International Journal of Management Science Research, Vol.9, Issue 2, (Feb) 2026
ISSN 2536-605X
DOI: 10.53469/ijomsr.2026.09(02).02

Research on the Coupling and Coordinated Development of Higher Vocational Education and New Quality Productivity Forces in Henan Province

Limin Wang, Lejie Yang, Qingfeng Wang

School of Economics and Management, Zhongyuan University of Technology, Zhengzhou 450007, China
**Correspondence Author*

Abstract: ***Using data from Henan Province from 2010 to 2023 as samples, this study constructs evaluation systems for Higher Vocational Education (HVE) and New Quality Productive Forces (NQPF) based on the CIPP model and the theory of NQPF, respectively. It then adopts the Entropy Method to calculate the comprehensive indices of both, and employs the Coupling Coordination Degree Model to assess the level of synergy. The study shows that the development of HVE and NQPF in Henan Province presents significant characteristics of synergistic mutual promotion and system coupling. Their relationship has shifted from extreme imbalance in 2010 to high-quality coordination in 2023, achieving a qualitative change from initial synergy to deep integration, and from quantitative adaptation of elements to innovation adaptation.***

Keywords: Higher Vocational Education; New Quality Productive Forces; Coupling Coordination Degree.

1. INTRODUCTION

Faced with the new landscape of global technological competition and the profound restructuring of the international industrial pattern, General Secretary Xi Jinping proposed the groundbreaking theoretical framework of New Quality Productive Forces (NQPF), emphasizing the need to "foster a sound cycle of education, science and technology, and talent." This statement profoundly elucidates the strategic supporting role of education in cultivating NQPF and reveals the mutually reinforcing mechanism of their deep integration. Education injects momentum into NQPF through talent supply and knowledge innovation, while NQPF, in turn, drives the structural adjustment of the education system through technological revolution and industrial transformation, forming a dynamic two-way interaction. As a type of education closely aligned with industrial development, Higher Vocational Education (HVE)-with its inherent attribute of industry-education integration-has become a crucial carrier for the development of NQPF. Against the backdrop of economic transformation and upgrading, increasingly driven by scientific and technological innovation, and particularly amid the macro trend of NQPF-driven changes in production methods, HVE, as an important bridge connecting talent supply and industrial demand, its coupling coordination with the development of NQPF directly affects the high-quality development of regional economies and societies. Taking Henan Province as a case study, this paper systematically analyzes the coupling coordination relationship between HVE and NQPF, with the aim of providing insights and references for achieving high-quality socioeconomic development in the region.

2. COUPLING MECHANISM BETWEEN HVE AND NQPF

NQPF are an advanced form of productive forces driven primarily by scientific and technological innovation, with new types of laborers, innovative means of labor, and new subjects of labor as their basic elements, and high-quality development as their goal [1]. As a type of education directly aligned with industrial demands, HVE has a precise matching relationship of "supply-demand" two-way interaction with the element composition of NQPF in terms of its functional positioning.

Firstly, HVE precisely aligns with the requirements of NQPF for new types of laborers through talent cultivation. As the dynamic creative subjects of production, new types of laborers need to possess high educational attainment, strong learning abilities, and cross-disciplinary integration capabilities [2]. This characteristic determines that the demand for laborers under NQPF is shifting from "quantity-oriented" to "quality-oriented," with an urgent need for high-caliber talents equipped with technological innovation, digital literacy, and cross-domain collaboration

skills [3]. To address this, HVE has made adaptations in three aspects: First, in terms of scale and structure, it dynamically adjusts and expands enrollment in emerging majors such as intelligent manufacturing and digital economy according to the needs of regional NQPF-related industrial positions, ensuring a balance between talent supply and demand. Second, in terms of educational investment, it increases the proportion of practical teaching, focusing on strengthening students' hands-on abilities, innovative thinking, and cross-domain problem-solving skills through measures like building high-level training bases, introducing enterprise mentors, and implementing the "Post-Course-Competition-Certificate" integrated education model. Third, in terms of achievement transformation, it encourages students to participate in technological improvements and innovations through graduation designs, real enterprise projects, etc., enabling them to master cutting-edge technologies and quickly adapt to production needs. This interaction of "demand driving supply and supply creating demand" makes HVE the main front for cultivating new types of laborers, providing sustained high-quality talent support for the development of NQPF.

