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Research on New Models of Cooperation Between Vocational Education and Enterprises from the Perspective of Industry-Education Integration

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Abstract: Under the background of the new economic landscape and technological transformation, vocational education faces the challenge of a mismatch between talent cultivation and industrial demand. Deep enterprise involvement has become a crucial approach to improving education quality. Based on the theory of industry-education integration, this study adopts a mixed-methods approach, combining surveys, interviews, and case analyses to systematically explore new models of cooperation between vocational colleges and enterprises. The research finds that building a multi-stakeholder, benefit-sharing, and practice-oriented school-enterprise cooperation mechanism can optimize talent training structures, enhance employment alignment, and provide valuable references for policy formulation and practical implementation.

Keywords: Industry-education integration; Vocational education; School-enterprise cooperation; Collaborative mechanism; Talent cultivation

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1. Introduction

1.1. Research status at home and abroad

In recent years, research in the field of UAV (Unmanned Aerial Vehicle) target detection has developed rapidly, driven by deep learning technologies. In parallel, China's vocational education reform has been deepening, particularly since the release of the Implementation Plan for National Vocational Education Reform (commonly referred to as the "20 Vocational Articles"), which has institutionalized the concept of industry-education integration. Studies show that traditional school-enterprise cooperation models are often superficial and formalistic, failing to effectively support high-quality talent development [1].Some scholars advocate for a deeper implementation of the "dual system" cooperation mechanism to reinforce the central role of enterprises in talent cultivation [2]. Moreover, with the promulgation of the Vocational Education Law (2022Revision), legal protection

for enterprise participation in vocational education has been strengthened, although practical challenges remain, such as fragmented policies and insufficient incentive mechanisms [3].

(1) German dual system: Enterprise-led apprenticeship and standardized certification system

Germany's dual system is a global model for industry-education integration, with enterprises deeply involved in the entire vocational education process. Students attend vocational schools for theoretical study while spending 3-4 days a week in enterprises for practical training. Companies bear about 70% of the training costs and follow standardized skill certification as mandated by the Federal Vocational Training Act. Leading companies like Volkswagen and Siemens use this model to cultivate highly skilled workers, underpinning the competitiveness of German manufacturing. The system's success lies in its legal framework and the coordination role played by industry unions [4–6].

(2) U.S. community colleges: Modular curriculum development based on regional industrial needs

Community colleges in the United States are designed to serve regional economies and achieve industry-education integration through cooperative education programs (Co-op). For example, Michigan's community colleges collaborate with automotive manufacturers to co-develop modular courses, enabling students to alternate between school and internships each semester. Course content is dynamically adjusted to align with technological updates in industries, such as electric vehicle maintenance. This approach is highly flexible but relies heavily on voluntary enterprise participation and lacks systemic policy support [7,8].

(3) Domestic exploration: Modern apprenticeship, industry colleges, and new corporate apprenticeship models

(A) Modern apprenticeship: Inspired by the German model. For instance, Zhejiang Institute of Mechanical and Electrical Engineering partners with Geely Group, where students have dual identities as "students" and "apprentices." However, the approach faces challenges such as weak enterprise motivation and imbalance in mentor-apprentice ratios [9].

(B) Industry colleges: Examples include Shenzhen Polytechnics collaboration with Huawei to establish the "Huawei ICT Academy," jointly developing courses and building training facilities. Nevertheless, some industry colleges exist in name only, lacking mechanisms for converting educational efforts into tangible outcomes [10].

(C) New corporate apprenticeship: Supported by government subsidies to promote on-the-job training in enterprises. However, small and medium-sized enterprises struggle with resource constraints, and training content often diverges from real enterprise needs [11].

