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Analysis of the Coupling between Vocational Undergraduate Program Development and Market Demand under the Deep Integration of Industry and Education

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Abstract: The coupling effectiveness between vocational undergraduate program development and market demand is a key indicator for measuring educational quality and service capabilities. Based on the perspective of industry-education integration, this study systematically analyzes the theoretical basis, practical requirements, and the adaptation relationship with regional industrial structures of vocational undergraduate program development. The study reveals deep-seated problems in the current program development, such as structural mismatch, mechanistic obstacles, and disconnection in the training process, mainly manifested as program homogenization, superficial industry-education integration, and weak student job adaptability. To address these issues, a systematic solution is constructed, including multi-entity collaborative governance, professional cluster construction, school-enterprise collaborative education, and dynamic early warning evaluation. The study proposes that reforms should be promoted from three levels: provincial policy guidance, municipal overall coordination, and internal governance of colleges and universities, to establish a rapid-response and dynamically optimized program development mechanism, providing theoretical reference and practical paths for enhancing the adaptability and service contribution of vocational undergraduate education.

1. Introduction

As a crucial component of China's modern vocational education system, professional undergraduate education holds an irreplaceable strategic position in serving the high-quality development of regional economies and cultivating high-level, technically skilled talent[1]. With the deepening of a new round of technological revolution and industrial transformation, the industrial structure is accelerating its shift towards technology-intensive and intelligent directions, placing higher demands on talent's job adaptability, technological integration capabilities, and innovative literacy[2]. Against this backdrop, the establishment of disciplines, as a nexus connecting educational supply and industrial demand, directly determines the effectiveness of professional undergraduate education in nurturing talent and its service capabilities.

Industry-education integration, as the fundamental institutional arrangement for vocational education, provides the basic framework for the establishment of professional undergraduate disciplines[3]. It requires that the disciplinary structure must be aligned with the regional industrial layout, the curriculum content must be synchronized with the technological evolution of enterprises, and talent cultivation must be matched with the requirements of job competencies. However, current professional undergraduate institutions still face practical problems in the process of establishing disciplines, such as an unsound research mechanism, a low degree of matching with industrial needs, and a lack of dynamic adjustment mechanisms, leading to a structural mismatch between educational supply and market demand[4]. This not only restricts the employment competitiveness and career development potential of graduates but also weakens the supporting role of professional undergraduate education in regional industrial upgrading.

Therefore, this study, based on the perspective of deep industry-education integration, focuses on the coupling relationship between the establishment of professional undergraduate disciplines and market demand, aiming to systematically analyze the internal logic, realistic dilemmas, and optimization paths between the two. By constructing a dynamic coupling model of professional discipline establishment of "demand-supply-feedback-adjustment," this study explores the establishment of a multi-party collaborative, responsive, and continuously optimized professional governance mechanism, thereby enhancing the social adaptability, service contribution, and sustainable development capabilities of professional undergraduate education.

2. Theoretical Foundations and Practical Requirements

The establishment of majors in vocational bachelor's education is not a simple teaching arrangement but a complex multi-dimensional system involving educational philosophy, industrial economics, and institutional design[5,6]. In-depth analysis of its theoretical foundations and practical requirements is the prerequisite for constructing a scientific and rational major establishment mechanism.

2.1 Typological Characteristics and Educational Positioning of Vocational Bachelor's Degrees

The essential characteristics of vocational bachelor's degrees lie in the unified triad of "vocational nature," "high level," and "adaptability." From the perspective of educational typology, Professor Pan Maoyuan's theory of educational types provides a crucial framework for understanding vocational bachelor's degrees. Vocational bachelor's degrees are not a simple extension of associate degree education, nor are they a vocational education version of ordinary bachelor's degrees, but a new type of education with independent value. In terms of talent cultivation goals, it pursues the in-depth development of technical skills and the ability to integrate and apply theoretical knowledge, aiming to fill the structural talent gap between the insufficient theoretical depth of traditional associate degree graduates and the weak practical ability of ordinary bachelor's graduates.

This type of positioning determines that the internal logic of vocational bachelor's degree major establishment must follow the "vocational ability-oriented" principle. The logical starting point for major establishment is not a disciplinary system but the ability requirements of specific occupational clusters or technical fields. This makes the professional connotation transcend single-skill training and shift to the systematic cultivation of compound abilities covering technology application, process innovation, production management, and teamwork. The major establishment of vocational bachelor's degrees, therefore, becomes a core node connecting vocational education and industrial upgrading, and its level of establishment directly reflects the education system's ability to respond to industrial changes.

