

A Study on the Synergistic Development of Professional Structures and Industrial Demands in the Context of Industry-Education Integration

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Abstract: As a key strategic platform for China's reform and opening-up in the new era, Hainan Free Trade Port is experiencing a growing demand for high-level applied and multidisciplinary talent against the backdrop of rapid industrial transformation and upgrading. This paper constructs an indicator system comprising educational and industrial subsystems, conducting a systematic analysis of the synergistic efficiency between vocational undergraduate programme structures and industrial demands. It reveals that Hainan's vocational education maintains a high degree of alignment with industrial demands within traditional sectors of strength. However, in emerging fields such as cross-border e-commerce, fintech, and big data, challenges persist including lagging programme development, insufficient talent supply, and low local industrial absorption rates. From a synergistic perspective, the study proposes countermeasures to optimise programme structures, deepen industry-education integration, and enhance educational quality. These recommendations aim to provide theoretical reference and practical pathways for the high-quality development of vocational undergraduate education and regional industrial upgrading.

Keywords: Industry-Education Integration; Vocational Bachelor's Degree; Professional Structure; Industrial Demand

1. Introduction

As the new wave of technological revolution and industrial transformation accelerates, new technologies such as digitalisation, intelligentisation and green transformation continue to reshape the global economic

structure and competitive landscape. As a vital component of the education system, vocational undergraduate education not only shoulders the responsibility of cultivating high-level technical and skilled professionals but also directly serves the national and regional objectives of industrial restructuring and high-quality development. It stands as a key force underpinning industrial upgrading and the high-quality development of regional economies. The Opinions on Deepening the Reform of the Modern Vocational Education System, issued in December 2022, explicitly state that efforts should be made to deepen supply-side structural reform in vocational education and promote the high-quality development of vocational undergraduate education to meet the urgent demands of industrial restructuring and the development of emerging industries [1].

In recent years, the state has successively introduced multiple policies emphasising the integration of the education chain, talent chain, industrial chain and innovation chain. These require vocational institutions to closely align their disciplinary structures with regional industrial development, making industry-education integration a strategic choice for advancing the high-quality development of vocational education [2]. However, a significant contradiction persists in practice: on the one hand, the demand for talent in emerging and strategic industries is growing rapidly, while the development of relevant academic programmes lags behind, resulting in a mismatch between supply and demand [3]; On the other hand, certain traditional disciplines suffer from excessive scale and a mismatch between training objectives and job requirements, resulting in the coexistence of both 'employment difficulties' and 'recruitment difficulties' [4]. Therefore, exploring effective

alignment between disciplinary structures and industrial demands within the context of industry-education integration holds significant practical importance [5].

From an international research perspective, the synergy between vocational education and industrial development has become a significant trend in global higher education reform. The OECD (2019) notes that deep integration between industry and education enhances the social relevance of higher education, thereby providing human capital support for economic transformation [6]. In Western countries, the dual-track system has matured considerably, fostering a virtuous cycle through strengthened collaboration between educational institutions and industry. Within the Asia-Pacific region, Japan and South Korea emphasise the integration of industry, academia and research, prioritising the alignment of professional structures with regional economic needs [7].

Domestic scholars have also conducted in-depth research into the coupling relationship between vocational undergraduate education and industrial development. Research suggests that higher vocational institutions should establish a dynamic adjustment mechanism to serve regional industrial development, thereby ensuring alignment between educational provision and industrial demand [8]; Empirical evidence indicates that talent development reforms tailored to industry needs can effectively enhance the employment suitability of graduates [9]; Other studies, grounded in fundamental principles and practical challenges, have proposed pathways for optimising the professional structure [10].

In summary, both domestic and international research emphasises the synergy between vocational education and industrial development. However, in the advancement of vocational undergraduate education in China, the critical challenge remains how to achieve high-quality development through optimising programme structures and deepening industry-education integration mechanisms. This research is conducted against this backdrop, aiming to provide theoretical and practical guidance for establishing a mechanism that aligns vocational undergraduate education with industrial development.

