

# TALENT CULTIVATION PATHS OF HIGHER VOCATIONAL EDUCATION SERVING REGIONAL INDUSTRIAL CLUSTERS: FROM THE PERSPECTIVE OF UNIVERSITY-ENTERPRISE COMMUNITY OF SHARED FUTURE

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**Abstract:** Against the backdrop of China's policy-driven integration of production and education, industrial cluster upgrading, and insufficient adaptability of higher vocational education (HVE) talent cultivation, this study explores the alignment between HVE and regional industrial clusters from the innovative perspective of the University-Enterprise Community of Shared Future. Employing literature research, case analysis (Zhuhai Semiconductor and Integrated Circuit Cluster), and comparative research, it analyzes practical effects (preliminary talent adaptability improvement, initial resource integration) and core dilemmas (loose community connections, talent-demand mismatch, inadequate collaborative mechanisms, weak double-qualified teams) of current HVE talent cultivation. It then constructs a four-dimensional path: concept innovation, mechanism construction (interest linkage, collaborative governance, demand feedback), model innovation (modular curriculum, dual training, customized cultivation), and support strengthening (teacher development, quality evaluation, policy guarantees). The Zhuhai case verifies that the University-Enterprise Community of Shared Future bridges talent supply and industrial demand. The proposed path effectively promotes precise matching between HVE and regional industrial clusters, realizing a win-win for education, industry, and regional development.

**Keywords:** Higher vocational education; Regional industrial clusters; University-enterprise community of shared future; Talent cultivation paths

## 1 INTRODUCTION

### 1.1 Research Background

#### 1.1.1 Policy background

China's national government has established a vocational education policy system featuring "top-level design guidance and implementation detailed rules support". Core policies such as the Action Plan for Improving Quality and Cultivating Excellence in Vocational Education (2020-2023) and the Guidelines for the Construction of Modern Industrial Colleges explicitly take the integration of production and education as the core development orientation. They require breaking down university-enterprise cooperation barriers and building a collaborative talent cultivation model of "joint talent training, resource sharing, and joint responsibility assumption", providing solid policy guarantees for fostering the University-Enterprise Community of Shared Future. Such policies drive higher vocational colleges to break traditional school-running inertia, proactively align with regional industrial development rhythms, and achieve precise alignment between educational supply and industrial demand.

#### 1.1.2 Industrial background

China's regional industrial clusters are accelerating upgrades toward high-end, intelligent, and green development. Key manufacturing clusters—such as equipment manufacturing in the Yangtze River Delta and electronic information in the Pearl River Delta—have extensively promoted "machine replacement" and intelligent transformation. Service clusters like cross-border e-commerce and modern logistics focus on enhancing digital service capabilities. Demand for compound skilled talents with both professional skills and comprehensive literacy has shifted from "quantity supplement" to "quality adaptation". However, talents trained under HVE's traditional model often face a single skill structure and disconnection between core competencies and new technology applications, failing to meet industrial clusters' upgrading needs. This objectively requires reconstructing a talent cultivation system adapted to cluster development.

#### 1.1.3 Educational background

As the core carrier serving regional industrial development, HVE faces prominent challenges of insufficient talent cultivation adaptability. Specifically, curriculum updates lag behind industrial technological iteration, training scenarios are disconnected from actual enterprise production, and the professional competence of "double-qualified" teaching teams is weak. More critically, most university-enterprise cooperation remains superficial—limited to "student internship placement" or "enterprise naming sponsorship". Some "order classes" even become hollow, with "only naming rights but no substantive education". The "joint talent training, risk sharing, and benefit sharing" model emphasized by Ge Xiaobo [1] remains unestablished, leading to inadequate alignment between talent cultivation and industrial demand.

## 1.2 Research Significance

### 1.2.1 Theoretical significance

Current academic research on the University-Enterprise Community of Shared Future mostly focuses on binary university-enterprise cooperation, lacking in-depth exploration of its integration with the key scenario of "regional industrial clusters". This study deeply integrates regional industrial clusters' core characteristics with community construction, innovatively developing a three-dimensional theoretical model of "cluster demand identification - community collaborative operation - adaptive talent output". This enriches the theory's application connotation and practical boundaries in regional industrial service fields. Addressing the "macro emphasis over micro paths" gap in HVE adaptability research, it systematically analyzes internal optimization logic from stakeholder and collaborative governance theory perspectives, integrating modular teaching and customized cultivation to refine theoretical cores and improve the full-chain theoretical system of "demand identification - cultivation implementation - quality evaluation - dynamic optimization".