2.2 Logical Relationship between Industry-Education Integration System and Major Establishment

Industry-education integration has risen from a school-running concept to a basic system of vocational education, and its legal status has been established through policy documents such as the "Vocational Education Law" and the "Administrative Measures for the Establishment of Undergraduate Vocational Education Majors (Trial)." This institutional arrangement provides a mandatory framework for the establishment of vocational bachelor's degree majors, requiring that major establishment be embedded in the regional industrial development ecosystem to realize the organic connection of the education chain, talent chain, industry chain, and innovation chain.

Under the industry-education integration system, the essence of major establishment is an institutionalized matching process between educational supply and industrial demand. This matching is reflected in three levels: At the strategic level, major planning needs to be synchronized with regional industrial development planning to ensure that educational investment is consistent with regional strategic priorities; at the content level, the curriculum system and curriculum standards need to incorporate industry technical standards and vocational ability requirements to maintain dynamic adaptation of educational content and technological development; at the process level, teaching activities need to be deeply integrated with enterprise production practices, and school-enterprise collaborative education is used to achieve the contextualization and realization of talent cultivation[7].

This institutional requirement makes major establishment transcend the scope of institutional autonomy and become a public governance affair requiring the joint participation of multiple entities such as the government, industry, and enterprises. The major establishment under the framework of industry-education integration actually constructs a stakeholder collaboration network with talent cultivation as the core, and its effectiveness depends on the degree of institutionalization and collaboration efficiency of all parties' participation.

2.3 Intrinsic Drive of Market Demand on Program Development

Against the backdrop of the knowledge economy and digital transformation, the driving role of market demand in the development of vocational bachelor's degree programs is becoming increasingly significant and complex. This driving force is not only reflected in the demand for talent quantity but also profoundly reflected in changes in talent structure, ability dimensions, and quality requirements.

From the perspective of industrial structure evolution, the digital transformation of traditional industries and the rise of strategic emerging industries have spawned a large number of emerging vocational positions and technology fields. These emerging fields place new demands on the knowledge integration, technology transfer ability, and innovative literacy of talents, directly driving the vocational bachelor's degree program development to break through the boundaries of traditional disciplines and develop towards interdisciplinary and integrated directions. For example, emerging fields such as intelligent manufacturing, digital twins, and the industrial Internet require program development to integrate multiple disciplines such as mechanical engineering, information technology, and data analysis to form a comprehensive knowledge system for problem-solving.

From the perspective of the pace of technological change, the acceleration of technology iteration cycles has significantly shortened the professional half-life, and one-time professional skill acquisition can no longer meet the needs of career development. This requires vocational bachelor's degree program development to shift from "job skill matching" to "vocational ability foundation," strengthening students' basic theoretical literacy, lifelong learning ability, and job transfer ability. Program development should focus on building a sustainably updated ability framework rather than

a fixed list of knowledge and skills.

From the perspective of regional economic characteristics, there are significant differences in the industrial agglomeration and development strategies of different regions. This difference requires vocational bachelor's degree program development to reflect regional characteristics and form a strategic match with local industrial clusters. The local adaptability of program development has become a key indicator for measuring its scientific nature and an important way for vocational bachelor's degree colleges to form core competitiveness.

3. Analysis of the Coupling Status and Problems between Vocational Bachelor's Degree Program Settings and Market Demand

Vocational bachelor's education, as a crossover between higher education and vocational education, directly impacts educational effectiveness and service levels through the degree of coupling between its program settings and market demand. Currently, China's vocational bachelor's degree program settings are in a critical phase of transitioning from scale expansion to intrinsic development, and the coupling mechanism with market demand is not yet sound, with multiple structural contradictions and mechanistic obstacles.

3.1 Insufficient Matching between Program Settings and Industrial Structure

The adaptability of vocational bachelor's degree program settings to regional industrial structures still needs improvement. From a macro layout perspective, the homogenization of program settings is a prominent phenomenon. In their program planning, many vocational bachelor's colleges tend to focus on opening professional fields with relatively low operating costs and strong student appeal, such as finance, economics, trade, and electronic information[8]. However, there is a clear lack of program layout related to technology-intensive industries such as high-end equipment manufacturing, new materials, and biomedicine, which are urgently needed for regional economic development. This professional convergence leads to the dispersion of educational resources, making it difficult to form professional clusters that match regional industrial characteristics, and also creates a structural contradiction in which the supply of talent in specific fields is both excessive and scarce.

From the perspective of connection accuracy, there is a lag in the connection between the existing professional system and the direction of industrial upgrading. Faced with industrial transformation trends such as intelligent manufacturing and digital transformation, vocational bachelor's colleges are slow to respond in terms of professional content updates and curriculum system restructuring. The training programs of most majors still focus on traditional technology systems and fail to incorporate emerging technological elements such as the Industrial Internet, digital twins, and artificial intelligence in a timely manner, resulting in a clear generational difference between the knowledge structure of graduates and the cutting-edge needs of the industry. This lag is particularly prominent in rapidly iterating technology-intensive industries, directly affecting graduates' job adaptability and career development potential.

