

# The Development Path of High-quality Vocational Education to Promote the Construction of Industry-education Integration Cities

-- Take Wenzhou as An Example

**Dandan Lu**

Wenzhou Polytechnic, Wenzhou, Zhejiang, 325035, China

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**Abstract:** The development of industry-education integration cities places high demands on urban economic growth, social progress, industrial transformation, and the advancement of high-quality vocational education. Case studies in Wenzhou demonstrate that establishing a comprehensive multi-tiered vocational education system, expanding its spatial coverage, and enhancing professional alignment are fundamental pathways to achieve high-quality vocational education development and promote the construction of industry-education integration cities.

**Keywords:** Industry-education integration city, vocational education, realization path.

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## 1. Introduction

In July 2021, China's National Development and Reform Commission (NDRC) and Ministry of Education jointly designated the first batch of 21 national pilot cities for industry-education integration. This initiative seeks to coordinate urban resources, leverage regional industrial clusters, deepen collaboration between educational and industrial chains, and enhance education's role in driving regional economic growth, social development, and industrial upgrading. The program ultimately aims to replicate these reform achievements nationwide.

Cities integrating industry and education represent new models of urban development where educational resources and industrial assets converge, driving high-quality economic and social progress through technological innovation. Understanding these cities' essence at multiple levels is crucial for deepening industry-education collaboration, advancing urban development, and promoting modern vocational education. From an educational perspective, cities reflect a region's comprehensive capabilities in politics, economy, and culture. Urbanization facilitates population concentration, creating foundations for educational growth and accelerating human capital development. National statistics show higher education institutions are predominantly located in prefecture-level cities, with vocational colleges in nearly every such city. This establishes a spatial network where vocational education centers at the prefecture level and higher education hubs at the city level coexist, making resource concentration vital for urban development and industry-education integration. From an industrial standpoint, modern cities rely on thriving industries as their economic foundation. The scale effects of industrial innovation, knowledge spillovers, and collaborative advantages from large-scale industrial clusters have become essential drivers for building industry-education integration cities. Cities develop distinctive regional industrial clusters through industrial agglomeration. Pilot cities like Ningbo, Shenzhen, and Qingdao demonstrate strong economic foundations that provide material support for urban growth

and robust infrastructure for industry-education integration initiatives.

## 2. The Ensemble Characteristics of Industry-education Integration Cities

### 2.1. High Level of Economic and Social Development

The integration of industry and education is inseparable from the development of urban economy and society, and they complement each other. The construction of cities integrating industry and education lies in achieving a high-level state of economic and social development. High GDP provides sufficient material support for the construction of industry-education integration. According to the 2024 National Statistical Yearbook and provincial/municipal statistical yearbooks, through analysis of 21 pilot cities for industry-education integration, it is found that 14 cities with such integration all rank within the top 50 nationally in GDP, with 11 ranking among the top 20. For instance, Guangdong Province, which has long ranked first in national GDP, recorded a total GDP of 13.56732 trillion yuan in 2023, 800.5 billion yuan less than the second-ranked Jiangsu Province, and even higher than Hainan Province's GDP. Among these, Shenzhen and Guangzhou, two pilot cities for industry-education integration in Guangdong Province, both maintained a GDP of 3 trillion yuan in 2024, firmly ranking among the top 5 nationally. These figures provide solid financial support for deepening industry-education integration. In the 2024 New Era China Urban Social Development Index and Top 100 List, which ranked 297 prefecture-level cities nationwide, 13 pilot cities for industry-education integration were selected into the top 30 comprehensive rankings of China's urban social development index, with 5 of them ranking in the top 10. In November 2024, the Institute of Global Innovation and Development at East China Normal University released the "2024 Global Science and Technology Innovation Center Assessment

Report". Among the top 100 global science and technology innovation centers, China had 21 cities on the list, including 7 pilot cities for industry-education integration. Notably, Shanghai, Shenzhen, Hangzhou, and Guangzhou ranked in the top 30. Data from Ren Zeping's team's "China Urban Development Potential Ranking (2024)" shows that 15 of the top 50 cities nationwide are industry-education integration cities. The "China Urban Talent Attraction Ranking (2024)" reveals that 14 of these top 50 cities are also industry-education integration cities. In summary, the urban development index once again validates the inherent requirements of industry-education integration cities for urban economic, social, and technological development.

