual simulation software to simulate basic business processes, enabling students to establish intuitive understanding from the introductory stage.

Second, the Professional Core Competency Module Cluster: Precisely empowering alignment with job positions.

This is the core of the entire curriculum system, directly corresponding to the high-weight, high-frequency core skill points in the job competency map. It should closely align with the regional industrial layout, offering highly contextualized, project-based directional modules such as "Industrial Data Analysis and Visualization," "Intelligent Supply Chain Management," and "Cross-border Digital Marketing Planning." Vigorously promote "Project-Based Learning," introducing real projects from partner enterprises into the classroom, and deeply integrate the "1+X" certificate system, using industry certification standards as an important basis for course assessment, significantly enhancing students' job competency and employment competitiveness.

Third, the Cross-border Innovation Competency Module Cluster: Cultivating new-quality talent for the future.

For students with spare capacity and innovative potential, offer modules exploring cutting-edge technologies and solving complex problems, such as "Generative AI Business Applications" and "Digital Twin System Design and Simulation." Through forms like "Innovation Incubation Workshops," "University-Enterprise Joint Laboratories," and "Real Sci-Tech Innovation Project Tackling," and under the dual guidance of university teachers and enterprise technical experts, complete the full-process training from creative conception, technical implementation to business roadshows, focusing on cultivating students' critical thinking, interdisciplinary integration skills, and innovation and entrepreneurship spirit.

3.3 Virtual-Real Integrated Practical Training System – The "Training Ground" Breaking Time and Space Limits

To achieve "learning by doing and doing by learning," a highly realistic practical environment must be built. Virtual-real integration is the optimal solution to address pain points such as high training costs, high risks, and limited opportunities.

First, construction of high-immersion virtual simulation training platforms.

Introduce or co-develop virtual simulation training platforms based on VR/AR/MR technologies, highly restoring real enterprise work scenarios, equipment operation processes, and unexpected events (e. g., smart factory fault troubleshooting, virtual international business negotiations, immersive customer service scenario simulation).

Second, enterprise real practice under the "Dual-Mentor Project System."

Third, support from an integrated digital resource management and service platform.

Build a unified smart teaching service platform integrating all modular course resources, virtual training projects, enterprise case libraries, academic literature, etc., achieving unified resource management, convenient retrieval, one-click access, and seamless flow of learning data. This platform is the technical foundation supporting personalized learning, blended teaching, and whole-process evaluation.

4 Building a "Incentive - Certification - Sharing" Trinity Policy and Mechanism Synergy System

Any advanced concept and pathway, if lacking strong support and guarantees, will struggle to take root. Addressing the practical bottlenecks faced by private universities in university-enterprise cooperation, such as "insufficient motivation for enterprise participation," "uneven cooperation quality," and "poor resource flow," top-level institutional design is necessary to build a stable, sustainable collaborative guarantee system.

4.1 Incentive Policies – Solving the "Hot University, Cold Enterprise" Dilemma and Stimulating Endogenous Motivation in Enterprises

Allowing enterprises to obtain tangible "returns" from participating in talent cultivation is key to stimulating their sustained enthusiasm. It is possible to actively advise local governments to establish special development funds for industry-education integration, providing substantive benefits such as tax reductions, equipment donation deductions, and additional deductions for R&D expenses to enterprises recognized as "Industry-Education Integration Type." Provide appropriate financial subsidies for costs incurred from receiving student interns and teacher secondments.

Jointly with industry associations, media, etc., regularly conduct selection activities such as "Outstanding Contribution Enterprise in Industry-Education Integration" and "Gold Industry Mentor," and widely publicize them through official channels, shaping participation in industry-education integration as an important way for enterprises to fulfill social responsibility and enhance brand reputation.

4.2 Certification Policies – Establishing Quality Benchmarks and Enhancing the Credibility of Cooperation Projects

Through the establishment of scientific standards and third-party certification, "endorse" high-quality industry-education integration projects, guiding the preferential choice of students, parents, and social resources. Led by the education authorities, jointly with relevant industry associations, leading enterprises, and education experts, jointly develop and release standards for university-enterprise joint training programs, including curriculum standards, faculty standards (especially "dual-qualified" teacher standards), practical training base construction standards, and quality evaluation standards.