### 1.2.2 Practical significance

For higher vocational colleges, the proposed "cluster-adaptive" talent cultivation system provides direct guidance for optimizing training programs, adjusting curricula, and innovating training models, effectively resolving core issues like curriculum-industry disconnection and low training quality. For cluster enterprises, stable adaptive talent supply fills skill gaps from technological upgrades, reducing internal training costs and post adaptation cycles. For regional development, precise talent matching accelerates industrial cluster upgrading, forming a virtuous cycle of "talent cultivation empowering enterprise development and enterprise growth driving cluster expansion". It also provides empirical basis for governments to improve production-education integration policies, ultimately achieving a win-win pattern for education, industry, and regions.

## 1.3 Research Status at Home and Abroad

### 1.3.1 Domestic research

Domestic studies focus on university-enterprise cooperation model innovation (e.g., Zheng Yiqi's [2] in-depth industry cooperation, Liu Yang's [3] customized cultivation), production-education integration mechanism reform (e.g., Geng Xuanzhen's [4] modular teaching system), industrial college governance paths (e.g., Wang Yan's [5] "co-construction to symbiosis" mechanism), and community construction logic (e.g., Ge Xiaobo [1], Zhu Jinfeng [6]). However, most studies address single cooperation dimensions or specific practices, lacking closed-loop research on "regional industrial cluster demand - community operation - HVE talent cultivation" and failing to reveal internal collaborative mechanisms.

### 1.3.2 Foreign research

Mature vocational education-industry coordination models exist abroad, such as Germany's dual system and Australia's TAFE system, which achieve precise talent-industry alignment through deep enterprise participation in teaching. Japan's Toyota "enterprise-run school" model even builds an internal closed loop of "talent cultivation - technological R&D - industrial application". However, these market-driven models lack integration with localized connotations like benefit sharing and risk sharing in China's "community of shared future", making direct adaptation to policy-driven regional industrial clusters difficult. Their localization requires further exploration.

### 1.3.3 Research review

Existing studies provide a solid theoretical and practical foundation for HVE-industry coordination but have obvious gaps. Domestic research is limited to binary university-enterprise interaction, lacking closed-loop "demand-operation-cultivation" frameworks and differentiated adaptation analysis across cluster types. Foreign models lack compatibility with China's policy environment and industrial characteristics, with unclear localization paths. These gaps hinder effective guidance for HVE to meet regional industrial cluster upgrading needs, highlighting the urgency of deepening research on community-talent cultivation correlations centered on regional industrial clusters.

## 1.4 Research Ideas and Methods

### 1.4.1 Research ideas

Taking the University-Enterprise Community of Shared Future as the core link, this study constructs a three-dimensional research framework of "HVE supply - regional industrial cluster demand - talent matching". First, relying on industrial cluster theory and literature research, combined with field surveys of typical clusters (e.g., Yangtze River Delta equipment manufacturing, Pearl River Delta electronic information), it systematically analyzes talent demand characteristics and enterprise differentiated needs. Second, through in-depth analysis of 6 typical cases (including McDonald's-Zhejiang Oriental Vocational and Technical College cooperation, "Ruipai" Pet Medical Industrial College), it explores core practical experience, dilemmas, and root causes of HVE serving cluster talent cultivation. Finally, supported by stakeholder, industrial cluster, and collaborative governance theories, it constructs an adaptability improvement path from concept innovation, mechanism construction, model innovation, and support strengthening dimensions, integrating modular teaching to optimize details and form a complete research closed loop of "demand identification - problem diagnosis - path construction - practical verification".

### 1.4.2 Research methods

Literature Research: Systematically reviewing core literatures and domestic-foreign studies to extract community

theoretical achievements, practical models, and research frontiers, tracing the application origin of stakeholder theory.

Case Analysis: Selecting 6 typical university-enterprise cooperation samples across manufacturing and service clusters, analyzing practical experience and dilemmas through on-site interviews and data collation.

Comparative Research: Comparing international mature models (e.g., Germany's dual system, Australia's TAFE) with China's regional practices to extract localized adaptation core points.

## 2 DEFINITION OF CORE CONCEPTS AND THEORETICAL BASIS

### 2.1 Definition of Core Concepts

#### 2.1.1 University-enterprise community of shared future

A collaborative education ecosystem constructed by higher vocational colleges, regional industrial cluster enterprises, industry associations, and government departments based on strategic consensus. Breaking the traditional "separated supply-demand, one-way interaction" cooperation paradigm, it takes "joint talent training, resource sharing, mutual benefit, and risk sharing" as the core link. Its core characteristics include interest symbiosis (organic alignment of multi-party demands), joint responsibility (reasonable division of training obligations), and development coordination (synchronization with cluster upgrading). It effectively promotes the transformation of university-enterprise cooperation from superficial interaction to in-depth integration, ensuring precise talent-industry matching.

