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Exploring the Construction Path of Specialized Programs in Private Vocational Colleges Under Regional Industrial Demand Orientation: A Case Study of Hainan Vocational University of Science and Technology

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Abstract: In the context of China's vigorous promotion of vocational education and high-quality regional economic development, private vocational undergraduate institutions serve as crucial bridges connecting vocational training with regional industries. These institutions must develop distinctive professional clusters centered on local industrial demands. Taking Hainan Vocational University of Science and Technology as a case study, this paper analyzes the current practices and challenges in building specialized academic programs within the university's framework, aligned with the industrial development needs of the Hainan Free Trade Port. Through examining five key dimensions—industry demand research mechanisms, dynamic program adjustments, deep integration of industry-education collaboration, faculty development, and quality evaluation systems—the study explores pathways for constructing distinctive professional clusters in private vocational institutions, providing actionable references for similar educational organizations to support regional industrial advancement.

Keywords: Regional industrial demand; Private vocational undergraduate; Characteristic major group; Hainan Vocational University of Science and Technology; Industry-education integration

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1. Introduction

The 2024 "Guidelines on Deepening the Modern Vocational Education System" explicitly states that vocational undergraduate institutions should "align with regional industrial upgrading priorities and develop specialized program clusters that match local economic structures" [1]. As a key national strategic zone, Hainan Free Trade Port has prioritized the development of tourism, modern service industries, high-tech sectors, and tropical specialty agriculture (collectively termed the "3+1" key industries) in recent years, resulting in explosive growth in demand

for high-level technical and skilled professionals [2–3].

Private vocational undergraduate institutions, leveraging their flexible operational mechanisms and direct industry connections, have become vital forces in meeting regional talent demands. However, some institutions still face challenges in developing specialized program clusters, including "disconnection from industry needs, insufficient coordination among programs within clusters, and inadequate integration of industry and education" [4–5]. As one of Hainan Province's first privately-run vocational undergraduate institutions, Hainan Science and Technology Vocational University has accumulated valuable experience in building distinctive program clusters by aligning with the industrial layout of the Hainan Free Trade Port. This paper takes the university as a case study to explore development pathways for specialized program clusters under regional industry demand orientation, offering significant theoretical and practical implications [6].

2. The logical relationship between regional industrial demand and characteristic professional groups of private vocational undergraduate colleges

2.1. Regional industrial demand is the core orientation of the construction of characteristic professional groups

The structural adjustment and upgrading of regional industries directly determine the types, levels, and specifications of talent demand. Private vocational undergraduate institutions position their educational focus on "serving regional economic development", with their program clusters closely aligned with the "industry chain, supply chain, and innovation chain" of local industries. This approach cultivates high-level technical and skilled professionals who possess "solid theoretical foundations, advanced technical expertise, and industry adaptability." For instance, in the "3+1" key industries of Hainan Free Trade Port, the tourism sector's demand for "smart tourism management and international hotel management" professionals, and the high-tech industry's need for "new energy technology and artificial intelligence applications" experts, all provide clear directions for developing distinctive program clusters [7–9].

2.2. Specialized program clusters serve as the core platform for private vocational undergraduate institutions to support regional industries

Through cluster-based development guided by core disciplines and supported by related fields, specialized program clusters effectively dismantle traditional disciplinary barriers [10]. This approach achieves seamless alignment between curriculum content and professional standards, as well as between teaching processes and real-world production workflows, cultivating versatile professionals that meet industry demands [11]. Compared to single-discipline programs, these clusters better address regional industrial needs characterized by "multi-role collaboration and cross-domain integration." Serving as a strategic lever, they empower private vocational undergraduate institutions to enhance industrial service capabilities and strengthen their core competitiveness [12].