2. Current Status of Professional Structure and Industrial Development in Hainan Free

Trade Port

As a key strategic platform for the nation's new round of reform and opening-up, the Hainan Free Trade Port has witnessed rapid industrial development and heightened demand for skilled professionals in recent years. This presents fresh challenges regarding the adaptability and alignment of vocational undergraduate education.

2.1 Industrial Development Framework of Hainan Free Trade Port

The Hainan Free Trade Port represents a significant initiative in China's deepening reform and opening-up during the new era. Under policy impetus, its industrial structure is undergoing rapid adjustment and upgrading. According to the 2023 Statistical Bulletin on National Economic and Social Development of Hainan Province, the province's gross domestic product reached ¥755.118 billion in 2023, representing a year-on-year increase of 9.2%. Within the industrial composition, tourism and modern services held prominent positions. In 2023, the province welcomed 90.0062 million domestic and international visitors, generating total tourism revenue of ¥181.309 billion, representing year-on-year increases of 49.9% and 71.9% respectively. The functions of modern logistics and port-and-shipping hubs continue to strengthen. In 2023, the province's port cargo throughput exceeded 200 million tonnes, with container throughput approaching 6 million TEUs; Meanwhile, cross-border e-commerce has experienced rapid growth, with transaction volumes reaching 40 billion yuan in 2023, representing a year-on-year increase of over 25%. It is evident that the industrial development of Hainan Free Trade Port has established a diversified structure characterised by 'tourism as the leading sector, modern services as the mainstay, and logistics, finance, and the digital economy as new drivers of growth'. This framework provides robust support for the regional economy while also placing heightened demands on the availability of high-calibre, application-oriented, and multidisciplinary talent.

2.2 Supply and Discipline Structure of Vocational Undergraduate Education

To meet the talent requirements for industrial transformation and upgrading in the free trade port, Hainan Province is actively advancing

vocational undergraduate education. According to the Hainan Provincial Higher Vocational Education Quality Annual Report (2024), the province hosts 13 independently established higher vocational institutions, including one undergraduate-level vocational university (Hainan University of Science and Technology). Aligned with national South China Sea strategy and Hainan Free Trade Port development requirements, this institution offers 26 vocational undergraduate programmes. It has established a discipline system centred on engineering with maritime specialisation, notably introducing the Maritime Technology programme—a pioneering vocational undergraduate specialism filling Hainan's undergraduate programme gap. Humanities programmes concentrate on fields highly aligned with the Free Trade Port's key industries, such as modern logistics management, tourism management, and financial management. These are progressively expanding into emerging areas including cross-border e-commerce, big data and financial management, and fintech applications. This framework demonstrates Hainan's establishment of an education chain serving industrial chains through vocational undergraduate education at both institutional and structural levels, forming a relatively clear professional layout system.

2.3 The Alignment of Vocational Undergraduate Programmes with Industry Needs

From a macro perspective, the vocational undergraduate programmes offered at Hainan Free Trade Port align closely with the direction of industrial development. Graduates in Tourism Management and Exhibition Economics directly contribute to the establishment of an international tourism consumption hub, maintaining an employment rate between 85% and 90%. Professionals from the Modern Logistics Management programme are widely distributed across port and shipping logistics, express delivery, and supply chain enterprises, effectively supporting Hainan's strategic goal of establishing an international logistics hub. Vocational undergraduate programmes in Financial Management and Financial Services align with cross-border and offshore financial operations, gradually becoming a talent supply source for Hainan's financial opening-up strategy. These

programmes demonstrate high employment stability and job relevance, highlighting the significant role of vocational undergraduate education in supporting traditional industries of strength. However, in the field of emerging industries, the imbalance between supply and demand is particularly pronounced. In 2023, Hainan's cross-border e-commerce transaction volume grew by over 25% year-on-year. However, the establishment of relevant undergraduate programmes in this field remains relatively recent, with limited institutional capacity. The annual number of graduates falls significantly short of enterprises' demand for new positions, exacerbating the contradiction between the industry's rapid expansion and the insufficient supply of skilled personnel. Similar challenges exist in fields such as fintech and big data analytics, where industrial demand is robust yet the vocational undergraduate curriculum framework, practical training facilities, and teaching staff are still under development. Consequently, the quantity and quality of talent produced cannot fully meet industry requirements in the short term. Moreover, some vocational undergraduate graduates experience an outflow phenomenon in employment, with insufficient local industrial absorption rates, thereby diminishing the direct contribution of programme offerings to the regional economy.