## **2.2. Agglomeration of High-Quality Educational Resources**

The integration of industry and education is the essential path for the high-quality development of higher education and vocational education. Education bears the responsibility of cultivating theoretical and applied talents that meet industrial demands, while high-quality industrial development cannot be achieved without talent support. The construction of industry-education integration cities places high requirements on both the quantity and quality of higher education institutions within the region. Only when higher education and vocational education are highly developed can they possess strong internal motivation to deeply participate in industry-education integration, continuously leading industrial upgrading and driving technological innovation. According to the 2024 Provincial Statistical Yearbook, analysis of 21 pilot cities for industry-education integration reveals that these cities have relatively abundant resources in higher education and vocational education. They maintain a large number of higher education institutions with substantial student populations, accounting for a significant proportion among provincial-level cities. For instance, Guangzhou has 84 higher education institutions (including vocational colleges), with over 1.46 million students enrolled, representing nearly 50% of Guangdong Province's total higher education enrollment. In terms of types, there are both general universities focusing on theoretical research and vocational colleges cultivating applied technical talents. From an organizational perspective, pilot cities emphasize deep integration of industry and education. Among the first batch of 28 municipal-level industry-education consortiums announced in 2023, 11 were from industry-education integration pilot cities. The first national-level industry-education integration consortium was established in Changzhou, Jiangsu Province, specifically for the national rail transit equipment industry [1]. According to two batches of municipal industry-education consortium lists released by the General Office of the Ministry of Education, 11 out of 21 cities with integrated industry-education systems have established municipal-level consortia, each encompassing industrial parks, universities, and enterprises. For instance, the Tangshan High-Tech Industrial Development Zone Industry-Education Consortium, based in the same zone, is jointly led by Tangshan Polytechnic University and CITIC Heavy Industries Kaicheng Intelligent Equipment Co., Ltd., integrating high-quality educational resources from 11 institutions. Similarly, the Changzhou New Energy Industry-Education Consortium in Wujin National High-Tech Industrial Development Zone is spearheaded by Changzhou Polytechnic College and Wanbang Digital Energy Co., Ltd.,

bringing together 10 secondary vocational, higher vocational, and undergraduate institutions for collaborative development [2].

## **2.3. Large Number and High Quality of Enterprises in The Industry**

In 2017, the "Several Opinions of the General Office of the State Council on Deepening the Integration of Industry and Education" first proposed the concept of "industry-education integration enterprises." The state has subsequently issued a series of policy documents, designating the cultivation of industry-education integration enterprises as a major reform pilot for deepening industry-education integration. The 24 industry-education integration enterprises prioritized for development announced by the Research Institute of Vocational Education Center under the Ministry of Education in April 2019, and the 63 national industry-education integration enterprises listed by the General Office of the National Development and Reform Commission and the Ministry of Education in July 2021, directly reflect the interactive relationship between vocational education and regional economic development [3]. The published national industry-education integration enterprise lists reveal significant regional disparities in the number of selected enterprises across provinces (municipalities). Over 40% of these enterprises are distributed in industry-education integration cities, such as Shanghai, Guangdong, and Shandong, which collectively demonstrate the high quantity and quality of selected enterprises in these cities. However, imbalances in industry-education integration and school-enterprise cooperation persist among different industry-education integration cities, influenced by factors such as regional fiscal investment, historical foundations, and industrial structures. Taking Shanghai, where the China (Shanghai) Pilot Free Trade Zone is located, as an example: 15 industry-education integration communities have been established in sectors including digital agriculture, new energy vehicles, and integrated circuits. Through deep industry-education integration, these efforts not only effectively advance the construction of industry-education integration cities but also provide industrial support and momentum for regional economic development.

## **3. The Influence of Vocational Education on The Construction of Industry-education Integration Cities**

### **3.1. Selection of Research Subjects**

This study takes Wenzhou City in Zhejiang Province as the case study. Located on the southeastern coast of Zhejiang, Wenzhou borders Ningde in Fujian Province to the south, Lishui City to the west, and Taizhou City to the north. As the third largest city in Zhejiang, it was once known as the "Iron Triangle" alongside Hangzhou and Ningbo, two major central cities in the province. As a pioneer zone for China's reform and opening-up, Wenzhou has created the representative "Wenzhou Model" through its unique geographical location and pioneering innovative spirit, becoming a model for the development of China's private economy. From an economic and social development perspective, Wenzhou achieved a regional GDP of 971.88 billion yuan in 2024, representing a 6.3% year-on-year increase and surpassing both national and

