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Research on the Cultivation System of Digital New-Quality Skilled Talents based on the Integration of Industry, Education, and Research: A Case Study of the Higher Vocational Business Data Analysis and Application Major

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Abstract: The rapid digital transformation and the emergence of "new quality productive forces" have intensified the demand for skilled talents with technical competence, innovative thinking, and interdisciplinary capability. However, higher vocational colleges in China still face major challenges in emerging majors such as Business Data Analysis and Application, including mismatches between talent supply and market needs, the absence of a systematic cultivation framework, curriculum–job misalignment, and short-term-focused evaluation mechanisms. To address these issues, this study proposes a talent cultivation model based on the integration of industry, education, and research, featuring the Position–Course–Competition–Certificate (PCCC) framework, which aligns curricula with job requirements, develops competency-based courses, embeds industry-recognized competitions, and links learning outcomes to professional qualifications, complemented by a long-term, multi-dimensional evaluation mechanism. Findings indicate that this model enhances graduates' job readiness and innovation ability, supports enterprise digital transformation, and offers scalable guidance for cultivating digital new-quality skilled talents, contributing to the construction of an education ecosystem aligned with the digital economy.

Keywords: Integration of Industry, Education, and Research, New Quality Productive Forces, Digital Talent Cultivation, Business Data Analysis, Position–Course–Competition–Certificate (PCCC) Framework.

1. Introduction

With the deepening of the scientific and technological revolution and industrial transformation, digital transformation has become a key driving force for the development of various industries. Against this backdrop, the concept of "new quality productive forces" has emerged, emphasizing the enhancement of the qualitative characteristics of productivity through the integration of intelligent and green technologies, thereby driving innovation in both industry and the economy. In 2023, General Secretary Xi Jinping pointed out that the development of "new quality productive forces" urgently requires a digital talent pool that possesses technical competence, innovative capacity, and interdisciplinary capability, particularly high-skilled professionals in fields such as data analysis and artificial intelligence. The cultivation of such a talent force has become an essential component in accelerating China's digital economy and social transformation.

However, despite the rapid pace of China's digital transformation and technological innovation, talent cultivation has not kept pace with enterprise demand. According to McKinsey's 2025 projection, China will face a shortage of over 14 million data professionals in the next five years. This reality highlights the urgent need for high-skilled digital talent among enterprises, while higher education institutions face significant challenges in preparing professionals who meet market requirements. At present, many higher vocational colleges have curriculum systems that diverge considerably from actual enterprise needs, resulting in low graduate employment rates and an inability to effectively satisfy industry demand for advanced technical personnel.

From a policy perspective, the government is actively promoting the cultivation of digital talent. In 2024, the Ministry of Human Resources and Social Security issued the Action Plan for Accelerating the Cultivation of Digital Talent (2024–2026), which explicitly called for deepening the integration of industry and education, fostering innovative talents suited to the digital economy, and promoting high-quality development (MOHRSS, 2024). The release of this policy provides important guidance for higher education institutions in cultivating digital talent, clarifying cultivation objectives, and requiring the education system to closely align with industrial development needs while promoting in-depth cooperation between enterprises and universities.

In summary, the cultivation of digital talent is in urgent need of reform. Promoting the deep integration of industry, education, and research to build a bridge between education and industrial needs has become a critical issue in current educational reform and talent development.

2. Current Situation and Problem Analysis

Based on field investigations and data analysis conducted by the research team, several prominent issues remain in the talent cultivation process for the Business Data Analysis and Application major at higher vocational colleges in China.

2.1. Market–Talent Gap

Although the demand for business data analysis professionals continues to grow and job categories are becoming increasingly specialized, graduates from current

higher vocational programs often fail to meet the actual hiring standards of enterprises. This mismatch manifests in the inability of students' acquired knowledge and skills to fully meet the comprehensive competencies required in the workplace, particularly in scenario-based applications of data processing, cross-departmental collaboration, and innovative problem-solving. Consequently, graduates' competitiveness in the job market is significantly constrained.