#### 2.1.2 Regional industrial cluster

An industrial ecological aggregate formed by gathering upstream-downstream enterprises, R&D institutions, industry associations, and financial institutions in a specific geographical space, with a leading industry as the core, featuring division of labor, resource sharing, and coordinated development. Its core characteristics are geographical agglomeration (reducing cooperation costs), industrial relevance (forming common skill demands), and dynamic growth (upgrading with technological iteration). Its talent demand structure evolves with cluster development stages, providing precise direction for HVE talent cultivation.

#### 2.1.3 HVE Talent cultivation serving regional industrial clusters

Whole-chain adaptive cultivation activities conducted by higher vocational colleges based on the "regional service" core positioning, taking cluster technological upgrading directions and post capability changes as the fundamental orientation—covering talent specification positioning, training program design, teaching implementation, and quality evaluation. Its core logic is not simply "talent supply on demand" but building a closed-loop operation mechanism of "precise demand identification - cultivation system reconstruction - dynamic quality feedback - program continuous optimization". It captures enterprise differentiated needs through the University-Enterprise Community of Shared Future, reconstructs cultivation systems by integrating practical experience, and ensures quality with enterprise-industry evaluation as the core.

### 2.2 Theoretical Basis

#### 2.2.1 Stakeholder theory

Proposed by Freeman, its core lies in identifying core demands and responsibility boundaries of various stakeholders in organizational development, achieving multi-party demand balance and win-win through mechanism design—providing core logical support for community construction. In this study, it clarifies differentiated rights and responsibilities of higher vocational colleges (core demands: improved talent quality, scientific research transformation), cluster enterprises (core demands: precise talent supply, technological upgrading support), government departments (core demands: cluster upgrading, employment stability), and students (core demands: high-quality employment, career development). It resolves the traditional dilemma of "passive enterprise participation and one-way school output", laying a logical foundation for the community's "joint talent training and risk sharing" operation model.

#### 2.2.2 Industrial cluster theory

With Porter's "Diamond Model" as the core support, it focuses on synergy effects and development laws of industrial agglomeration, providing methodological guidance for precise HVE talent positioning. Cluster geographical agglomeration shortens university-enterprise spatial distance, reducing information communication and resource integration costs. Industrial relevance forms common skill demands among cluster enterprises, providing a basis for modular curriculum construction. Dynamic growth requires talent cultivation systems to establish flexible adjustment mechanisms, adapting to cluster technological iteration and industrial upgrading in a timely manner, ensuring synchronization between talent cultivation directions and cluster development processes.

#### 2.2.3 Collaborative governance theory

Originating from public management, it emphasizes that multi-stakeholders achieve common goals through equal consultation, resource integration, and joint responsibility—providing key theoretical support for community operation mechanism design. In teaching implementation, it supports the construction of the "university-enterprise double tutor" system and curriculum co-construction mechanism. In training practice, it facilitates the collaborative development of the "school-in-factory + factory-in-school" dual training platform. In quality evaluation, it promotes the formation of a three-dimensional system of "school evaluation + enterprise evaluation + industry evaluation", effectively resolving issues like insufficient collaborative mechanisms and vague responsibility division, improving overall talent cultivation efficiency.

### 3 ANALYSIS OF THE CURRENT SITUATION OF HVE TALENT CULTIVATION SERVING REGIONAL INDUSTRIAL CLUSTERS FROM THE COMMUNITY PERSPECTIVE

#### 3.1 Practical Effects

##### 3.1.1 Preliminary improvement of talent cultivation adaptability

The practical value of the university-enterprise collaborative training model has initially emerged. For example, Zhejiang Oriental Vocational and Technical College and McDonald's jointly built a "422 flexible semester system", aligning teaching cycles with enterprise operation rhythms. Students' post adaptability significantly improved after practical training. The customized cultivation model implemented in equipment manufacturing majors greatly enhanced the compatibility between graduates' professional quality and enterprise post demands by reconstructing curricula and training standards. Cluster enterprises' recognition and retention willingness of graduates increased notably, fully confirming the core role of university-enterprise collaboration in improving talent adaptability.

##### 3.1.2 Initial results in university-enterprise resource integration

A two-way resource flow mechanism between universities and enterprises has gradually taken shape. For example, a mechanical major in a higher vocational college co-built a provincial training center with regional leading enterprises, integrating high-quality equipment and technical resources, and decomposing training modules according to cluster core post capability requirements—effectively expanding the depth and breadth of students' practical training. The "Ruipai" Pet Medical Industrial College in Zhu Jinfeng's [6] research achieved in-depth resource integration: enterprises invested core diagnosis and treatment equipment and clinical case resources, while the school provided venues and teaching management services to co-build training bases and teacher training centers, conducting regular practical training. This effectively resolved the dual dilemmas of insufficient HVE training resources and poor enterprise technical inheritance.