provincial averages. The number of above-designated-size industrial enterprises expanded to 9,291, generating an added value of 173.69 billion yuan, marking a 10.2% year-on-year growth rate that led the province. Wenzhou's five traditional pillar industries—shoe leather, apparel, electrical equipment, auto parts, and pumps and valves—are transitioning toward high-tech development, with their added value growing by 13.9% year-on-year. Both automotive components and electrical industries achieved double-digit growth rates. Strategically, Wenzhou occupies a pivotal position at the intersection of the Yangtze River Delta and the Haixi region, serving as one of the 27 core cities in the Yangtze River Delta and one of the five major centers in Haixi. In terms of education, Wenzhou currently has 11 regular higher education institutions, including 6 undergraduate colleges, 5 vocational colleges, and 40 secondary vocational schools. In 2024, the city's higher education enrollment reached 180,000 students, while secondary vocational school enrollment stood at 90,000, matching the number of universities and students in Ningbo. According to the data of China City Talent Attraction Ranking (2024), Wenzhou ranked 25th.

In recent years, Wenzhou has faced challenges such as industrial relocation and talent outflow due to regional economic disparities and differences in production factors. The gap with Hangzhou and Ningbo has been widening, causing the original "iron triangle" of industrial clusters to gradually lose balance. Meanwhile, the rapid rise of neighboring cities has intensified competition, driving Wenzhou to accelerate industrial transformation and upgrade while speeding up the development of an industry-education integration-oriented city. As pioneering national pilot cities for industry-education integration, Hangzhou and Ningbo have leveraged their unique advantages to promote high-quality urban economic development, optimizing the industry-education integration model. Their experiences provide valuable references for advancing the construction of second-batch national vocational education industry-education integration pilot cities. This study selects Wenzhou as a representative case among the new batch of cities applying for national industry-education integration pilot status, exploring practical pathways for vocational education to advance the development of industry-education integration cities.

3.2. Research Programme

Representative indicators of vocational education development and industrial development were selected for analysis, and compared with the level status of Zhejiang

Province as well as the level status of two industry-education integration cities, Hangzhou and Ningbo, to discuss the coordination between vocational education and regional economic industrial development. The data were mainly sourced from the China Statistical Yearbook, Zhejiang Statistical Yearbook, Wenzhou Statistical Yearbook, Hangzhou Statistical Yearbook, and Ningbo Statistical Yearbook.

3.2.1. Analysis of the Coordination Between the Scale of Vocational Education and Regional Economic Development

Vocational education and regional economic development interact with each other. The scale of vocational education development is based on meeting the demand for technical and skilled talents driven by regional productivity growth, which is influenced and constrained to some extent by the level of regional productivity development. By adopting the "scale coordination index" — representing the ratio between vocational education scale (measured by graduates from higher vocational colleges and secondary vocational schools) and economic development scale (measured by gross domestic product) —we evaluate the coordination between regional vocational education scale and economic development scale [4]. Using Wenzhou's industrial transformation period over the past five years as a time series, we derive the scale coordination index between vocational education and economic development in Wenzhou (see Table 1). Compared with Zhejiang Province, the coordination between vocational education scale and economic development scale in Wenzhou has maintained a steady upward trend with high coordination over the five-year period. Notably, Wenzhou's secondary vocational education coordination with economic development scale exceeds that of the entire province, far surpassing Hangzhou and Ningbo. In contrast, Wenzhou's higher vocational education coordination lags behind the provincial average and shows a gap compared to Hangzhou, but remains generally higher than Ningbo. This indicates that overall, Wenzhou's gross domestic product growth rate and vocational education scale development pace have progressed in tandem, with the development gap with Zhejiang Province gradually narrowing. Although the number of graduates from Wenzhou's vocational institutions continues to increase annually, there remains a certain disparity compared to the city's socio-economic development needs, suggesting that the scale expansion of vocational education has yet to keep pace with economic growth.

