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Construction and Implementation Path of Vocational Undergraduate Curriculum System Based on Competency-Based Approach

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Abstract: The construction of a vocational undergraduate curriculum system is a core component to ensure the quality of cultivating high-level technical and skilled talents. Aiming at the problems existing in the current practice, such as the vague positioning of objectives, the disconnection between content and industry, the loose structure, and the singular implementation evaluation, this study proposes a practical path to systematically construct a vocational undergraduate curriculum system based on the competency-based approach as the fundamental principle. The study clarifies the connotation of the competency-based approach in the vocational undergraduate level toward the expansion of comprehensive vocational abilities and reveals that the construction of the curriculum system needs to follow the five logics of vocational education development, knowledge construction, cognitive development, school-enterprise symbiosis, and curriculum evaluation. On this basis, a systematic solution is proposed with the "two-domain and two-dimension" goal framework, the "four basic rules" content specification, the "modular and spiral" structural design, and the "school-enterprise dual-system" implementation mode as the core, providing theoretical basis and practical guidance for vocational undergraduate colleges to carry out curriculum reform and highlight type characteristics.

1. Introduction

With the deepening transformation and upgrading of China's industrial structure and the rapid development of a new round of technological revolution, there is an unprecedentedly urgent social demand for high-level technical and skilled personnel who can solve complex technical problems and promote technological innovation[1,2]. Against this backdrop, vocational undergraduate education has emerged, entrusted with the strategic mission of cultivating "master craftsmen of a great power and highly skilled craftsmen," becoming a crucial link in building a modern vocational education system. However, its core carrier for talent cultivation-the specialized curriculum system-faces profound identity crises and developmental challenges in practical exploration[3]. The curriculum systems of many vocational undergraduate institutions exhibit obvious path dependencies, either as simple "extended versions" of higher vocational college courses or blindly

converging with the disciplinary models of ordinary undergraduate programs, resulting in a failure to organically integrate their "higher-level" and "vocational" characteristics, leading to a vague and indistinctive type of education. This predicament is specifically manifested in unclear definitions of "what makes it undergraduate and what makes it high-level" in curriculum objectives, disconnection between curriculum content and high-end industries and advanced technologies, failure of curriculum structure to follow the inherent logic of technical knowledge and students' cognitive development laws, the virtualization of school-enterprise collaborative education mechanisms in curriculum implementation, and the single and rigid curriculum evaluation methods. Tracing back to the source, the essence of these problems lies in the failure of curriculum system construction to thoroughly anchor and systematically implement the core concept of competence-based vocational education[4].

In response to the aforementioned practical problems, this study aims to transcend fragmented strategy discussions and, from the theoretical logic and system construction level, deeply explore the inherent laws and feasible implementation paths that a competence-based vocational undergraduate curriculum system should follow. This study has a dual value: at the theoretical level, by clarifying the connotation expansion and logical rationale of competence-based education in the specific education type and level of vocational undergraduate education, it can enrich and develop vocational education curriculum theory, providing academic support for establishing the unique identity of the vocational undergraduate curriculum system; at the practical level, it is committed to constructing a systematic and operational curriculum system framework-from goal setting, content design, structural design to implementation and evaluation-providing a direct guiding action plan for vocational undergraduate institutions to carry out internal development and solve reform problems.

2. Theoretical Logic

The scientific construction of a vocational undergraduate curriculum system must be built on a solid theoretical foundation. Competency-based education theory provides the core value orientation for it, while the complexity of the curriculum system itself and the particularity of vocational education require that its construction process must follow a set of diverse and complex internal logic. This chapter aims to analyze the diverse logical rationales that should be followed in the construction of a vocational undergraduate curriculum system, so as to lay a theoretical foundation for subsequent problem diagnosis and path construction[5,6].

2.1 Logic of Goal Establishment

Curriculum goals are the soul of the curriculum system, and their establishment is deeply constrained by the development law of vocational education. Since its birth, vocational education has been closely symbiotic with industrial development, and its fundamental mission is to serve economic and social development and people's career development. The emergence of vocational undergraduate education is a direct product of the information technology revolution promoting industries to move towards high-end and intelligent development, thereby putting forward higher requirements for the quality of the labor force. This historical development law determines that the establishment of vocational undergraduate professional curriculum goals must meet both "enterprise needs" and "student needs." The former requires the curriculum system to adhere to the instrumental value of education, take the needs of high-end industries and high-end positions in industries as the guidance, and cultivate adaptive talents who can be competent for technically complex positions; the latter requires adhering to the people-oriented value of education, paying attention to students' all-round development and lifelong learning ability, and providing them with

greater career development space and career flexibility. The dialectical unity of these two needs constitutes the basic logical starting point for the establishment of curriculum goals.