Secondly, HVE synergistically supports the intelligent, digital, and green upgrading of new forms of labor materials within NQPF through its technical service functions [4]. Leveraging training bases and industry-education integration platforms, higher vocational institutions collaborate with enterprises to establish practical training centers such as digital factories and intelligent production lines. These facilities not only provide students with hands-on environments to operate smart equipment and learn cutting-edge processes but also utilize real-world enterprise data to ensure that training content evolves in sync with technological advancements [5]. Meanwhile, institutions employ platforms like technology R&D centers and enterprise workstations to conduct joint research on actual technical pain points faced by businesses, delivering immediately applicable technical solutions. This "education-enterprise" synergy mechanism enhances the intelligent level of labor materials while strengthening the social service capacity of HVE [6], thereby serving as a critical technological accelerator for transforming traditional labor materials into new qualitative forms.

Finally, HVE promotes the expansion of new subjects of labor through applied research and the commercialization of innovative outcomes. NQPF rely on scientific and technological innovation to develop new materials, new energy, and new data, thereby breaking through the limitations of traditional labor objects. With its applied research characteristics, HVE serves as a bridge linking science and technology with production. On one hand, higher vocational institutions focus on solving practical problems for enterprises through technical platforms, accelerating the commercialization of research findings. On the other hand, they integrate cutting-edge industrial cases into teaching, cultivating students' ability to participate in innovation and forming a virtuous cycle of "talent-driven innovation and innovation-expanded objects."

3. RESEARCH DESIGN

3.1 Comprehensive Evaluation Indicator System for HVE

Building on and integrating relevant research findings and practical experiences [7-8], this paper constructs a comprehensive indicator system for evaluating the development of HVE based on the CIPP model. The system captures the full picture of HVE development from the macro to the micro level, specifically comprising four core criterion layers: scale, input, quality, and outcomes. Among these, scale serves as the foundation for HVE development, measuring the size and coverage capacity of education; input acts as the guarantee for development, reflecting the intensity of resource allocation and the support of conditions; quality constitutes the core of development, concerning the educational process and connotative development; and outcomes represent the goal of development, reflecting the final output and social contribution of education. The entire evaluation indicator system is refined into 16 specific indicators (see Table 1 below), aiming to provide an accurate portrayal of the development status of HVE in Henan Province through objective data.

Table 1: Comprehensive Evaluation Indicator System for the Development Level of HVE in Henan Province

Target Layer	Criterion Layer	Indicator Layer	Weight Coefficient (%)
Development Level of HVE	Scale (22.00%)	Number of Higher Vocational Colleges (units)	4.5090
		Number of Enrolled Students (persons)	11.4056
		Annual Enrollment (persons)	6.0820
	Input (27.42%)	Per Student Educational Expenditure (yuan)	4.9910
		Total Number of Full - time Teachers (10,000 persons)	6.0498
		Per Student Teaching Instrument and Equipment Value (yuan)	5.3864
		Per Student School Building Floor Area (square meters)	7.3345

		Per Student Book Quantity (volumes)	3.6557
	Quality (30.82%)	Number of Full - time Teachers with Senior Professional Titles or Above (10,000 persons)	4.6968
		Student - to - Teacher Ratio(%)	5.5049
		Number of Higher Vocational Enrolled Students per 100,000 Population (persons)	11.3042
		Number of Valid Invention Patents (items)	9.3156
	Achievements (19.76%)	Number of Graduates (persons)	11.6014
		Number of Persons Obtaining Certificates via Vocational Skills Appraisal (units)	4.2283
		Proportion of Employed Persons with Junior College Education in Employed Persons (%)	3.9347

Note: The student-teacher ratio indicator is a negative indicator, and the rest are all positive indicators.