2.2. Fragmented and Non-Ecosystemic Cultivation Framework

As an emerging interdisciplinary field, Business Data Analysis and Application requires students not only to possess solid foundations in mathematics and computer science but also to have strong business acumen, analytical skills, and communication capabilities. However, most higher vocational colleges lack systematic top-level design and resource integration mechanisms in talent cultivation, making it difficult to establish an ecosystem that coordinates "curriculum–practice–research–industry" in a multi-chain, collaborative manner. While some institutions have introduced relevant programs, enterprise project integration, joint school–enterprise training bases, and the feedback of research outcomes into teaching remain fragmented and one-directional, lacking both systemic design and sustainability.

2.3. Curriculum–Job Misalignment

The current curriculum system shows a significant disconnect from actual job demands. On the one hand, there is a temporal and content gap between the skills taught in school and those required by enterprises, forcing graduates to undergo lengthy secondary training before fully adapting to their positions. On the other hand, the curriculum lacks skill training and comprehensive project-based practice grounded in real business scenarios, and participation in skills competitions is insufficient. As a result, students lose valuable opportunities to test and improve their abilities in near-real work environments. Moreover, the curriculum does not adequately align with professional certification requirements, depriving students of pathways to obtain recognized qualifications and thereby placing them at a disadvantage in the job market. In addition, the curriculum design fails to systematically incorporate the creativity, technical competence, and interdisciplinary capabilities necessary for cultivating "new quality" skilled talents, deviating from national strategic requirements for new quality productive forces and lacking forward-looking planning.

2.4. Short-Term and Narrow Evaluation Mechanisms

Current evaluation systems for talent cultivation focus predominantly on short-term indicators such as academic performance during school, mastery of short-term skills, or employment rate upon graduation. There is a lack of longitudinal, multi-dimensional tracking of graduates' career development, lifelong learning ability, and contributions to society. The existing evaluation framework suffers from narrow criteria, low participation from industry enterprises, and incomplete feedback and improvement mechanisms, making it difficult to form a continuous optimization loop in talent cultivation. Such short-term, fragmented evaluation methods are inadequate for comprehensively assessing and enhancing the quality of talent cultivation in the Business Data Analysis and Application major at higher vocational colleges.

3. Proposed Solution

In May 2022, the newly revised Vocational Education Law of the People's Republic of China explicitly stipulated that vocational education should adhere to the principle of integrating industry with education[1]. In October 2022, the report of the 20th National Congress of the Communist Party of China emphasized the advancement of the integration of vocational and general education, the integration of industry and education, and the integration of science and education, once again clarifying the developmental direction of vocational education. These national policies have provided clear guidance and new opportunities for deepening industry–education integration and promoting high-quality development in vocational education. Against this backdrop of fostering "new-quality productive forces," this project proposes a talent cultivation system based on the integration of industry, education, and research to address the aforementioned challenges faced by higher vocational colleges in cultivating digital new-quality skilled talents. The specific reform strategies are outlined as follows.

3.1. Lack of Systematic and Ecosystem-Oriented Talent Cultivation

Proposed Solution: Establish a diversified and innovative talent cultivation model integrating industry, education, and research (IER model). This model should leverage enterprise resources to introduce real projects into the classroom, promote the joint construction of training bases between schools and enterprises, strengthen interdisciplinary collaboration, and create a closed-loop system where research outcomes feed back into both teaching and industrial practice.

Reform Measures: Build a digital enterprise–college cooperation platform, establish joint training bases, integrate authentic enterprise cases into the curriculum, strengthen the involvement of industry mentors, and develop an interconnected "position–course–competition–certificate" (PCCC) ecosystem to ensure alignment with industry standards.