3. The current situation of the construction of characteristic major groups in Hainan Vocational University of Science and Technology

3.1. Relying on the industrial layout of Hainan Free Trade Port, the construction direction of professional groups is clarified

Hainan Vocational University of Science and Technology has established four distinctive professional clusters

aligned with Hainan's "3+1" key industries [13]. These include: 1) Smart tourism service and management cluster: Centered on "Tourism Management" to meet the needs of Hainan's International Tourism Consumption Center, supported by related fields like "Hotel Management", "Exhibition Economy and Management", and "Business English." This cluster cultivates technical professionals for international hotel operations, smart scenic area management, and cross-border exhibition services. 2) new energy and intelligent connected vehicles cluster: Focused on "New Energy Vehicle Engineering Technology" to comply with Hainan's "2030 Fuel Vehicle Ban" policy, complemented by "Automotive Service Engineering" and "Intelligent Connected Vehicle Technology." It trains high-level professionals for new energy vehicle R&D support, inspection/maintenance, and smart operations. 3) Tropical specialty high-efficiency agriculture cluster: Rooted in "Horticultural Technology" and leveraging Hainan's tropical agricultural resources, supported by "Food Quality and Safety" and "Agricultural Biotechnology." This cluster develops technical experts for tropical crop cultivation, agricultural product processing, and quality inspection. 4) Cross-border trade and financial services cluster: Centered on "International Economics and Trade" to align with Hainan Free Trade Ports' "Zero Tariff, Low Tax Rate" policy, supported by "Fintech Applications" and "Customs Declaration and International Freight." The industry cultivates interdisciplinary talents in cross-border e-commerce operation, international logistics management, and free trade port financial services [14–15].

3.2. Deepen the integration of industry and education, and build a practical teaching platform for professional groups

Guided by industry demands, the university has established in-depth partnerships with over 20 leading enterprises in Hainan, jointly building "Industry Colleges" and "Practical Teaching Bases" to provide practical support for professional cluster development [16]. In collaboration with Hainan New Energy Vehicle Group, they co-created the "New Energy Vehicle Industry College", integrating real production projects from enterprises. Courses such as "New Energy Vehicle Battery Testing" and "Motor Repair" were brought directly into corporate workshops, achieving seamless integration of "teaching-practice-employment." Through cooperation with Hainan International Convention and Exhibition Center, they established an "Exhibition Practice Teaching Base" where students majoring in "Exhibition Economy and Management" participate in planning and execution of large-scale events like the Boao Forum for Asia and Hainan International Tourism Island Festival, enhancing their practical skills [17]. Additionally, in partnership with Hainan Tropical Agricultural Science Academy, they developed a "Tropical Crop Cultivation Training Base" offering hands-on instruction in tropical fruit cultivation and pest control for students in the "Horticulture Technology" program, effectively translating research achievements into teaching content [18].

3.3. Optimize the curriculum system to match the ability requirements of industrial positions

For the industrial job groups corresponding to the professional groups, the university has reconstructed the "modular and project-based" curriculum system:

Core curriculum modules: These modules are designed around essential job competencies in key disciplines, such as "New Energy Vehicle Power System Design" and "Intelligent Connected Vehicle Control Systems" for the "New Energy Vehicle Engineering Technology" program [19]. Related curriculum modules: These connect with professional requirements across related disciplines within the cluster, including "Cross-border Tourism Service Etiquette" and "Digital Operations of Smart Scenic Areas" for the "Smart Tourism Service and Management"

program, covering roles in hotel management and exhibition services. Industry-specific Modules: These integrate Hainan Free Trade Port's industrial characteristics, such as "Hainan Free Trade Port Tariff Policy Implementation" and "Cross-border E-commerce Live Streaming Operations" for the "Cross-border Trade and Financial Services" program, ensuring curriculum content closely aligns with regional industry demands [20].

4. Challenges in the construction of characteristic major groups in Hainan Vocational University of Science and Technology

4.1. The industrial demand research mechanism is not perfect, and the adjustment of professional groups lags behind

While the school has conducted industry demand research, the research remains predominantly school-led with limited participation from enterprises and industry associations. The survey methods mainly rely on "roundtable discussions and questionnaires", lacking dynamic tracking of industry job competency requirements. Furthermore, the research outcomes are not closely integrated with adjustments to academic program clusters. This disconnect results in some specialized programs lagging behind emerging industries in the Hainan Free Trade Port (such as marine engineering equipment and digital trade), making it difficult to promptly respond to talent demand changes driven by industrial upgrading.

4.2. Insufficient collaboration within the professional cluster and low efficiency in resource integration

Some professional clusters face challenges in coordinating core and related disciplines. Firstly, the curriculum lacks systematic integration, resulting in redundant teaching and content fragmentation. For instance, the "Cross-border Trade and Financial Services" cluster overlaps content between "International Trade Practice" and "Cross-border E-commerce Operations", while "Free Trade Port Financial Policies" lacks a proper connection with "International Freight Forwarding." Secondly, practical training resources remain underutilized. The automotive inspection laboratory in the "New Energy and Intelligent Connected Vehicles" cluster, for example, is exclusively accessible to core majors, leaving related disciplines with limited access—a situation that leads to resource waste.