3.2 Comprehensive Evaluation Indicator System for NQPF

Marxist theory of productive forces posits that productive forces are not static; rather, they undergo continuous dynamic development and evolution alongside advances in science and technology. New-quality laborers, as the main agents of value creation, have their capabilities, qualities, and consciousness concretized through a multi-dimensional indicator system encompassing laborer skills, labor productivity, and laborer awareness [9].New-quality subjects of labor focus on the objects of labor action, covering the construction of industrial systems and the transformation of the natural environment. This paper measures new-quality subjects of labor from two aspects—new-quality industries and ecological environments—aiming to reflect a new paradigm of green and sustainable development. New-quality instruments of labor are divided into tangible and intangible categories. Tangible instruments of labor refer to material means of production, while intangible instruments of labor center on technological innovation and digitalization levels [10], reflecting the development degree of new-quality productive forces in terms of innovation, digitalization, etc. They are integrated with tangible instruments of labor to jointly drive the development of NQPF. Based on the connotation and characteristics of NQPF [11-12], this paper constructs a comprehensive evaluation indicator system comprising three dimensions: laborers, subjects of labor, and instruments of labor. Specific indicators are shown in Table 2.

Table 2: Comprehensive Evaluation Index System for NQPF

Target Layer	Dimension Layer		Indicator Layer	Weight Coefficient (%)
NQPF	New Quality Laborers (32.92%)	Laborers' Skills	Average number of higher - education students enrolled per 100,000 people (persons)	6.5157
			Researchers' proportion in high - skilled R&D personnel (%)	13.9014
		Labor Productivity	Per capita GDP (yuan)	4.0875
			Per capita wage (yuan)	3.0826
		Laborers' Awareness	Proportion of employed persons in the tertiary industry (%)	5.3326
	New Quality Objects of Labor (25.12%)	New Quality Industries	Total profit from high - tech industries' production and operation (100 million yuan)	3.5584
			R&D expenditure of high - tech industries (10,000 yuan)	8.3498
		Ecological Environment	Built - up area greening coverage rate (%)	6.5044
			Forest coverage rate (%)	6.7085
	New Quality Means of Production (41.96%)	Material Means of Production	Total energy consumption (10,000 tons of standard coal)	4.1027
			Internet broadband subscribers (10,000 households)	6.8643
			Railway mileage (km)	4.9192
			Highway mileage (km)	5.7489
		Intangible Means of Production	Number of patent applications (pieces)	6.5985
			Number of high - tech enterprises (pieces)	4.6758
			Number of enterprises with R&D activities in high - tech industries (pieces)	4.7923
			Proportion of enterprises with e - commerce trading activities (%)	4.2572

3.3 Research Methods

3.3.1 Entropy Method

The Entropy Method is a multi-indicator objective weighting approach based on information entropy theory, which determines indicator weights by quantifying the dispersion degree of index data. Its core idea is that the greater the data variation, the higher the indicator weight; conversely, the smaller the difference, the lower the weight. When measuring the coupling coordination development level between HVE and NQPF in Henan Province, this paper uses the Entropy Method to determine the weight distribution of each indicator in the evaluation system through objective weighting.