3.2. Curriculum Misaligned with Job Requirements

Proposed Solution: Optimize the talent cultivation pathway by reconstructing the curriculum to be demand-driven, modular, and competency-based. Ensure direct alignment with actual job roles and integrate industry-recognized certifications alongside competition-based experiential learning.

Reform Measures: Redesign the curriculum to center on workplace competencies, integrate multi-skill learning modules, embed industry skill competitions, align with national occupational standards, and ensure a "teaching–assessment–certification" linkage to enhance employability[2].

3.3. Limited Graduate Skills and Practical Ability

Proposed Solution: Establish a multi-dimensional, long-term evaluation system to track graduates' professional development, entrepreneurship, and societal contributions. Promote lifelong learning and strengthen graduates' adaptability to rapid technological change.

Reform Measures: Develop comprehensive evaluation metrics covering in-school performance, employment quality, career progression, innovation capacity, and social contribution. Encourage students to engage in internships, innovation projects, and entrepreneurship training.

3.4. Mismatch between Talent Supply and Market Demand

Proposed Solution: Create a dynamic adjustment mechanism for talent cultivation plans based on real-time industry demand analysis. Increase industry involvement in curriculum development and establish effective feedback channels between employers and educational institutions.

Reform Measures: Implement a big data monitoring system for talent demand, conduct periodic enterprise needs surveys, update curriculum content and skill requirements dynamically, and strengthen regional industry–education cooperation to improve alignment with market needs.

4. Implementation Pathway

4.1. Top-Level Design: Talent Cultivation System for Digital New-Quality Skilled Talents Based on Industry–Education–Research Integration

In the current talent cultivation system for the Business Data Analysis and Application major, industrial, educational, and research resources remain largely independent, without forming an integrated industry–education–research framework around talent cultivation. This disconnection leaves students confined to the "ivory tower," unable to align with the practical requirements of industry positions. Given the hands-on and application-oriented nature of business data analysis talent demands, the existing cultivation model is evidently inadequate for producing digital new-quality skilled professionals.

To address this, the project team has explored industry–education collaborative education in depth, integrating the strengths and interests of enterprises, educational institutions, and research organizations. With a goal of achieving mutual benefit, a deeply integrated and mutually supportive talent cultivation system has been developed, as illustrated in Figure 1. This system ultimately meets enterprise staffing needs, benefits industry, and promotes the integration of science and education, thereby forming a "positive cycle" of industry–education–research integration.

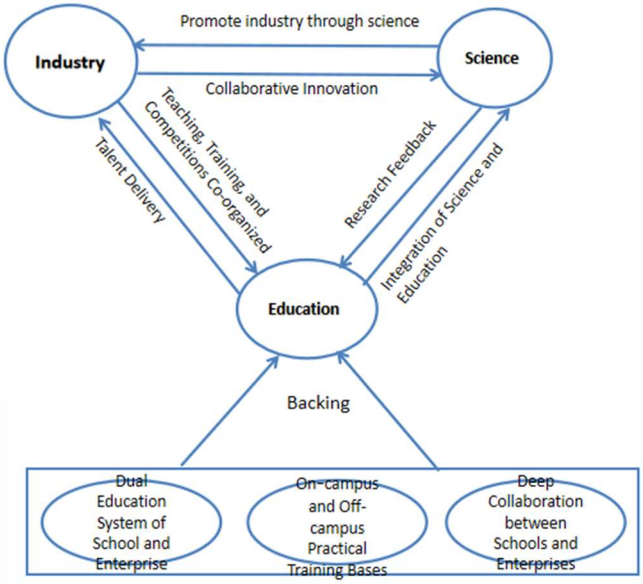

Figure 1. Talent cultivation system based on industry–education–research integration

4.2. Mid-Level Implementation: Position–Course–Competition–Certificate (PCCC) Curriculum System with "New-Quality" Attributes

Under the framework of industry–education integration and science–education convergence, the proposed curriculum system is guided by "industry" and centered on "education," forming the PCCC structure.