4.3. The integration of industry and education is not deep enough, and the team of "double-qualified" teachers is weak

While the school has established partnerships with enterprises, most collaborations remain at a superficial level of "jointly building training bases and corporate guest lecturers", without forming a deep cooperation mechanism of "joint talent cultivation, shared benefits, and risk-sharing." For instance, enterprises show limited enthusiasm in curriculum design and teaching evaluation, with only a small proportion of real production projects being integrated into teaching. Meanwhile, the development of "dual-qualified" faculty faces bottlenecks: less than 30% of full-time teachers have industry experience, and part-time corporate instructors struggle to maintain consistent participation due to busy schedules. This results in an imbalance between the teacher's "industry practice capabilities" and "teaching competencies."

4.4. The quality evaluation system is single and lacks diversified evaluation with industrial participation

The current quality evaluation of the school's professional clusters still primarily focuses on "teaching indicators"

such as "employment rate, course pass rate, and practical training hours", while neglecting core metrics like "industry alignment, corporate satisfaction, and students' job competency." With the school as the sole evaluator and limited participation from enterprises, industry associations, and graduates, the assessment results fail to accurately reflect the cluster's effectiveness in serving regional industries. This lack of input prevents the development of scientific evidence for optimizing and adjusting the professional clusters.

5. Construction path of characteristic major groups in private vocational undergraduate colleges under regional industrial demand orientation

Based on the practice of Hainan Vocational University of Science and Technology and the orientation of regional industrial demand, private vocational undergraduate colleges can optimize the construction path of characteristic major groups from the following five dimensions:

5.1. Establish a collaborative industry demand research mechanism involving government, industry, enterprises, and academia to enable dynamic adjustments to professional clusters

Establish an "Industrial Demand Research Committee" comprising government agencies (e.g., Hainan Provincial Department of Education, Department of Human Resources and Social Security), industry associations (e.g., Hainan Tourism Association, New Energy Vehicle Association), leading enterprises, and educational institutions. The committee will define clear responsibilities: government agencies provide industrial policies and talent demand data; industry associations establish job competency standards; enterprises share authentic job requirements; and educational institutions oversee research organizations and data integration.

Establish a "Dynamic Industry Demand Tracking Platform": By leveraging big data technology, the committee collects real-time information on job openings, competency requirements, and technological upgrades across the "3+1" key industries in Hainan Free Trade Port. The platform regularly publishes the "Industry Talent Demand White Paper" to provide data-driven support for adjusting academic programs. For instance, in response to the rise of Hainan's digital trade sector, the committee promptly added the "Digital Trade Technology Application" specialization to the "Cross-border Trade and Financial Services Program Cluster."

Formulate the "dynamic adjustment mechanism of professional group": According to the research results, the "professional setting, curriculum system, and training direction" of the professional group should be evaluated and adjusted every two years to ensure that the professional group always keeps in sync with the regional industrial needs.

5.2. Strengthen coordination within professional groups and improve the efficiency of resource integration

To coordinate curriculum system design, the committee establishes a "professional cluster curriculum matrix" centered on "industry position competency clusters." Led by core disciplines, this framework collaborates with faculty from related fields and industry experts to define clear teaching objectives, content modules, and interconnections across courses, thereby preventing redundant instruction and content fragmentation. For instance, the "Smart Tourism Service and Management Professional Cluster" organizes "tourism services" into three tiers: "basic competencies", "specialized competencies", and "comprehensive competencies." Core and related disciplines, respectively, deliver courses at these distinct levels.

To enhance resource sharing in practical training, the committee will establish a "Professional Cluster

Training Resource Sharing Center" to centrally manage laboratories, training bases, and teaching equipment within the cluster, while formulating shared usage policies. For instance, the automotive inspection laboratory under the "New Energy and Intelligent Connected Vehicle Professional Cluster" can be opened to all disciplines within the cluster, enabling efficient resource utilization through a reservation system. Additionally, the committee will promote cross-disciplinary training project designs, such as organizing a "New Energy Vehicle Exhibition" training program where core discipline students provide technical support, while students from related disciplines handle exhibition planning and management, thereby strengthening interdisciplinary collaboration within the cluster.