##### 3.1.3 Gradual enhancement of industrial service capabilities

A symbiotic development relationship between higher vocational colleges and regional industrial clusters has initially formed. For example, the Industrial College of Chongqing Water Resources and Electric Engineering Vocational College, investigated by Wang Yan [5], deepened from initial training base co-construction to symbiotic cooperation in technological research and development and employee training, continuously providing technical solutions and skill improvement services for regional water conservancy enterprises. "Ruipai" Pet Medical Industrial College not only transported a large number of professional talents for the regional pet medical industry but also formed a technical service team of university-enterprise experts, providing technical guidance and standardized operation consulting for small and medium-sized pet diagnosis and treatment institutions—effectively promoting the overall improvement of industry service levels and verifying the feasibility of university-enterprise collaboration in strengthening HVE industrial service capabilities.

#### 3.2 Existing Dilemmas

##### 3.2.1 Loose community connection

Most university-enterprise cooperation features "short-term utilitarian orientation". Cluster enterprises mostly focus on filling temporary labor gaps, showing low enthusiasm for participating in in-depth cooperation links such as curriculum reconstruction, training standard formulation, and teacher team building. Most cooperation remains at the superficial level of "student internship placement". Some "order classes" implemented by colleges even become hollow, with "only naming rights but no substantive education"—enterprises provide nominal support without participating in teaching, and the collaborative education pattern of deep interest binding and joint responsibility has not been formed[7].

##### 3.2.2 Talent cultivation-cluster demand mismatch

An obvious "time lag" exists between the talent cultivation system and cluster technological iteration. HVE curricula still take traditional disciplinary knowledge as the core framework, with core skill modules adapting to cluster upgrading (e.g., digitalization, intelligence) being either missing or insufficient. Taking manufacturing clusters as an example, while technologies like industrial robot operation and intelligent production line maintenance have been widely popularized, some higher vocational colleges still focus on basic skill training such as traditional machine tool operation—resulting in a "supply-demand mismatch" between talent output and cluster needs.

##### 3.2.3 Lack of collaborative governance mechanisms

The division of rights and responsibilities between universities and enterprises lacks clear norms. Key cooperation links such as training equipment maintenance, student internship safety guarantees, and teaching quality evaluation standards are vaguely defined. Interest distribution and risk sharing mechanisms are unsound: enterprises' investment in equipment, technology, and teachers is difficult to obtain reasonable returns, while higher vocational colleges are unwilling to bear potential risks of talent cultivation model reform due to insufficient special compensation funds. In addition, the "free-rider" phenomenon is prominent among small and medium-sized enterprises in clusters—they enjoy talent dividends relying on leading enterprises' cooperation resources but do not participate in talent cultivation investment, further restricting collaborative efficiency.

##### 3.2.4 Insufficient "double-qualified" teaching teams

The construction of "double-qualified" teaching teams faces a two-way bottleneck: "school teachers lack practice, enterprise teachers lack teaching skills". HVE professional teachers have solid theoretical teaching capabilities but most lack frontline industrial practical experience, making it difficult to accurately impart post practical skills and cutting-

edge technologies. Cluster enterprise technical backbones have rich practical experience but lack systematic teaching method training, unable to transform technical key points into teaching content suitable for HVE students' cognitive laws. The construction of cross-domain teacher sharing platforms lags behind, and normalized mechanisms such as university-enterprise mutual employment and job rotation have not been formed—leading to a "last mile" disconnection between teaching content and industrial practice.

### 3.3 Causes of Dilemmas

#### 3.3.1 Insufficient interest drive

Enterprises face significant "cost-benefit" imbalance in participating in talent cultivation. They need to invest explicit costs such as equipment procurement, technical backbone time, and training venue transformation, while bearing implicit risks like long talent cultivation cycles and uncertain graduate retention rates. However, cooperative benefits are mostly reflected in long-term talent supply, with no obvious short-term direct economic returns. Meanwhile, relevant policy incentives have implementation deviations: existing tax reductions, subsidies, and other policies are mostly inclined to leading enterprises, making it difficult for small and medium-sized enterprises to enjoy equal support. The subsidy scope is narrow, focusing more on hardware investment such as training base construction, with insufficient support for soft investment such as curriculum development and teacher training—directly leading to insufficient depth and sustainability of enterprise participation.

#### 3.3.2 Poor demand transmission

A three-level normalized demand feedback mechanism of "industrial cluster - core enterprise - higher vocational college" is lacking. At the cluster level, there is no unified talent demand research and information release platform, the bridge role of industry associations is not fully played, and differentiated demands of leading and small and medium-sized enterprises are difficult to integrate effectively. At the enterprise level, demand feedback mostly relies on the human resources department, with core post demands (e.g., technical, production departments) not effectively transmitted. Higher vocational colleges lack full-time docking teams, and there is no rapid transformation channel after receiving demand information. Adjustments to curriculum content and training standards lag behind cluster technological iteration, further exacerbating the talent-industry mismatch.