Table 1. Coordination degree between scale of vocational education and economic development in Wenzhou and related comparative data

| a particular year | Wenzhou City                                                                |                                                                                     |                                                                                                           | Zhejiang Province                                                           |                                                                                     |                                                                                                                    | Hangzhou City                                                               |                                                                                     | Ningbo City                                                                |                                                                                     |
|-------------------|-----------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------|-------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------|-------------------------------------------------------------------------------------|----------------------------------------------------------------------------|-------------------------------------------------------------------------------------|
|                   | Coordinating degree of higher vocational colleges (person/100 million yuan) | Scale coordination degree of secondary vocational schools (person/100 million yuan) | Scale coordination degree of higher vocational and secondary vocational schools (person/100 million yuan) | Coordinating degree of higher vocational colleges (person/100 million yuan) | Scale coordination degree of secondary vocational schools (person/100 million yuan) | Scale coordination degree of higher vocational colleges and secondary vocational schools (person/100 million yuan) | Coordinating degree of higher vocational colleges (person/100 million yuan) | Scale coordination degree of secondary vocational schools (person/100 million yuan) | Scale coordination of higher vocational colleges (person/100 million yuan) | Scale coordination degree of secondary vocational schools (person/100 million yuan) |
| 2019              | 1.73                                                                        | 3.80                                                                                | 5.53                                                                                                      | 2.11                                                                        | 2.61                                                                                | 4.72                                                                                                               | 3.64                                                                        | 0.09                                                                                | 1.49                                                                       | 1.63                                                                                |
| 2020              | 1.79                                                                        | 3.79                                                                                | 5.58                                                                                                      | 2.07                                                                        | 2.49                                                                                | 4.56                                                                                                               | 3.67                                                                        | 0.09                                                                                | 1.40                                                                       | 1.73                                                                                |
| 2021              | 1.85                                                                        | 3.48                                                                                | 5.32                                                                                                      | 1.93                                                                        | 2.16                                                                                | 4.09                                                                                                               | 3.19                                                                        | 0.07                                                                                | 1.30                                                                       | 1.21                                                                                |
| 2022              | 2.14                                                                        | 3.66                                                                                | 5.80                                                                                                      | 2.24                                                                        | 2.28                                                                                | 4.52                                                                                                               | 3.67                                                                        | 0.07                                                                                | 1.64                                                                       | 1.24                                                                                |
| 2023              | 2.58                                                                        | 3.49                                                                                | 6.08                                                                                                      | 2.23                                                                        | 2.23                                                                                | 4.46                                                                                                               | 3.62                                                                        | 0.08                                                                                | 1.54                                                                       | 1.22                                                                                |

Note: The data are from Wenzhou Statistical Yearbook, Zhejiang Statistical Yearbook, Hangzhou Statistical Yearbook

### **3.2.2. Coordination Between Vocational Education and Industrial Development**

From the perspective of educational development, Wenzhou region had established higher education institutions in the early years after liberation. During the period of China's higher education system reform from the late 20th to early 21st century, vocational colleges and secondary vocational schools underwent mergers, upgrades, and reorganizations, with the rapid addition of higher education institutions to achieve scale expansion of local higher education. Wenzhou boasts universities such as Wenzhou Medical University and Wenzhou University, which have doctoral and master's degree authorization, as well as vocational colleges excelling in vocational education. For instance, Wenzhou Vocational and Technical College, selected as a China Characteristic High-Level Vocational College and a National Demonstration Vocational College, has established a modern vocational education system that vertically integrates secondary vocational, higher vocational, undergraduate, and graduate education while meeting urban industry-education integration needs. Vocational education has gradually expanded geographically to county-level cities and industrial parks. This multi-tiered, multi-type, and multi-regional higher education framework provides robust talent and intellectual support for Wenzhou's socioeconomic development. From an industrial perspective, Wenzhou's economy is dominated by secondary and tertiary industries. Among annual industrial enterprises above designated size, the added value of high-tech industries and equipment manufacturing both exceeded the average level of large-scale industries. The year saw 716 new high-tech enterprises added, with revenue from high-tech service industries and core digital economy service industries growing by 6.1% and 9.5% respectively compared to the previous year. Wenzhou's private sector remains vibrant, with private enterprises contributing 90.8% of the added value in large-scale industries. By the end of 2024, the city had over 1.5 million market entities, with six private enterprises listed among China's Top 500 Enterprises in 2024. Compared with Hangzhou and Ningbo, which mostly focus on large enterprises or high-tech industries, Wenzhou is closer to the actual needs of small and medium-sized enterprises, and focuses on traditional manufacturing industry.