2.2 Logic of Content Setting

Curriculum content is the carrier of competency development, and its setting needs to follow the construction law of subject knowledge, especially technical knowledge. The construction of technical knowledge has distinct characteristics of social demand-driven and practice-oriented. It is not a static disciplinary conclusion, but a dynamic system that is constantly generated, evolved, and developed in the process of solving practical production problems. On the one hand, the emergence of emerging industries and future industries constantly spawns new knowledge resource demands, forcing curriculum content to timely absorb new technologies, new processes, and new norms to keep pace with the forefront of industrial technology. On the other hand, the complex and non-conventional problems faced by high-end positions often require breaking traditional disciplinary boundaries and integrating and applying interdisciplinary knowledge. Therefore, the setting logic of vocational undergraduate curriculum content requires that it must originate from real industrial practice, take the work tasks of enterprise positions and the complex technical problems faced as the basic material, and form learning content that supports the cultivation of comprehensive professional abilities through educational refinement and reconstruction, and establish a continuous update mechanism to realize the collaborative evolution of curriculum content and industrial technical knowledge.

2.3 Structural Design Logic

The curriculum structure determines the spatial arrangement and temporal sequence of the curriculum content. Its design must conform to students' cognitive development patterns to enhance learning efficiency and effectiveness. Constructivist learning theory reveals that learning is a process where learners actively construct meaning based on their existing cognitive schemas through assimilation and accommodation mechanisms. The learning transfer theory further points out that effective learning transfer depends on a deep understanding of knowledge and the similarity of contexts. Information processing theory emphasizes the limitations of the human cognitive system and the possibility of improving information processing capabilities through organization, repetition, and reinforcement. Based on these fundamental principles of cognitive science, the design of vocational undergraduate curriculum structures must fully consider students' existing knowledge base and cognitive level, establishing a core competency-based association system that can be understood and internalized by students. This means that the curriculum should horizontally focus on the organic connection between different curriculum modules, forming a "modular" structure that supports knowledge integration and competency fusion; vertically, it should follow a progressive principle from shallow to deep, from simple to complex, carrying out "spiral" rolling reinforcement and deepening of core knowledge and competencies, thereby promoting the continuous development and optimization of students' cognitive structures and achieving a steady advancement of capabilities.

2.4 Implementation Process Logic

Curriculum implementation is the process of transforming the curriculum plan into real educational actions. For vocational undergraduate education, its effectiveness highly depends on adhering to the principles of school-enterprise symbiosis. Vocational education and industry have formed an interdependent, mutually beneficial, and symbiotic ecological relationship through

long-term interaction. This symbiotic relationship is reflected in the continuous exchange of energy (such as talent, information, and technology) and materials (such as equipment and facilities), and the resulting synergistic evolution. The positioning of vocational undergraduate education in cultivating high-end technical and skilled talents determines that its curriculum implementation cannot be limited to the confines of the school walls and must strengthen the deep coupling with industry. Following the laws of symbiosis requires the curriculum implementation subject to shift from a "single subject" of the school to a "dual subject" of school and enterprise, building a collaborative and progressive educational ecology. Schools need to open up to enterprises, sharing intellectual resources and scientific research results, and deeply embed practical teaching links into the real production environment of enterprises; enterprises need to deeply penetrate into schools, providing practical venues, facilities, cases, and mentor resources, and participating in the design and execution of the teaching process. Through this two-way empowerment, curriculum implementation can truly align with the technical practice site, achieving the same-frequency resonance of talent cultivation and industrial needs.

3. Analysis of the Absence of Ability-based Orientation

After clarifying the logical construction of what a vocational bachelor's degree curriculum system should be at the theoretical level, it is crucial to turn to an examination of the actual state. Currently, vocational bachelor's degree education in China is still in the exploratory stage, and its curriculum system has exposed many problems in practical operation, the core problem of which is the systematic lack of a competency-based concept[7]. This chapter will deeply analyze existing problems from five dimensions: curriculum objectives, content, structure, implementation, and evaluation, revealing its deviation from the logical ideal, so as to point out the direction for subsequent systematic optimization.

3.1 Vague Curriculum Objectives

The primary problem with vocational bachelor's degree curriculum objectives is their vague positioning, failing to clearly define the essential differences in competency requirements between them and ordinary bachelor's degrees and higher vocational college degrees, resulting in a lack of clarity as to where the "high" is reflected. On the one hand, the descriptions of talent training goals for vocational bachelor's degrees are often confused with the "application-oriented" talents of ordinary bachelor's degrees or the "technical skill-based" talents of higher vocational colleges, lacking unique value anchors. This convergence phenomenon means that the curriculum objectives fail to highlight the essential characteristics of being rooted in the vocational field and directly facing work practice in terms of type, and fail to clarify the degree of technical complexity, innovation content, and scope of responsibility that they should have compared with vocational college education in terms of level. The vagueness of the objectives directly leads to the lack of a clear guiding nature of the curriculum system.