3.2 Mechanistic Obstacles in the Program Setting Process

The decision-making mechanism for vocational bachelor's degree program settings is not yet perfect, which restricts its effective connection with market demand. In the research and demonstration stage, most colleges' professional setting research has problems such as limited scope, single methods, and insufficient depth. The research subjects are mostly concentrated in existing cooperative enterprises, lacking comprehensive coverage of upstream and downstream enterprises

in the industrial chain; the research methods rely excessively on questionnaire surveys and secondary data, lacking in-depth job competency analysis and technical path research; the research content focuses on short-term employment needs, ignoring the long-term requirements of industrial technology evolution and organizational change for talent capabilities. This superficial research is difficult to support the scientific decision-making of professional settings.

At the level of school-enterprise cooperation, the insufficient depth of industry-education integration leads to a lack of effective participation from an industrial perspective in professional settings. Although most vocational bachelor's colleges have established school-enterprise cooperation mechanisms, corporate participation mostly stays at a superficial level, such as providing internship positions and accepting student visits, and fails to deeply participate in core links such as professional standard setting, curriculum development, and teaching quality evaluation. At the same time, the stability and sustainability of cooperative relationships are insufficient, making it difficult to form a long-term mechanism for joint construction and management. This superficial cooperation makes it difficult for professional settings to accurately reflect the real needs and technological dynamics of enterprises.

In terms of teacher participation, the synergy between professional settings and teacher development is insufficient. Most teachers in vocational bachelor's colleges lack first-line work experience in the industry, and their understanding of new technologies and new processes mostly stays at the theoretical level, making it difficult to effectively transform cutting-edge technological elements into teaching content. At the same time, the teacher evaluation system focuses on scientific research and teaching workload, and there is insufficient incentive to participate in professional construction and curriculum reform, which weakens teachers' intrinsic motivation to participate in professional settings and optimization.

3.3 Disconnection in Cultivating Students' Job Adaptability

Vocational bachelor's programs have systemic shortcomings in cultivating students' job adaptability. From the perspective of ability structure, the existing training model overemphasizes proficiency in specific job skills, and the cultivation of students' cross-job transfer ability, technology integration ability, and innovative problem-solving ability is clearly insufficient. In an intelligent production environment, technical workers need to shift from single-skill operations to composite abilities such as multi-equipment collaboration, process optimization, and anomaly handling. However, current professional teaching still focuses on standardized skill training, which is difficult to meet the needs of enterprises for "multi-skilled in one specialty" composite talents.

From the perspective of the training process, the integration of theoretical and practical teaching is insufficient. Although vocational bachelor's programs emphasize practical teaching, there is a large gap between the content of practical training and the real production scenarios of enterprises. The updating of on-campus practical training equipment lags behind the technological upgrades of enterprises, and the practical training projects are mostly verification and simulation tasks, lacking comprehensive and innovative practical links. This kind of practical training that is divorced from the real production context makes it difficult to cultivate students' ability to solve complex engineering problems and their awareness of technological innovation.

From a development perspective, insufficient attention is paid to students' professional qualities and sustainable development capabilities. Modern enterprises' expectations for talent have surpassed purely technical skills, and they pay more attention to qualities such as craftsmanship, quality awareness, teamwork, and independent learning. However, the current professional teaching still focuses on technology transfer as the core, and the cultivation of students' professional identity, professional ethics, and career development capabilities is relatively weak, which affects the

long-term competitiveness of graduates in their careers.

4. Paths to Building a Coupling Mechanism between Vocational Bachelor's Degree Program Settings and Market Demand

To resolve the structural contradiction between vocational bachelor's degree program settings and market demand, it is necessary to construct a systematic coupling mechanism with multi-party collaboration and dynamic adaptation. This mechanism should focus on the integration of industry and education, run through the entire process of program settings, and achieve effective alignment between education supply and industry demand.

4.1 Building a Multi-Agent Collaborative Governance Model for Program Settings

Establishing a collaborative governance model for program settings with government guidance, in-depth participation of industry enterprises, implementation by higher education institutions, and third-party evaluation is crucial. At the government level, macro-level coordination should be strengthened by formulating industrial talent demand forecast reports and program setting guidance catalogs to provide directional guidance for program settings in higher education institutions. Industry organizations should play a bridging role, organizing the formulation of industry competence standards and technical specifications to provide a basis for professional certification. Enterprises need to transform from resource providers to strategic partners, substantially participating in the formulation of talent training programs, curriculum development, and teaching quality evaluation through the joint construction of industrial colleges, enterprise studios, and other carriers.