1.2. Theoretical foundations of industry-education integration

The concept of "industry-education integration" was first proposed by Chinese scholars, emphasizing the deep integration of the education and industrial chains, and promoting synergy between education and production, as well as learning and working [12]. Theoretically, it draws from systems synergy theory, resource-sharing theory, and interest community theory, highlighting the collaborative efforts of schools, enterprises, and governments to form a "co-educational synergy" mechanism [13]. In recent years, this concept has evolved from policy advocacy to institutional construction and mechanism improvement, becoming a key path for achieving high-quality vocational education development.

Scholars have explored practical pathways for industry-education integration from multiple dimensions. First, in terms of cooperation mechanisms, they have proposed the "Four Co-construction Mechanism" co-

developing majors, co-training faculty, co-building platforms, and co-evaluating outcomes [14]. Second, regarding governance structures, they recommend mixed-ownership educational models to enable enterprises to act as "investors," "decision-makers," and "participants." Third, for institutional guarantees, scholars suggest establishing stable financial support systems, tax incentives, and third-party evaluation mechanisms [15].

2. Theoretical model and research methodology

2.1. Theoretical model based on industry-education integration

This study constructs a theoretical model of industry-education integration centered on "bidirectional school-enterprise interaction-benefit sharing-risk co-bearing." The model draws primarily from system synergy theory and resource dependence theory, emphasizing the dynamic relationship and structural coordination between schools and enterprises throughout the collaboration process.

Specifically, school-enterprise cooperation is not merely about resource complementarity but a deep collaborative process. Within this framework, schools contribute educational resources, talent reserves, and research capabilities, while enterprises offer technical standards, real-world scenarios, and job demands. Both parties collaboratively engage in a closed-loop mechanism of "co-designing curricula, co-implementing teaching, co-evaluating outcomes" in the talent cultivation process. Additionally, the establishment of benefit-sharing mechanisms (e.g., outcome transformation, joint brand building, and resource sharing) and risk-sharing mechanisms (e.g., proportional investment agreements, legal contracts, and government incentive guidance) enhances the stability and sustainability of the partnership.

From a supply-demand matching perspective, this study further introduces a three-dimensional dynamic relationship model of education supply-enterprise demand-industry evolution. In this model, industrial structure upgrading and technological transformation are the primary driving forces, generating new demands for compound technical and skilled personnel from enterprises. This, in turn, prompts timely adjustments in the vocational education system in terms of program offerings, curriculum structure, and teaching content.

2.2. Research methodology

This study adopts a mixed research method combining both qualitative and quantitative approaches to enhance the practical relevance and scientific rigor of the theoretical exploration.

In terms of qualitative research, the expert interview method was employed by conducting semi-structured in-depth interviews with 12 experts, including officials from government education authorities, vocational college administrators, and HR managers from enterprises. The aim was to identify bottlenecks in implementation and innovative practices in industry-education integration. Additionally, the case study method was used to examine five joint school-enterprise programs in Zhejiang, Guangdong, and Sichuan. These cases were analyzed for their practical experiences in "co-developing majors, co-training faculty, co-building training platforms, and co-assessing talent" allowing for the extraction of key features of new cooperation models.

In terms of quantitative research, a structured questionnaire was designed around four dimensions: enterprise participation, collaborative governance mechanisms, satisfaction with industry-education synergy, and the quality of talent output. The questionnaire used a five-point Likert scale and was distributed both online and offline. A total of 600 questionnaires were distributed, with 527 valid responses collected, yielding a response rate of 87.8%. Data analysis was conducted using SPSS 26.0 and AMOS 24.0 software to perform descriptive statistics, correlation analysis, and structural equation modeling (SEM) to test the research hypotheses and theoretical

framework.

3. Exploration of new models for school-enterprise cooperation and practical pathways

Driven by the new quality productive forces, vocational education and enterprise cooperation are now showing a development trend characterized by "deeper synergy, mechanism innovation, and value co-creation." Based on the aforementioned theoretical analysis and empirical research, this paper proposes a new school-enterprise cooperation model that integrates multi-stakeholder participation, resource sharing, and goal collaboration. The model is systematically discussed in terms of its constituent elements, implementation pathways and collaborative mechanisms.