#### 3.3.3 Single evaluation system

The "school-oriented" evaluation orientation is obviously disconnected from actual industrial demands. The existing evaluation system still takes theoretical knowledge examinations and on-campus training assessments as core indicators, with enterprise evaluation only as an additional item—mostly a formality completed through simple methods like stamping internship appraisal forms. Core dimensions highly concerned by enterprises, such as practical proficiency, problem-solving ability, and professional quality, are not included in the evaluation core. More critically, evaluation results are not effectively connected with cluster skill certification systems. Graduates' skill levels lack authoritative enterprise endorsement; even those with excellent on-campus performance require secondary enterprise training after employment, highlighting the evaluation system's insufficient adaptability to industrial demands.

## 4 CONSTRUCTION OF HVE TALENT CULTIVATION PATHS SERVING REGIONAL INDUSTRIAL CLUSTERS FROM THE COMMUNITY PERSPECTIVE

### 4.1 Concept Innovation: Establishing the "Cluster-Oriented + Symbiosis and Common Prosperity" Cultivation Concept

#### 4.1.1 Higher vocational colleges

Completely abandon the traditional "discipline-oriented" school-running concept, establishing a service orientation of "taking cluster demands as the core and collaborative education as the support". Jointly establish a dynamic cluster development research mechanism with regional industry associations, regularly tracking cluster technological upgrading directions and post capability changes, and fully integrating core skill objectives and professional quality requirements into talent training programs. Reserve room for dynamic adjustment in top-level designs such as professional settings and curriculum development, breaking fixed teaching plans to achieve the core goal of "HVE precisely cultivating talents needed by industrial clusters".

#### 4.1.2 Enterprises

Break through the short-sighted "short-term employment-oriented" utilitarian thinking that overemphasizes immediate talent output, establishing a long-term symbiotic development concept of "talent cultivation as strategic investment" for mutual growth. Leading cluster enterprises should fully play their leading and driving role, proactively incorporating talent cultivation into their medium and long-term development strategies, deeply participating in core links such as talent specification formulation, curriculum system development, and practical training guidance, and effectively transforming enterprise technical standards and post operation specifications into specific, operable teaching content. Small and medium-sized enterprises should abandon the passive "free-rider" mentality, actively participating in university-enterprise cooperation through industry associations to share high-quality training resources and complementary teacher forces. They should fully recognize that university-enterprise collaboration not only secures highly adaptive talents to meet production needs but also leverages the scientific research strength of higher vocational education (HVE) institutions to solve practical technical problems, forming a virtuous cognition and interactive mechanism of "talent cultivation supporting enterprise upgrading and enterprise growth feeding back cultivation

optimization".

## **4.2 Mechanism Construction: Improving the Community Operation Guarantee System**

### **4.2.1 Interest linkage mechanism**

Construct a benefit balance system of "diversified benefit sharing + reasonable risk sharing", establishing a multi-dimensional benefit sharing model including talent transportation rewards, technological R&D dividends, and training service income. Provide incentives such as tax reductions and policy inclinations for enterprises deeply participating in curriculum development and teacher training, proportional to their investment. For small and medium-sized enterprises with insufficient investment capacity, industry associations should coordinate resources, sharing cooperation costs and talent dividends according to enterprise employment scale and demand proportion. Meanwhile, set up a risk reserve fund co-funded by the government, schools, and enterprises in a certain ratio to cover potential risks such as training equipment loss, student internship safety accidents, and cooperation project adjustments—ensuring stable community operation.

### **4.2.2 Collaborative governance mechanism**

Build a four-party collaborative governance structure of "school-enterprise-government-industry", establishing a council composed of HVE presidents, leading cluster enterprise chairmen, government department heads, and industry association secretaries-general as the core decision-making body. Hold quarterly demand docking meetings to coordinate core matters such as talent training plans and training base construction. Set up three special working groups (teaching reform, resource integration, quality evaluation) responsible for implementing specific cooperation tasks. Establish a closed-loop "decision-making - execution - supervision - optimization" mechanism: industry associations lead cooperation satisfaction evaluations, regularly feedback multi-party demands, adjust cooperation plans, and clarify responsibility boundaries to resolve the "free-rider" problem.

### **4.2.3 Demand feedback mechanism**

Build an "intelligent platform for regional industrial cluster talent demands" relying on digital technology. Enterprises can upload core information such as post demands and technological upgrading directions in real time. Industry associations integrate multi-enterprise demands to form the White Paper on Cluster Talent Demands, released regularly. Higher vocational colleges set up full-time docking teams, completing demand analysis within 72 hours and feeding back to teaching management departments. Establish a "monthly dynamic update + quarterly thematic discussion" demand transformation mechanism, adjusting curriculum modules and training content in response to cluster technological iteration—effectively solving the problem of lagging demand transmission.