3.3.2 Coupling Coordination Degree Model

The Coupling Coordination Degree Model is a comprehensive model used to evaluate the interaction intensity and coordinated development level between two or more systems, effectively revealing the synergistic state of mutual dependence and mutual promotion among systems during their dynamic evolution. This paper applies the Coupling Coordination Degree Model to measure the coupling coordination degree between HVE and NQPF. The calculation formula is as follows:

$$C = 2\sqrt{F(H)F(H)/[F(H) + F(P)]^2} \quad (1)$$

$$T = \alpha F(H) + \beta F(H) \quad (2)$$

$$D = \sqrt{C \times T} \quad (3)$$

Among them, *F(H)* represents the comprehensive development level of the HVE system in Henan Province, and *F(P)* represents the comprehensive development level of the NQPF system. The coupling coordination degree *D* is a core indicator used to measure the state of mutual promotion, harmonious coexistence, and overall synergistic development between HVE and NQPF during their dynamic evolution. The coupling degree *C* reflects the intensity of interaction between the two systems, while the comprehensive coordination index *T* integrates the overall development levels of both systems. Among them, α and β are weight coefficients, representing the proportion of contribution of HVE and NQPF to the comprehensive coordination, respectively. Based on the equal importance of the two systems, the study sets α=β=0.5.

3.4 Data Sources

The data for this study are primarily sourced from the *Henan Statistical Yearbook, China Statistical Yearbook, China Education Statistical Yearbook, China Energy Statistical Yearbook, China Environmental Statistical Yearbook, and the Statistical Bulletin on the Development of Education in Henan Province* for the years 2011 to 2024. To ensure data completeness and reliability, linear interpolation was employed to fill in any missing data points.

4. EMPIRICAL ANALYSIS

First, the paper employs the Entropy Method to objectively weight the indicators of the HVE system and the NQPF system respectively, thereby avoiding interference from subjective human factors. The specific weight allocation results are shown in Tables 1 and 2. On this basis, the comprehensive development indices of the two major systems in Henan Province from 2010 to 2023 are calculated, and the Coupling Coordination Degree Model is used to measure the coupling coordination level of the two. The specific results are shown in Table 3.

Table 3: Coupling Coordination Degree between HVE and NQPF in Henan Province from 2010 to 2023

Year	Comprehensive Index of HVE	Comprehensive Index of New - Quality Productive Forces	Coupling Coordination Degree
2010	0.1179	0.0486	0.100
2011	0.1798	0.2118	0.384
2012	0.2252	0.2352	0.450
2013	0.3257	0.2103	0.509
2014	0.3328	0.2614	0.548
2015	0.3557	0.3005	0.585
2016	0.3729	0.3981	0.645
2017	0.4183	0.4262	0.684
2018	0.4669	0.5124	0.746

2019	0.5453	0.5615	0.804
2020	0.6741	0.6140	0.879
2021	0.6689	0.6866	0.903
2022	0.7356	0.7199	0.941
2023	0.8218	0.7875	0.995

Based on the data in Table 3, it can be seen that the comprehensive development indices of both systems show a continuous upward trend, indicating that Henan Province has made significant progress in both the development of HVE and the cultivation of NQPF, and exhibits characteristics of significant synergistic mutual promotion and system coupling. HVE provides key human resource support for the development of NQPF by continuously expanding the scale of talent cultivation and optimizing the quality of talent. Especially in fields such as high-tech manufacturing and digital technology, a large number of professional and technical personnel trained by higher vocational institutions have effectively supported enterprises' technological upgrading and innovation activities, promoting the improvement of core indicators of NQPF from the perspective of talent supply. At the same time, the rapid development of NQPF has also put forward new requirements for and injected new impetus into HVE. The growth of the NQPF comprehensive development index indicates that Henan Province has made substantive progress in innovation capability, industrial upgrading, and other aspects. In this process, emerging industries have continuously emerged, bringing corresponding demands for emerging professional talents, which drives higher vocational institutions to optimize their professional structures, update their curriculum systems, and deepen school-enterprise collaboration.

Specifically, the development of HVE and the cultivation of NQPF in Henan Province exhibit a distinct characteristic of "synchronous growth and synergistic enhancement", which can be divided into distinct developmental phases.