3.1. Constituent elements of the new school-enterprise cooperation model

(1) Clarity of cooperation goals

The new cooperation model is centered on the core goals of joint talent cultivation, resource sharing, and co-creation of outcomes, no longer limited to the traditional functions of "order-based training" or "internship and employment delivery." Both parties must sign strategic cooperation agreements in the early stages, clearly defining medium- and long-term talent supply and demand plans, as well as professional development goals. This ensures that enterprise development strategies and professional training plans are organically aligned.

(2) Synergy in core mechanisms

The model emphasizes establishing a collaborative governance mechanism between schools and enterprises, such as forming joint councils or industry-education integration committees to enable shared decision-making, co-management of processes, and mutual evaluation of results. Particularly in course standardization, practice organization, and quality assessment systems, this model encourages enterprises to transition from being "supporting participants" to "core participants."

(3) Systematic resource integration and sharing

The cooperation model promotes resource sharing between schools and enterprises along three key dimensions: (A) Spatial resource sharing: Co-building and sharing training bases, enterprise workshops, and virtual simulation labs; (B) Human resource interchange: Industry experts are invited as part-time teachers, while faculty members are sent to enterprises for training, forming "dual-teacher" teams; (C) Information resource connectivity: Digital platforms are developed to interconnect course resources, student data, and job demand information. This model creates a sustainable and scalable cooperation ecosystem by integrating systems, personnel, facilities, and information in a four-dimensional way.

3.2. Implementation pathways and operational processes

For the new model to be implemented, a systematic process design and executable pathway are necessary. This paper proposes the following practical pathways:

(1) Co-developing talent training plans and curriculum systems

Both parties, based on job competency models and vocational skill standards, collaboratively design talent training plans and implement "modular teaching + project-based implementation + enterprise case integration" as a teaching reform. For example, real enterprise tasks are incorporated as course projects,

and job standards are transformed into course assessment criteria to achieve an integrated model of "teaching, learning, doing, and evaluating".

(2) Establishing dual-teacher teams and high-level training bases

Schools select professional teachers to undergo on-the-job training in enterprises, while enterprises send senior engineers or frontline managers to serve as part-time mentors, forming a joint teaching team. Additionally, schools and enterprises co-establish school-based factories or factory-based schools, forming an "industry-academia-research integration platform" that combines teaching, research, and training, thus enhancing students' technical application and innovation capabilities.

(3) Deep enterprise involvement in course design, practical teaching, and skill assessment

Enterprises should not only participate in course development but also be key participants in practical teaching and student evaluation. Specific segments, such as "enterprise workshops" and "school-enterprise joint training weeks" can be introduced in the curriculum structure to implement real-world project-oriented teaching. Enterprise mentors should be involved in student process evaluation and outcome validation, improving the job relevance and authenticity of the assessments.

3.3. Multi-stakeholder collaborative innovation mechanism

(1) Government guidance, school reform, and active enterprise participation synergy

Setting development directions and standards through policy documents (e.g., Vocational Education Law and National Industry-Education Integration Pilot Program), establishing mechanisms for selecting industry-education integration enterprises, funding mechanisms, and performance evaluation systems. School Reform: Promoting governance structure adjustments, innovating faculty management systems, and developing school-based teaching materials. Enterprise Participation: Stimulating enterprises' intrinsic motivation to participate in talent development, such as incorporating cooperative outcomes into enterprise talent development plans, social responsibility evaluations, or enjoying incentives like tax reductions and preferential access to land. These three parties collaborate to form a closed-loop interactive system, establishing institutionalized cooperation pathways.