4.2.1. Position–Course Integration

Job responsibilities are transformed into curriculum content. For the Business Data Analysis and Application major, relevant job roles include data analysis specialist, data analyst, platform operations specialist, e-commerce operations assistant, and e-commerce data analysis specialist. Theoretical courses are categorized into foundational, core, and advanced professional courses, while practical courses are divided into foundational skills, core skills, and comprehensive skills training.

4.2.2. Course–Competition Integration

A multi-tier competition framework has been established, covering campus-level, provincial-level, and national-level competitions. These competitions progressively develop students from single-skill proficiency to integrated skills and finally to innovative thinking. Competitions include business data analysis, e-commerce competitions, cross-border e-commerce competitions, statistical survey design competitions, and university economic management case

competitions. Competition content is embedded into training modules, such as integrating e-commerce data analysis training into business data analysis competitions, and innovation and entrepreneurship practice into cross-border e-commerce competitions[3]. Second-classroom activities are organized in the form of interest groups and clubs to prepare students for higher-level competitions.

4.2.3. Course–Certificate Integration

National occupational skill standards are embedded into course standards, and training modules are integrated into the overall curriculum. Selected certifications include the Business Data Analyst Certificate and the E-Commerce Data Analysis 1+X Vocational Skill Certificate[4]. Related knowledge and skills are incorporated into both theoretical and practical courses.

4.2.4. Integration of "New-Quality" Attributes

The curriculum is fine-tuned to reflect the requirements for new-quality skilled talents-creativity and transformative thinking, systemic and interdisciplinary thinking, and technological adaptability[5]. "Creativity and transformative capability" is embedded in innovation and entrepreneurship practice courses, "technical capability" is developed through industry-specific application courses, and "interdisciplinary capability" is fostered in comprehensive skills training and competitions.

Through careful curriculum design, the cultivation of new-quality skilled talents not only meets basic standards but also addresses diverse and individualized developmental needs, enhancing students' social adaptability and career orientation[6].

4.3. Grassroots Practice: Processing Workflow for Digital New-Quality Skilled Talents

The cultivation process is designed as a staged "production line" model:

Stage One: In fully equipped industry–education integration training workshops, students learn foundational and core theoretical and practical courses through project-based teaching, integrated training, and real enterprise case studies, achieving mastery of basic knowledge and skills.

Stage Two: Students undergo assessment for vocational skill certification-akin to a "quality inspection" stage. Students who fail the assessment re-enter the cultivation process for further training. Those who pass proceed to advanced workshops. Students with standard pass results enter industry–education integration enhancement workshops focusing on industry modules, comprehensive training, enterprise projects, and studio work. Outstanding students enter science–education integration enhancement workshops to participate in competitions, innovation projects, entrepreneurship incubation, and research activities, thereby enhancing innovation and comprehensive capabilities.

Stage Three: Students in industry–education workshops are assessed on job-specific skills, while those in science–education workshops are evaluated on innovation, entrepreneurship, and comprehensive abilities. High-achieving students with entrepreneurial aspirations are assigned to industry–innovation internship workshops for entrepreneurship training, while others are placed in enterprise internships or choose their own employers.

Final Product: Graduates undergo a final comprehensive evaluation. Those meeting the quality standards receive graduation certificates; those not meeting the standards undergo supplementary training or examinations. The result is the production of high-quality, market-ready digital new-quality skilled talents.

4.4. Evaluation and Continuous Improvement: Talent Quality Assessment System

At the initial stage of the cultivation process, information on industry talent demand and student profiles is collected and analyzed. During the cultivation process, professional standards and status data are systematically compiled, and comprehensive teaching data-covering courses, instructors, and students-are gathered to build a professional big data evaluation system. This enables a more holistic understanding of students' learning and teaching quality, facilitating information-based management of the talent cultivation process.