Initial Synergy Phase (2010-2015), Both indices experienced low-level growth during this phase. The coupling coordination degree gradually increased but remained below 0.6, reaching only a "Barely Coordinated" level. The synergy was primarily manifested in the preliminary alignment between the expansion of educational scale and the accumulation of industrial foundations. HVE expanded its enrollment to build a foundational labor reserve for industrial development, while the scaled growth of traditional agriculture and manufacturing provided a stable demand scenario for vocational talent. However, constrained by relatively low technological content, the coordination between the two largely remained at a level of quantitative matching.

Accelerated Synergy Phase (2016-2020), This phase witnessed a significant increase in the growth rates of both indices. The coupling coordination degree surpassed 0.879, advancing to the "Good Coordination" grade. The core driver of this shift stemmed from the technological upgrading of the industrial structure. Traditional manufacturing began integrating digital technologies, agricultural modernization increased demand for IoT and big data technologies, and emerging industries gradually formed cluster effects. HVE responded by adjusting its program offerings and strengthening practical teaching, progressively achieving technological alignment with the core domains of NQPF. Consequently, the technological relevance between educational supply and industrial demand improved markedly.

Deep Integration Phase (2021-2023), Both indices continued to grow at a high level. The HVE index reached 0.8218 and the NQPF index increased to 0.7875 in 2023. The coupling coordination degree approached 0.995, achieving a state of "High-Quality Coordination." The defining feature of this phase is the two-way integration of the innovation chain and the industrial chain. NQPF evolved towards a more advanced form, exemplified by developments in hydrogen energy technology and AI applications, which in turn demanded that HVE cultivate technical and skilled talents with innovative capabilities. In response, HVE deepened industry-education integration, incorporating cutting-edge industrial technologies into the teaching system, thereby fostering a profound convergence between the educational chain and the innovation chain.

As a major agricultural province and an advanced manufacturing base, Henan Province faces the dual demands of transforming traditional agriculture into smart agriculture and upgrading traditional manufacturing with intelligent technologies, while also undertaking the critical task of cultivating strategic emerging industries such as electronic information, new energy, and new materials. Driven by technological innovation as its core engine, NQPF emphasize the deep integration of technology, industry, and talent. This has created an urgent need for HVE to cultivate high-quality technical and skilled talents capable of adapting to industrial transformation. The synergistic development between HVE and NQPF in Henan Province is essentially a dynamic adaptation process between

regional industrial upgrading demands and the talent cultivation capacity of HVE, operating at the levels of technology, industry, and resources.

This adaptation process exhibits distinct stage-leaping characteristics. In the initial stage, quantitative adaptation was dominant. HVE primarily matched the talent demand generated by the scaled expansion of traditional industries by increasing student enrollment. In the mid-term stage, the focus shifted to technological adaptation. Faced with rising technological requirements in industries, vocational education adjusted its program structures and strengthened practical teaching, gradually achieving precise alignment with new technologies and emerging job roles. Currently, the process is advancing towards innovative adaptation. HVE not only supplies skilled labor but also actively participates in industrial innovation through activities like technology R&D and process improvement. Concurrently, the more complex talent demands of NQPF are driving the HVE system to upgrade towards a model of deeper "industry-education integration and science-education convergence".

This dynamic adaptation reflects HVE's proactive response to the developmental needs of NQPF. It also provides Henan's economy with a dual-engine drive of "talent support and technology propulsion" on its path towards high-quality development.