Encourage and support independent, authoritative third-party professional certification bodies to conduct objective and fair quality certification for voluntary university-enterprise cooperation projects (such as industry colleges, order-oriented classes). Credits from certified programs can be mutually recognized among alliance universities, and certificates obtained by students have higher value in the job market, thus forming a virtuous cycle of quality and value.

4.3 Sharing Policies – Breaking Down Resource Barriers and Promoting Two-Way Flow of Innovation Factors

Promoting the smooth flow and efficient allocation of resources, knowledge, and technology between universities and enterprises is the embodiment of deep integration.

It is recommended that local governments or leading industry associations take the lead in building regional or industry-specific public service platforms for industry-education integration. These platforms should have functions such as information release, resource matching, project cooperation, and data sharing, becoming the "information hub" and "resource supermarket" for university-enterprise cooperation.

Most crucially, through legally effective cooperation agreements, clearly define in advance the ownership, usage, and benefit distribution rules of intellectual property (such as jointly developed technology patents, co-built course resources, jointly developed software systems) generated during university-enterprise collaboration. Clear property rights definition is the "steadying pivot" for avoiding subsequent disputes, protecting the rights and interests of all cooperating parties, and stimulating collaborative innovation vitality.

5 Conclusion and Outlook

The wave of the Digital-Intelligent Era is surging forward, bringing unprecedented strategic opportunities and severe survival challenges for the transformation and development of private universities. Deepening the integration of industry and education and innovating educational models are no longer optional extras but core strategies concerning their right to survive and develop. Based on an in-depth analysis of the current dilemmas in industry-education integration in private universities, this paper has attempted to construct a systematic framework for an innovative pathway.

This study argues that for private universities to achieve a real breakthrough in digital-intelligent education, a trinity systematic reform is necessary: First, at the conceptual level, it is essential to establish the data-driven three-stage

synergistic education mechanism of "Demand Perception - Resource Adaptation - Quality Optimization," achieving a fundamental shift from experience-oriented to data-driven, and from standardized supply to personalized customization. Second, at the practical level, it is necessary to adhere to the guidance of dynamic job competency maps, reconstruct the modular curriculum system, and deeply integrate virtual simulation with real enterprise scenarios to create a new educational ecosystem integrating "learning-training-innovation." Finally, at the guarantee level, it is necessary to rely on the "Incentive - Certification - Sharing" trinity policy synergy to solve the institutional barriers to deep university-enterprise cooperation and create a favorable environment for sustainable development.

The discussion in this study remains a preliminary framework construction. Future research and practice can be further deepened in the following aspects: First, exploring deeper integration models of more advanced big data, AI, and blockchain technologies in educational scenarios; second, conducting in-depth comparative studies on the differentiated strategies and common patterns of digital-intelligent education pathways across different disciplines (e.g., engineering, business, humanities); third, establishing a set of scientific, dynamic, and operable evaluation indicator systems to accurately assess and continuously optimize the actual effectiveness of industry-education integrated education.

The path is long and winding, but perseverance will lead to the destination. It is believed that through continuous theoretical innovation, solid practical exploration, and strong institutional guarantees, private universities will surely find their positioning and highlight their characteristics within the higher education landscape of the Digital-Intelligent Era, making irreplaceable contributions to cultivating innovative, applied high-quality talents capable of undertaking the mission of national rejuvenation.

Funding

The 2025 Annual Research Project of the Liaoning Province Private Education Association on Educational Science: Innovative Research on the Digital and Intelligent Education Model of Industry-Education Integration in Private Colleges and Universities, (NO: LMJX2025207)

About the Author

Wenxiao Hu, holds a master's degree and works as an assistant professor. Her research focuses on green marketing and service marketing.

References

[1] Luo S . Multi-dimensional Exploration and Practice of Teaching Reform in Higher Vocational Colleges from the Perspective of School-Enterprise Cooperation and Integration of Industry and Education[J].Forum on Research and Innovation Management,2025,3(12).

[2] Fu P ,Huang C ,Sun D .Research on the Implementation Path of Industry-Education Integration from the Perspective of Educational Power[J]. Advances in Social Science and Culture,2025,7(5).

[3] Wang Q ,Zhao B .Research on the Training Mode of New Energy Professionals under the Background of Industry- Education Integration[J]. Education Reform and Development,2025,7(9):231-237.