The effective operation of this model depends on the establishment of institutionalized communication platforms. It is recommended to establish an industry-education integration council with the joint participation of education departments, industry departments, industry associations, and key enterprises to regularly discuss regional industrial development trends and changes in talent demand, and form a joint decision-making mechanism for program settings and adjustments. At the same time, a two-way flow system for school-enterprise personnel should be established to encourage enterprise technical backbones to participate in teaching, support college teachers to go to enterprises for practice, and promote the two-way transfer of knowledge and technology.

4.2 Promoting a Professional Cluster Construction Strategy Based on the Industrial Chain

Professional cluster construction is a key path to improving the adaptability of vocational bachelor's degree education. The traditional model of isolated development of a single program should be broken, and a modular, combined professional cluster architecture should be constructed around the industrial chain needs of regional leading industries and strategic emerging industries. Each program in the professional cluster shares basic underlying courses, faculty, and practical training resources, while reflecting the characteristics and depth of subdivided fields in professional direction courses, forming a "bottom-level sharing, mid-level separation, and high-level mutual selection" curriculum system.

The construction of professional clusters needs to be planned in synchronization with industrial technology evolution. In response to the trend of digital transformation, digital technology courses such as industrial data acquisition and intelligent manufacturing systems should be embedded in traditional manufacturing professional clusters; the content of emerging fields such as e-commerce and digital marketing should be strengthened in business and trade service professional clusters. Through this "program + digitalization" transformation path, the synchronous evolution of program

connotation and industrial upgrading can be realized. The management of professional clusters should introduce a matrix organizational structure, which not only maintains the vertical development of each program, but also strengthens the horizontal integration of resources within the cluster, improving the efficiency of education resource utilization and the comprehensiveness of talent training.

4.3 Deepening the Integration of Industry and Education Platforms

The substantialization and functionalization of industry-education integration platforms are crucial guarantees for ensuring that professional settings align with market demands. We should vigorously promote the construction of industry colleges, building them into comprehensive platforms integrating talent cultivation, technology research and development, and social services. Industry colleges should implement a president responsibility system under the leadership of the board of directors, introduce modern enterprise management systems, and ensure that they enjoy full autonomy in professional settings, curriculum reform, and faculty development.

The collaborative school-enterprise talent cultivation mechanism requires innovation at the institutional level. We should promote the "dual-mentor" system, where enterprise technical backbones and college teachers jointly guide students' project learning and internship; introduce real enterprise projects as graduation design topics, enabling students to improve their comprehensive abilities in solving practical problems; and jointly build technology and skill innovation platforms, encouraging teachers and students to participate in enterprise technology research to achieve deep integration of teaching and production. At the same time, we should establish a school-enterprise resource co-construction and sharing mechanism, where enterprises invest in advanced equipment to build on-campus training bases, and schools open laboratories to provide testing and R&D services for enterprises, forming a mutually beneficial and sustainable development model.

4.4 Establishing a Dynamic Early Warning and Evaluation Feedback System

Constructing a dynamic monitoring and early warning system for professional settings based on big data is the technical support for achieving scientific decision-making in professional settings. This system should integrate multi-dimensional information such as macroeconomic data, industry employment data, and graduate employment quality data. By constructing a matching model between professional settings and market demand, it can realize early identification and early warning of professional setting risks. An adjustment procedure should be initiated for majors with consistently low employment rates, low relevance rates, and low starting salaries to achieve closed-loop management of professional settings.

Professional evaluation should introduce a diversified evaluation mechanism, establishing a comprehensive evaluation system including student satisfaction, graduate employment quality, employer evaluation, and third-party professional certification. In particular, we must strengthen the voice of industry enterprises and employers in professional evaluation, taking the satisfaction of enterprises as an important basis for the continuation of a major. Evaluation results should be directly linked to enrollment plans and resource allocation, forming a quality-oriented dynamic adjustment mechanism for majors.

5. Conclusion

Establishing a coupling mechanism between vocational bachelor's degree programs and market demands is a systematic project that concerns the service effectiveness and sustainable development

of the modern vocational education system. Through theoretical analysis and problem diagnosis, this study reveals deep-seated contradictions in current program offerings, such as structural mismatches, systemic obstacles, and disconnection in the training process. Resolving these contradictions requires breaking through the path dependence of traditional program setting models and building a new professional development ecosystem with industry-education integration as the core and the collaborative governance of multiple stakeholders. Based on this, this article puts forward the following countermeasures and suggestions: At the provincial level, the synergy of policy guidance and resource allocation should be strengthened, a differentiated appropriation mechanism based on professional categories should be established, and schools should be guided to optimize their professional layout. At the municipal level, the overall coordination of industrial and educational departments needs to be strengthened, and a regional industry-education integration information platform should be built to realize the sharing and early warning of talent supply and demand data. At the school level, internal governance reform should be deepened, a market response mechanism and quality assurance system for program setting should be established, and teachers should be encouraged to devote themselves to program construction and teaching innovation.

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