At the quality assessment stage, graduate career trajectories and societal feedback are continuously tracked. Data analysis guides evaluation, diagnosis, and targeted improvement, forming a positive feedback loop. The system also provides instructors with actionable insights to refine teaching content and methods, thereby enhancing instructional quality.

5. Conclusion and Outlook

5.1. Impact on Practice

The proposed talent cultivation system, based on the integration of industry, education, and research (IER), has significant social and economic implications. For enterprises, deeper integration enables better cooperation with higher education institutions, improving the quality and employment rates of graduates. In fields like data analysis and AI, companies can cultivate high-quality technical talent, accelerating digital transformation and enhancing competitiveness[7]. For example, large companies such as Alibaba and Huawei have developed deep collaborations with universities, facilitating joint talent development[8]. These partnerships allow enterprises to directly influence curriculum and provide real-time industry feedback, improving educational content and approaches.

At the societal level, this model will drive digital economy development. More high-quality digital new-quality skilled talents will elevate national technological and innovative capacity, supporting economic development and job creation. Furthermore, the system fosters innovation, promoting the integration of traditional and emerging industries, and contributing to industrial upgrades.

For students, this approach enhances practical skills and innovation abilities through real-world projects, making them job-ready upon graduation and improving career prospects. For governments, supporting IER integration accelerates high-skill talent development, addresses talent shortages, and supports digital economy growth.

5.2. Future Outlook

5.2.1. Further Development of the IER Integration Model

While the proposed IER integration model addresses the gap between higher education and industry needs, further refinement is required. Future developments may include:

(1)Expanding Cross-Industry Integration:The current model is focused on specific sectors such as digital economy and e-commerce. Future efforts should involve traditional industries like manufacturing, agriculture, and services,

especially in their digital transformation, where there is a growing demand for technical talent. A cross-industry platform for integration should be developed to promote technology and vocational education.

(2)Deepening Industry Participation: Companies can further contribute by co-designing curricula, customizing training plans, and participating in teaching evaluations. This deeper collaboration between enterprises and universities can enhance the effectiveness and foresight of talent development.

5.2.2. Optimizing Talent Cultivation Systems with Emerging Technologies

With advancements in AI, big data, and blockchain, traditional education models face unprecedented challenges. To meet future demands, digital new-quality skilled talents must master interdisciplinary knowledge and skills. Key developments in the system may include:

(1)Utilizing Big Data and AI in Education:Data analytics can help institutions assess students' learning progress, mastery of knowledge, and employment prospects, facilitating personalized learning. AI can provide customized learning paths, improving efficiency and quality through virtual labs and intelligent tutoring systems.

(2)Updating Courses with Cutting-Edge Technologies:As technology evolves rapidly, regular updates to the curriculum are necessary to meet industry needs. Integrating emerging technologies such as big data analysis, blockchain, and cloud computing into talent training programs will enhance students' adaptability to digital transformation[9].

(3)Promoting Lifelong Learning:Given rapid technological change, formal education alone cannot meet future workforce needs. Governments and universities should foster a lifelong learning culture, creating flexible continuing education and vocational training systems to help workers upskill throughout their careers, promoting digital literacy and technological capabilities.

5.3. Policy Recommendations

At the policy level, the government should strengthen support for the IER integration model by aligning educational, industrial, and technological policies. Specific recommendations include:

(1)Supporting Industry–Education Integration:The government should introduce more policies to incentivize enterprise participation in talent cultivation, such as tax breaks and R&D funding, to reduce the cost and risk for businesses in educational cooperation.

(2)Encouraging Cross-Industry Talent Collaboration:The government should promote cooperation between sectors, encouraging the widespread application of cross-industry technologies like AI and big data, and facilitating the joint development of digital new-quality skilled talents across industries.

(3)Enhancing International Cooperation and Exchange:In a globalized context, talent development should emphasize international perspectives. The government can enhance international collaboration, drawing on advanced educational practices from abroad, to cultivate skilled talent with a global outlook for China's digital transformation.

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