(2) Designing benefit distribution, risk sharing, and incentive mechanisms

The new school-enterprise cooperation model must address issues of benefit allocation and risk control in long-term cooperation. This paper proposes the following mechanism designs: (A) Benefit-sharing mechanism: Defined revenue distribution for the transformation of teaching outcomes, student employment placement, and the joint development of technological achievements; (B) Risk-sharing mechanism: Establishing a risk-sharing mechanism and exit strategy to prevent unilateral damage due to market fluctuations or unequal cooperation; (C) Incentive mechanism: Includes performance-based funding (for schools), priority talent procurement (for enterprises), achievement recognition (for faculty), and project funding (for governments), creating a multidimensional incentive closed-loop.

4. Impact mechanisms and benefit evaluation

The implementation of the new school-enterprise cooperation model in the context of industry-education integration is profoundly changing the talent cultivation model in vocational education, with widespread and far-reaching impacts on student quality, enterprise development, and regional economies. This new model achieves precise alignment between educational supply and industrial demand by involving enterprises deeply in the entire

talent cultivation process.

In terms of talent development quality, the jointly developed curriculum system and practical platforms have effectively enhanced students' job adaptability and technical skills, strengthening the connection between theoretical knowledge and practical work. By completing practical tasks in real production environments, students accelerate the process of skill transformation, shortening the transition period from "student" to "professional." This approach also boosts their sense of professional identity and employment compatibility.

From the enterprise perspective, participating in vocational education cooperation not only helps enterprises access high-quality technical talent and reduces recruitment and training costs but also promotes the enhancement of their technological innovation capabilities. Through the establishment of joint R&D platforms with schools, enterprises can leverage academic research strengths to conduct applied technology development, improving the efficiency of converting results into products. Furthermore, enterprises responsibility and brand image enhancement are realized through the cooperation, further strengthening their leadership role in the regional industrial ecosystem.

At the regional level, the deep integration of vocational education and industry injects new momentum into local economic development. By utilizing industrial foundations and vocational school resources, a collaborative system for "education—talent-industry" integration has been formed, driving talent aggregation and industrial upgrading within the region. School-enterprise cooperation has facilitated technology diffusion, knowledge sharing, and the extension of the innovation chain, effectively supporting the regional economy's transition from an element-driven to an innovation-driven growth model.

Although the new school-enterprise cooperation model has significant institutional benefits and practical outcomes, there are still certain risks and challenges in its implementation. First, differences in goal orientation, interests, and organizational logic between schools and enterprises may lead to reduced cooperation efficiency. Second, some cooperation models suffer from overly strong enterprise leadership or formalism, which affects the realization of educational objectives. Additionally, students face dual challenges of labour rights protection and teaching quality control during their enterprise internships, posing potential threats to the sustainability of the model. Therefore, it is necessary to establish a systematic evaluation mechanism and risk prevention and control system, ensuring the scientific and institutional development of the cooperation model through a clear definition of cooperative responsibilities, standardizing cooperation processes, and improving supervision and assessment mechanisms, to ensure the high-quality development of industry-education integration.

5. Conclusion

This paper systematically explores the new model of school-enterprise cooperation from the perspective of industry-education integration. It constructs a collaborative cooperation mechanism centered on government guidance, school reform, and enterprise participation, and proposes an implementation pathway involving multi-stakeholder interaction, benefit sharing, risk co-bearing, and incentive linkage. The study shows that the new model has significant effectiveness in enhancing the quality of talent cultivation, promoting curriculum system optimization, and deepening practical teaching. It also positively contributes to increasing the adaptability of vocational education and its ability to serve regional economic development. At the same time, the paper points out that the current cooperation still faces challenges, including insufficient depth of cooperation, uneven resource allocation, and inadequate institutional guarantees. In the future, efforts should be made to further expand the collaborative cooperation mechanism supported by digital tools, improve policy support and performance

evaluation systems, promote deeper integration between vocational education and industrial development, and build an efficient and sustainable talent cultivation ecosystem.

Disclosure statement

The author declares no conflict of interest.

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