## **4.3 Model Innovation: Constructing a "Cluster-Adaptive" Talent Cultivation System**

### **4.3.1 Modular curriculum system**

Based on cluster core post capability analysis, construct a three-level curriculum system of "general literacy module + professional core module + cluster characteristic module". The general literacy module focuses on vocational general abilities and basic theories; the professional core module aligns with key skills of cluster leading industries; the cluster characteristic module precisely meets industrial upgrading directions (e.g., intelligent operation modules for manufacturing clusters, digital service modules for service clusters). Establish a curriculum development team composed of university-enterprise backbone teachers, transforming enterprise technical standards and post operation specifications into teaching content to achieve dynamic curriculum-cluster alignment.

### **4.3.2 "Dual-cooperation" training model**

Build a dual-carrier training platform of "school-in-factory + factory-in-school". The "school-in-factory" introduces core enterprise production equipment and real projects, enabling students to participate in practical training on campus. The "factory-in-school" sets up teaching points in enterprise production sites, implementing an integrated "teaching - training - production" cultivation model. Drawing on the cooperation experience between Zhejiang Oriental Vocational and Technical College and McDonald's, arrange students to take turns in practical work during enterprise peak operation periods—with enterprise technical backbones responsible for practical guidance and school teachers conducting synchronous theoretical teaching, effectively resolving the disconnection between traditional training and actual production.

### **4.3.3 Customized cultivation upgrading**

Construct a "hierarchical and classified" customized cultivation system. For leading enterprises' specialized technology and refined post needs, set up "leading enterprise order classes"—with deep enterprise participation in the full cultivation process to achieve precise talent-post matching. For small and medium-sized enterprises' common skill demands, establish "cluster general skill classes" focusing on universally applicable core skills, balancing post adaptability and career mobility. For example, in iron and steel industry cluster cultivation, special metallurgical skill courses are customized for leading enterprises, while general equipment operation and maintenance courses are offered for small and medium-sized enterprises—realizing precise coverage of differentiated demands.

## **4.4 Support Strengthening: Consolidating the Foundation for Cultivation Implementation**

### **4.4.1 Cross-domain teaching team construction**

Establish a "two-way exchange, mutual employment, and co-cultivation" teacher development mechanism. Clearly

require HVE professional teachers to practice in cluster enterprises for a certain period each year, participating in technological research and development or production management to systematically master cutting-edge industrial technologies and post practical requirements. Select outstanding cluster technical backbones, incorporating them into the school's part-time teacher database after special teaching ability training to undertake training courses and skill guidance. Rely on industrial colleges to form university-enterprise joint teaching and research teams, jointly carrying out curriculum development and teaching reform. Directly link enterprise practical experience and university-enterprise cooperation achievements with teacher title evaluation and performance assessment, stimulating enthusiasm for collaborative education and building a high-quality "double-qualified" teacher pool.

#### **4.4.2 Quality evaluation system optimization**

Construct a three-dimensional linkage evaluation system of "school evaluation + enterprise evaluation + industry evaluation", breaking the single "school-oriented" pattern. Schools mainly evaluate students' theoretical foundation and learning ability; enterprises, as the core evaluation subject, focus on assessing practical skill proficiency, post adaptability, and professional quality through internship performance evaluation and post skill tests; industry associations organize third-party skill certification and industry literacy assessment based on professional standards to ensure alignment with industrial demands. Establish a closed-loop evaluation result feedback mechanism, directly using evaluation data to optimize curriculum content, improve teaching methods, and enhance teacher capabilities—giving full play to evaluation's "baton" role[8].

#### **4.4.3 Policy and resource guarantee**

Build a multi-dimensional guarantee system of "government guidance, university-enterprise co-construction, and industry coordination". Proactively secure special government funds for production-education integration, focusing on core areas such as university-enterprise co-built training bases, cross-domain teacher training, and curriculum development. Promote the implementation of enterprise school-running incentive policies, providing tax reductions and honorary recognition for enterprises deeply participating in talent cultivation, increasing support for small and medium-sized enterprises, and reducing their participation costs through subsidies and rewards. Universities and enterprises integrate high-quality resources: enterprises invest core equipment, technology, and project resources; schools provide venues, teaching management, and teacher resources to co-build and share training platforms and scientific research carriers. Industry associations play a coordinating role, optimizing resource allocation and providing services such as standard docking and information consulting—consolidating the resource foundation for community operation.