## **4. The Realization Path of Promoting the Construction of Industry-education Integration Cities in The High-quality Development of Vocational Education**

### **4.1. Build a Complete Multi-Level Vocational Education System**

In the 2014 "Decision of the State Council on Accelerating the Development of Modern Vocational Education", it was first explicitly proposed to "accelerate the construction of a modern vocational education system", aiming to establish a framework that meets the demands of economic and social development, integrates industry and education deeply, connects secondary and higher vocational education, and facilitates communication between vocational education and general education. In the 2022 revision of the "Vocational Education Law of the People's Republic of China", the connotation of the "modern vocational education system" was

clarified for the first time through legal provisions, establishing a vocational education system that connects secondary vocational, higher vocational, and undergraduate education at all levels. The "Outline of the Education Powerhouse Construction Plan (2024-2035)" issued by the State Council in late 2024 further outlined arrangements for "accelerating the construction of a modern vocational education system". In advancing the development of industry-education integration cities, it is essential to follow China's direction in building a modern vocational education system and establish reasonable goals for municipal-level vocational education system construction. Within municipalities, a complete modern vocational education system spanning "secondary vocational—higher vocational—undergraduate (vocational undergraduate)—postgraduate education" should be established. The objectives, directions, and content of municipal-level vocational education system construction must be clarified, with coordinated planning for the integration of secondary and higher vocational schools. This will ensure organic connections and vertical integration between secondary and higher vocational education in terms of talent cultivation goals, curriculum systems, and teaching content, providing students with smooth pathways for further education. Support should be encouraged for "specialized-to-undergraduate" enrollment and joint programs between higher vocational colleges and undergraduate institutions, while supporting municipal-level undergraduate institutions in applying to become master's and doctoral degree-granting units. These measures will comprehensively enhance the quality and appeal of vocational education systems.

### **4.2. Expand the Spatial Coverage of Vocational Education**

As a vital platform for regional industrial upgrading and human capital development, the spatial distribution of vocational education directly determines the inclusiveness of technical and skilled talent cultivation. Currently, China's vocational education resources exhibit a "central urban agglomeration, county-level weakness" pattern across municipal regions. There is an urgent need to optimize spatial planning and innovate operational models to establish a comprehensive vocational education network system with full coverage and functional complementarity. A three-tier spatial framework should be established: urban centers, counties, and townships. Central urban areas should prioritize developing high-level vocational colleges specializing in emerging industries, technological innovation services, and faculty training to serve as demonstration hubs. Counties should leverage industrial parks to attract quality vocational institutions to set up branch campuses or teaching points, achieving spatial integration of industry-education collaboration and resource decentralization. Townships should consolidate vocational training resources and secondary vocational schools, collaborating with higher vocational colleges and leading enterprises through shared training bases, jointly developed curricula, and credit recognition mechanisms to ensure seamless integration between secondary and higher vocational education, thereby promoting rural revitalization and technical talent development. Enhanced spatial coverage of vocational education will boost human capital value, optimize industrial structures, and balance regional development, significantly impacting urban socioeconomic progress. The spatial layout of municipal vocational education should align with territorial

planning and industrial distribution strategies, ensuring coordinated planning, unified spatial configuration, and synchronized implementation to achieve spatial alignment between vocational education supply and regional economic growth [5].

### 4.3. Strengthen the Professional Adaptability of Vocational Education

The fundamental mission of vocational education lies in aligning academic programs with regional industrial development and talent demands. Vocational institutions develop specialized disciplines by addressing three core challenges: establishing programs that match regional pillar industries, creating service platforms for enterprise-specific needs, and cultivating technical professionals to meet technological demands. To enhance alignment between talent development and industrial chains, governments should implement incentive policies offering substantial support—including land allocation, fiscal benefits, and tax reductions—to enterprises actively engaged in industry-education integration. This encourages deep collaboration between industries and leading enterprises in talent cultivation, while supporting vocational colleges in co-establishing innovation hubs like R&D centers and industrial training bases with businesses. Through such partnerships, institutions gain real-time insights into emerging technological trends and solve corporate technical challenges, fostering mutually beneficial collaboration. By maintaining close ties with industries, vocational colleges can promptly identify talent requirements for urban core industries and strategic emerging sectors. Through dynamic program adjustments aligned with regional workforce gaps and technological trends, they develop specialized clusters that closely match dominant industries. This approach ensures precise alignment between academic programs (and program clusters), industrial standards, vocational benchmarks, and production processes, producing

graduates who meet corporate needs while boosting local employment rates.

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