5.3. Deepen the integration of industry and education, and build a "double-qualified" teaching team

Establishing a "deeply integrated industry-education collaboration mechanism": Through "industry-academy partnerships", institutions sign talent cultivation agreements with enterprises to clarify corporate responsibilities. Enterprises are required to contribute technical experts for curriculum design, deliver practical training programs, and provide real-world production projects. In return, schools offer technical training and research support, achieving mutual benefits. A prime example is the "New Energy Vehicle Industry Academy" co-established with Hainan New Energy Automobile Group, which mandates enterprises to integrate at least 5 authentic R&D projects into annual curricula while training no fewer than 100 technical professionals for the industry each year.

Enhancing the cultivation and recruitment mechanism for dual-qualified teachers: On one hand, implementing the "Teacher Enterprise Practice Program" requires full-time teachers to complete at least six months of corporate internships every three years, with practical experience factored into professional title evaluations. On the other hand, intensifying efforts to recruit corporate experts through flexible recruitment and high-salary hiring strategies, attracting corporate technical directors and senior engineers to serve as full-time faculty or academic leaders. Simultaneously, establishing a "School-Enterprise Dual Mentorship System" assigns students both academic advisors from universities and industry mentors from enterprises, providing joint guidance for students' learning and practical training.

5.4. Establishing a "multi-dimensional quality evaluation system with industrial participation"

The committee has established clear evaluation criteria, with "industry adaptability" as the core metric. This includes: "student satisfaction (30%), workplace competency (25%), industry contribution rate of professional clusters (20%), graduate salary levels (15%), and employment rates (10%)", ensuring alignment with regional industrial demands. A four-party evaluation mechanism has been implemented involving schools, enterprises, industry associations, and graduates. Schools evaluate teaching processes, enterprises assess practical skills, industry associations verify compliance with professional standards, and graduates provide feedback on curriculum relevance. For example, enterprises annually rate graduates "job-specific skills and professional ethics", while industry associations evaluate whether the curriculum meets industry standards.

Enhance the application of evaluation outcomes by integrating them with professional cluster adjustments, faculty assessments, and deepening school-enterprise collaboration. For instance, if an industry satisfaction rate below 80% is recorded for a specific professional cluster, the curriculum system and practical training orientation of that cluster must undergo re-evaluation and adjustment. Similarly, when instructors receive low competency

ratings from students in workplace assessments, they should be assigned to participate in enterprise practice training programs.

5.5. Relying on regional policy advantages to secure resource support

Private vocational undergraduate institutions should fully leverage regional industrial policies and vocational education policies to secure resource support for developing distinctive specialty clusters. For instance, Hainan Vocational University of Science and Technology could apply for "Special Funds for Specialty Cluster Development" under the Hainan Free Trade Ports "Several Policies Supporting Vocational Education Development", which would fund practical training base construction and cultivate "dual-qualified" faculty. Simultaneously, by aligning with key industrial projects in the Hainan Free Trade Port, such as the "International Tourism Consumption Center Development Project" and "New Energy Vehicle Promotion Project", the university could seek to integrate specialty cluster development into corporate talent cultivation plans, thereby obtaining dual resource support from both enterprises and government authorities.

6. Conclusion

Regional industrial demands serve as the fundamental guideline for developing distinctive specialty clusters in private vocational undergraduate institutions, which act as the core vehicles for these institutions to support regional industrial development. The experience of Hainan Vocational University of Science and Technology demonstrates that private vocational undergraduate institutions must implement five key strategies: refining industrial demand research mechanisms, enhancing collaboration within specialty clusters, deepening industry-education integration, establishing diversified quality evaluation systems, and securing regional policy support. These measures collectively enable the creation of specialty clusters that are highly aligned with regional industrial needs.

As Hainan Free Trade Port construction progresses, Hainan Vocational University of Science and Technology must optimize its distinctive program clusters to address challenges, including delayed industry demand alignment, insufficient industry-education integration, and underdeveloped faculty teams, thereby enhancing its capacity to serve regional industries. Meanwhile, its experience provides valuable references for similar private vocational undergraduate institutions nationwide, promoting high-quality coordinated development between private vocational education and regional economies.

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Disclosure statement

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