## **5 CASE ANALYSIS - TAKING ZHUHAI SEMICONDUCTOR AND INTEGRATED CIRCUIT INDUSTRIAL CLUSTER AS AN EXAMPLE**

### **5.1 Case Background**

Zhuhai Semiconductor and Integrated Circuit Industrial Cluster is a core carrier of strategic emerging industries in the Guangdong-Hong Kong-Macao Greater Bay Area, forming a complete industrial chain pattern of "Emphasize design, cultivate packaging and testing, and value innovation". It holds leading technological advantages in subdivided fields such as automotive-grade MCU and RISC-V architecture. The Zhuhai-Macao Collaborative Innovation Platform has gathered abundant innovative resources and enterprises, becoming an important engine for regional industrial upgrading. Cluster talent demand features distinct characteristics: ability structure emphasizing the compound nature of professional skills (e.g., chip design, packaging testing) and comprehensive abilities (e.g., data analysis, problem-solving); experience requirements prioritizing real project experience and industry certificates; technical adaptability requiring synchronization with chip technology iteration. As the first local HVE focusing on this field, Zhuhai City Polytechnic initially faced problems such as curriculum lagging behind industrial technology, lack of high-end training equipment, and insufficient "double-qualified" teacher professional capabilities—resulting in obvious talent-cluster demand mismatch. It therefore co-built a University-Enterprise Community of Shared Future with government departments, industry associations, and leading cluster enterprises to carry out targeted talent cultivation practices.

### **5.2 Practical Measures**

#### **5.2.1 Constructing a "government-industry-enterprise-school" collaborative governance system**

Under the guidance of relevant Zhuhai government departments, Zhuhai City Polytechnic took the lead in forming a collaborative education council with leading cluster enterprises (e.g., Ninesstar, Allwinner Technology) and the Zhuhai Semiconductor Industry Association. Quarterly demand docking meetings are held to coordinate talent training plans and skill standards. The government promotes cooperation implementation through carriers such as the Jinwan Intelligent Manufacturing Industrial College, setting up special support funds for training base construction and technological R&D projects, and providing tax reductions and policy inclinations for enterprises deeply participating in curriculum development and teacher training—stimulating multi-party participation enthusiasm.

#### **5.2.2 Full-chain embedding of enterprise demands into cultivation**

Universities and enterprises jointly established a professional teaching committee. Enterprise technical experts and school teachers co-refined talent training programs, transforming real enterprise R&D projects and technical standards into teaching cases and training materials. Technical experts from institutions such as the Southern Integrated Circuit Design Service Center regularly participate in classroom teaching and training guidance. Enterprises open advanced production lines and equipment (e.g., wafer testing, finished product packaging). Leading local packaging and testing

enterprises in Zhuhai provide dedicated real production workstations, arranging students to participate in on-the-job internships in core links (e.g., chip design, testing) after special skill training—achieving deep integration of teaching and production.

### **5.2.3 Precise reconstruction of the cultivation system by the school**

Breaking traditional professional setting frameworks, it subdivided cluster-adaptive professional directions such as RISC-V chip design, integrated circuit layout design, and automotive-grade chip testing. Built a three-level training system of "simulation - virtual training - real operation", reproducing high-end packaging process scenarios through VR technology—reducing training costs while ensuring core skill mastery. Established a special teacher enterprise practice mechanism, organizing professional teachers to participate in enterprise technological R&D, forming teaching and research teams with enterprise technical backbones to co-develop cluster-adaptive textbooks—continuously improving "double-qualified" teacher quality.

## **5.3 Implementation Effects**

### **5.3.1 Significantly improved talent cultivation adaptability**

Graduates' skill structures achieved precise matching with cluster post demands. Local counterpart employment rates and enterprise recognition increased substantially, with shortened post adaptation cycles—effectively reducing enterprise subsequent training costs. Graduates have become core talent reserves in shortage areas such as advanced packaging and chip testing, gaining high recognition from leading enterprises like Ninestar and Allwinner Technology.

### **5.3.2 Continuously enhanced industrial service capabilities**

The joint university-enterprise technical service team successfully solved multiple technical problems in chip testing, providing customized employee skill training for small and medium-sized cluster enterprises—helping improve their technical team professional levels and effectively supporting cluster "chain strengthening and supplementing".

### **5.3.3 Prominent model replication value**

Formed a replicable cultivation model of "government-industry-enterprise-school collaborative governance + subdivided direction customized cultivation + three-level training system guarantee". Through university-enterprise resource integration, it avoided redundant construction of high-end school equipment. Relevant practical experience has been adopted by multiple HVEs in western Guangdong, providing a mature model for talent cultivation in similar industrial clusters and realizing deep coupling of the education chain and industrial chain.