3. Indicator System Construction

To scientifically measure the efficiency of alignment between vocational undergraduate education and regional industrial demands, this paper constructs an indicator system comprising educational and industrial subsystems under the guidance of compatibility theory. During indicator selection, three core principles—scientific rigour, systematic coherence, and operational feasibility—were strictly adhered to. This ensures the chosen indicators comprehensively reflect the core characteristics of both educational and industrial systems while maintaining rigorous theoretical validity.

3.1 Construction of an Educational Attainment Indicator System

The indicator system for the education subsystem unfolds across three dimensions: talent cultivation, institutional scale, and cultural education. Talent cultivation constitutes the core component of vocational undergraduate

education. The number of students enrolled, the number of students currently enrolled, and the number of graduates respectively reflect the entry point, process, and exit point of education, revealing changes in educational supply capacity and talent output levels. The number of teaching staff directly reflects the development of the teaching faculty and serves as a key indicator for measuring educational quality and institutional standards. The scale of higher education provision, measured by the number of institutions, not only reflects the overall capacity for supplying educational resources within a region but also reveals the extent of expansion within the higher education system.

In terms of cultural and educational development, the average years of schooling indicate the region's human capital stock and the overall quality of its population. Per capita educational expenditure, meanwhile, reveals the level of investment in education by both government and society, exerting a direct influence on the quality of educational development. Table 1 below presents seven indicators for the education subsystem, which comprehensively reflect the overall level of vocational undergraduate education in terms of quantitative expansion, quality enhancement, and resource provision.

Table 1. Framework for Educational Attainment Indicators

Primary indicator	Secondary indicators	Level 3 indicators
Education	Talent Development	Enrolment figures for higher education institutions
		Number of students enrolled in higher education institutions
		Number of Higher Education Graduates
		Number of Higher Education Institution Teaching Staff
	Scale of operations	Number of Higher Education Institutions
	Cultural Education	Average years of schooling
		Per capita expenditure on education

3.2 Development of an Indicator System for Industrial Development Levels

The indicator system for the industrial subsystem is designed across four dimensions: industrial scale, industrial capacity, industrial demand, and industrial structure. Industrial scale is measured by the output value and employment figures of the primary, secondary, and tertiary sectors, reflecting both the contribution of industries to the regional economy and their capacity to absorb labour.

In terms of industrial capacity, key indicators such as industrialisation levels, industrial agglomeration, road mileage and freight volume reveal a region's production capabilities, the degree of industrial concentration and infrastructure conditions. Industrial demand is reflected through social consumption levels and openness to external markets: the former serves as a crucial driver for upgrading services and household consumption, while the latter determines a region's participation in global value chains and foreign trade, particularly concerning cross-border e-commerce and modern logistics. Industrial structure is characterised by rationalisation and upgrading. The degree of rationalisation reflects coordination among the primary, secondary,

and tertiary sectors, while the level of upgrading reveals the trajectory of transition from low-value-added to high-value-added industries. Table 2 presents indicators of industrial development levels.

3.3 Cooperative Development Analysis

The synergistic efficiency between vocational undergraduate education and regional industrial demands remains at a developmental stage, exhibiting an overall low level yet showing a gradual trend of improvement. The alignment between Hainan Free Trade Port's traditional advantage industries and relevant undergraduate vocational programmes is relatively high. Disciplines such as Tourism Management, Modern Logistics Management, and Convention and Exhibition Economics effectively support the development of the international tourism consumption hub and modern logistics hub. Graduates from these programmes consistently maintain employment rates above 85%, demonstrating notable job stability and role suitability. This reflects a relatively effective connection between educational provision and industrial demand. However, in emerging sectors such as cross-border e-commerce, fintech, and big data analytics, the alignment between education and

industry remains inadequate. Despite the sustained rapid growth of these industries in recent years, the establishment of relevant vocational undergraduate programmes remains relatively recent and limited in scale.