5. RESEARCH CONCLUSIONS

The paper systematically reveals the synergistic evolution laws between HVE and NQPF in Henan Province by adopting the Entropy Method, Coupling Coordination Degree Model. The main conclusions are as follows:

The development of HVE and NQPF in Henan Province presents significant characteristics of synergistic mutual promotion and system coupling. The coupling coordination degree between HVE and NQPF in Henan Province continuously increased from extreme imbalance in 2010 to high-quality coordination in 2023, achieving a qualitative change from initial synergy to deep integration, and from quantitative adaptation of elements to innovation adaptation. The evolutionary process can be divided into three stages: 2010–2015 (Initial Synergy Stage): Quantitative adaptation dominated, mainly characterized by the initial match between the scale expansion of HVE and the accumulation of traditional industrial foundations. 2016–2020(Accelerated Synergy Stage): Gradual realization of technological adaptation between HVE and core areas of NQPF, with a significant improvement in the technical correlation between educational supply and industrial demand. 2021–2023 (Deep Integration Stage): HVE promoted the deep integration of the education chain and the innovation chain by deepening industry-education integration, thereby achieving a two-way connection between the innovation chain and the industrial chain, and enabling the education chain to precisely serve the demands of NQPF.

ACKNOWLEDGEMENT

This paper is supported by the fund: Henan Provincial Soft Science Research Project: Research on Empowering High-Quality Development of the Real Economy in Henan Province with Digital NQPF (Project No.252400410658); Graduate Student Research Innovation Project of Zhongyuan University of Technology: Research on Empowering Modernization Development of the Low-Altitude Economy in Henan Province with Digital NQPF (Project No.: ZUT Yan [2025] No.3)

REFERENCES

[1] Pu Qingping, Xiang Wang. New Quality Productivity and Its Utilizations: New Driving Force for Chinese Modernization [J]. Journal of Xinjiang Normal University (Philosophy and Social Sciences Edition), 2024,45(01):77-85.
[2] Huang Qunhui, Sheng Fangfu. New Productive Forces System: Factor Characteristics, Structural Bearing and Functional Orientation [J]. Reform, 2024, (02): 15-24.
[3] Hu Huifang, Xi Kang. Integration of Science and Education Energizes New Productive Forces: Intrinsic Logic, Practical Dilemmas, and Paths for Implementation: From the Perspective of Higher Vocational Education [J]. Vocational Education Forum,2024,40(05):20-26.
[4] Zhou Wen, Xu Lingyun. On New Quality Productivity: Connotative Characteristics and Important Focus [J]. Reform, 2023, (10):1-13.
[5] Yan Zhili, Wang Shuhui. Vocational Education Empowers New Quality Productive Forces: Factor Allocation and Action Logic [J]. Chinese Vocational and Technical Education,2024,(07):3-10.

[6] Zeng Tianshan, Lu Yuzheng. Comprehensive Improvement of Vocational Education Quality to Accelerate the Development of New Quality Productive Forces [J]. Vocational Education Forum,2024,40(04):5-9.
[7] Shi Weiping, Fan Qiyin, Huang Songjie. The Mechanism, Evaluation and Enlightenment of the Coupling Coordination Between Higher Vocational Education and Regional Economy in China [J]. Modern Education Management, 2024, (04): 106-118.
[8] Yan Wei. Research on Practical Strategies of Vocational Education in Empowering New Quality Productive Forces through Cultivating New-Quality Laborers [J]. Hunan Social Sciences, 2025, (02):131-139.
[9] Ping Jing, Wang Gang, Sun Bufan. Research on the Spatiotemporal Pattern Evolution and Convergence of Coupling and Coordination Between Higher Vocational Education and New Quality Productive Forces [J]. Vocational Education Newsletter, 2025, (02): 44-61.
[10] Hu Ying, Fang Taikun. Further Discussion on Connotation Characteristics and Formation Path of New Quality Productive Forces: from the Perspective of Marx's Theory of Productivity [J]. Journal of Zhejiang Gongshang University,2024,(02):39-51.
[11] Wang Jue. New Quality Productive Forces: A Theoretical Frame and Index System [J]. Journal of Northwest University (Philosophy and Social Sciences Edition),2024,54(01):35-44.
[12] Zhang Anmin. Vocational Education Development and New Quality Productive Forces Improvement——Evidence from 274 Cities in China [J]. Vocational and Technical Education,2024,45(16):28-35.