## **6 CONCLUSIONS AND PROSPECTS**

### **6.1 Research Conclusions**

Taking the University-Enterprise Community of Shared Future as the core perspective, relying on stakeholder, industrial cluster, and collaborative governance theories, this study systematically explores the talent supply-demand adaptation problem of HVE serving regional industrial clusters. Core conclusions are as follows: First, the University-Enterprise Community of Shared Future is the key link to resolving insufficient HVE-cluster demand adaptability. Its core characteristics of "interest symbiosis, joint responsibility, and development coordination" effectively break traditional university-enterprise cooperation barriers of "superficial docking and one-way output". The Zhuhai Semiconductor and Integrated Circuit Cluster case confirms that community construction gathers multi-party efforts (schools, enterprises, governments, industries) to form a collaborative education pattern. Second, current HVE talent cultivation serving regional industrial clusters faces four core dilemmas: loose community connections, talent-demand mismatch, insufficient collaborative mechanisms, and weak "double-qualified" teams—rooted in three constraints: insufficient interest drive, poor demand transmission, and a single evaluation system. Third, constructing a four-dimensional linkage path system of "concept innovation - mechanism construction - model innovation - support strengthening" effectively resolves these dilemmas: concept innovation establishes "cluster-oriented + symbiosis and common prosperity" cognition; mechanism construction improves three guarantee mechanisms (interest linkage, collaborative governance, demand feedback); model innovation creates three core systems (modular curriculum, dual training, customized cultivation); support strengthening consolidates three implementation foundations (teachers, evaluation, resources)—forming a complete talent cultivation optimization closed loop. The Zhuhai case further verifies the path's feasibility and adaptability.

### **6.2 Future Prospects**

Future research can be deepened and expanded in four aspects: First, focusing on the digital transformation background, explore application paths of artificial intelligence and big data in dynamic cluster talent demand prediction, real-time modular curriculum updates, and virtual training scenario reconstruction—resolving the core contradiction between rapid industrial technological iteration and relatively fixed talent cultivation cycles. Second, expand research sample coverage, selecting different types and development stages of industrial clusters (e.g., Yangtze River Delta equipment manufacturing, Pearl River Delta cross-border e-commerce) for comparative analysis of talent demand characteristics and community construction differentiated laws, extracting classified adaptive talent cultivation models. Third, deepen research on long-term community operation mechanisms, exploring construction paths of differentiated policy incentive systems and cross-regional collaborative governance mechanisms to address practical issues such as insufficient small

and medium-sized enterprise participation motivation and cross-regional cluster collaborative education barriers. Fourth, conduct cross-regional comparative research, systematically sorting core characteristics of international models (e.g., Germany's dual system, Australia's TAFE), exploring localization adaptation points combined with China's regional industrial cluster development reality, comparing production-education integration model differences between the Guangdong-Hong Kong-Macao Greater Bay Area and the Yangtze River Delta—providing more universal theoretical and practical support for improving regional production-education integration ecosystems.

## COMPETING INTERESTS

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## REFERENCES

- [1] Ge Xiaobo. Era Implication, Practical Dilemmas, and Path Selection for the Construction of School-Enterprise Community of Shared Future in Vocational Colleges. *China Higher Education Research*, 2021(05): 98-102.
- [2] Zheng Yiqi. Reform and Practice of the Talent Training Model for Higher Vocational Marketing Majors Based on School-Enterprise Cooperation. *Scientific Journal Of Humanities and Social Sciences*, 2025, 7(1): 20-26.
- [3] Liu Yang, Jun Mengyan, Zhang Yanyan. Exploration and Practice of the "Tailor-made" Talent Cultivation Model under the Mode of Deepening School-Enterprise Cooperation. *Journal of Modern Educational Theory and Practice*, 2025, 1(3): 45-50.
- [4] Geng Xuazhen. Analysis on the Construction of Modular Teaching System in Colleges and Universities from the Perspective of Integration between Industry and Education. *Journal of Industry and Engineering Management*, 2023, 1(3): 32-36.
- [5] Wang Yan. "Co-construction" to "Symbiosis": Research on the Integrated Governance Mechanism of Industrial Colleges in Higher Vocational Colleges. *Journal of Contemporary Educational Research*, 2021, 5(9): 142-146.
- [6] Zhu Jinfeng, Wang Yanfeng, Zhang Dinghua. Construction Path and Practice of Building a Community of Shared Future Between Universities and Enterprises from the Perspective of Industrial College—Taking "Ruipai" Pet Medical Industrial College of Henan Agricultural Vocational College as an Example. *Chinese Vocational and Technical Education*, 2021(13): 87-92.
- [7] Jia Xingdong. Establishing a Community of Shared Future Between Universities and Enterprises for Collaborative Training of Technical and Skilled Talents. *Chinese University Science & Technology*, 2017(06): 78-80.
- [8] Xu Hongqin. Research on the Development Strategies of Integration of Production and Education in Vocational Education from the Perspective of Community of Shared Future. *Education and Vocation*, 2021(05): 45-49.