Consequently, both the quantity and quality of talent produced struggle to meet the job demands arising from industrial expansion, resulting in comparatively low levels of collaborative efficiency.

Table 2. Framework for the Industrial Development Level Indicator System

Primary indicator	Secondary indicators	Level 3 indicators
industry	Industrial scale	Primary, secondary and tertiary industries output value
		Employment figures for the primary, secondary and tertiary sectors
	Industrial production capacity	level of industrialisation
		Industrial concentration
		Highway mileage
		Freight volume
	Industrial demand	level of social consumption
		Degree of openness to the outside world
	Industrial structure	Rationalisation of industrial structure
		Upgrading of the industrial structure

Further observation reveals that variations in synergistic efficiency are closely linked to the distinct developmental rhythms of industry and education. The pace of industrial restructuring in Hainan has significantly outstripped the adjustment of educational specialisations. Vocational undergraduate programmes often adopt a reactive rather than proactive approach to curriculum development, rendering the education system ill-equipped to meet the urgent demands of emerging industries. Concurrently, vocational undergraduate education continues to exhibit shortcomings in curriculum design, practical teaching facilities, and faculty competence, which to some extent constrain its capacity to cultivate versatile and high-calibre professionals for emerging sectors. Furthermore, the regional outflow of some vocational undergraduate graduates and the insufficient local industrial absorption rate have also diminished the direct supportive role of education in regional industrial development.

The synergy efficiency between vocational undergraduate education and industrial demand exhibits a pattern where traditional industries demonstrate relatively high compatibility, while emerging industries face pronounced supply-demand mismatches. This indicates that vocational undergraduate education has established a certain foundation in supporting the development of advantageous industries, yet remains inadequate in addressing the rapid advancement of strategic emerging industries. To achieve deep synergy between education and industry, it is necessary to progressively

enhance matching efficiency through dynamic adjustments to disciplinary structures, sustained advancement of industry-education integration, and refinement of educational quality assurance systems. This will thereby drive the coordinated evolution of vocational undergraduate education alongside regional industrial development.

4. Summary

In response to the current situation where the coordination efficiency between vocational undergraduate education and industrial demands remains relatively low, sustained efforts are required in optimising programme structures, deepening industry-education integration, and enhancing educational quality. Vocational undergraduate education should establish a dynamic programme adjustment mechanism, enabling its disciplinary layout to closely align with the trends of industrial structure upgrading. For advantageous industries such as tourism and logistics, stable continuity and sustained talent supply should be maintained. For emerging sectors including cross-border e-commerce, fintech, and the digital economy, the development of relevant disciplines should be accelerated. This will foster forward-looking alignment between disciplinary clusters and industrial chains, thereby enhancing the adaptability of educational provision to industry demands. Secondly, efforts should be intensified to advance the integration of industry and education alongside school-enterprise

collaboration. By involving enterprises in curriculum design, teaching implementation and practical training, this approach not only enhances students' job readiness but also aligns talent development more closely with industrial demands. It will foster a shift from short-term partnerships to long-term, stable collaborative mechanisms, establishing a model of deep integration between educational pathways and industrial chains. This will thereby strengthen the effectiveness of education in serving industry. Concurrently, educators should be encouraged to enhance their professional application capabilities through practical experience, while industry experts should be invited into the classroom to strengthen teaching's practical relevance and cutting-edge focus. Regarding teaching facilities, experimental training bases and digital teaching platforms should be improved, enabling students to develop skills in environments approximating real industrial settings, thereby further elevating their vocational competence and employability.

Looking ahead, as the development of Hainan Free Trade Port enters a phase of comprehensive deepening, the regional industrial structure will exhibit increasingly diversified and high-end trends, placing greater demands on vocational undergraduate education. Vocational undergraduate education requires not only forward-looking planning in its disciplinary structure but also continuous innovation in talent development models to enhance graduates' adaptability and competitiveness. Furthermore, attention must be paid to the role of policy environments and institutional innovation in fostering industry-education integration, thereby further aligning educational resource allocation with industrial development strategies.

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