On the other hand, the competency dimension of the curriculum objectives is singular and the expression is empty and general. Many programs still use general terms such as "master basic knowledge and have basic abilities," and do not pay enough attention to core competencies that reflect the characteristics of "high-level" and "high-end skills," such as solving complex technical problems, optimizing technological processes, and participating in technological innovation. The objective elements are not complete and specific enough, failing to systematically cover multiple levels such as cognition, skills, and literacy, and lacking refined division of competency levels, such as distinguishing requirements for different cognitive levels such as understanding, application, analysis, synthesis, and creation. This lack of internal logic and uniformity makes it impossible for

curriculum objectives to effectively guide subsequent content selection and teaching implementation, and the competency-based approach is lost at the starting point.

3.2 Curriculum Content Detached from Occupational Standards

Curriculum content is the carrier of competency cultivation, and its practical problems are mainly manifested in serious detachment from occupational standards and industrial technology development. The most prominent phenomenon is "simply lengthening the higher vocational college academic system," that is, on the basis of the original vocational college curriculum system, the bachelor's degree stage is filled by increasing the types of courses or extending class hours, without fundamentally reconstructing and upgrading the knowledge structure and skill level of the curriculum content. This "new wine in old bottles" approach cannot support the ability to cope with technical complexity and uncertainty required by the vocational bachelor's degree training objectives, and the essential difference between the bachelor's and vocational college training objectives is dissolved in practice.

At the same time, the curriculum content is updated slowly, lagging behind the ever-changing industrial technology iterations. An effective mechanism has not been established to transform new technologies, new processes, and new norms of industry enterprises into teaching content in a timely manner. In the process of promoting the "1+X" certificate system, the book-certificate integration mechanism is not sound, and the new knowledge and new skills required by the vocational skill level standards have not been systematically integrated into the curriculum system, resulting in a "two skins" phenomenon. In the same major, the settings and number of professional basic courses and professional core courses vary greatly between different colleges, lacking a consensus content framework based on vocational ability analysis, which not only affects the benchmark of talent training quality, but also exposes the lack of standardization in curriculum content settings.

3.3 Loose Curriculum Structure

The curriculum structure suffers from systematic issues in both horizontal and vertical dimensions, weakening its support for competency development. Horizontally, there is a lack of inherent logical connection between theoretical courses, practical courses, and practical training sessions. Various courses often operate independently; theoretical teaching is detached from practical contexts, and practical training lacks the necessary theoretical enhancement, failing to form curriculum module clusters centered around typical work tasks or technical practical problems. This fragmented state hinders students from organically integrating theoretical knowledge and practical skills through knowledge assimilation and accommodation, making it difficult to form the complete cognitive structure needed to solve comprehensive problems.

Vertically, the sequence of course arrangements fails to fully follow the cognitive laws of progressive ability development. There are breaks in the connection of courses between grades and semesters. Prior courses fail to provide sufficient and solid knowledge and skill scaffolding for subsequent courses, and subsequent courses also fail to effectively deepen and expand upon what was learned previously. Especially in through-train programs such as secondary vocational to bachelor's and higher vocational to bachelor's programs, the connection of curriculum systems between different educational stages is inadequate, the alignment of practical teaching systems is not close enough, and there are phenomena of content repetition or abrupt increases in difficulty. This lack of vertical coherence disrupts the continuity of competency development and affects the orderly reorganization of students' cognitive structures and the spiral upward progression of abilities.

3.4 Singular Curriculum Implementation Entity

A prominent problem in the curriculum implementation phase is that the "dual" role of school-enterprise collaboration has not been truly realized, and the integration of industry and education remains superficial. Enterprises, as indispensable educational entities, have a level of participation that falls far short of the depth and breadth required by the laws of symbiosis. The collaborative education mechanism largely relies on personal relationships or short-term projects, lacking stable, institutionalized mechanisms for benefit-sharing and shared responsibility, resulting in insufficient intrinsic motivation for enterprise participation. A deeply integrated school-enterprise cooperative talent cultivation model with vocational bachelor's characteristics has not yet become widespread.

In terms of teaching methods, traditional teacher- and classroom-centered teaching models still dominate. Project-based teaching and case teaching based on real production scenarios are underutilized and implemented superficially. Students find it difficult to hone their professional abilities by completing comprehensive tasks in work environments that closely resemble real-world conditions. This "singular" implementation model significantly diminishes the practicality and vocational value inherent in the curriculum content during implementation, making it impossible to effectively achieve the goal of cultivating high-end skilled talent.

4. System Construction Path

In response to the core problems existing in the aforementioned vocational undergraduate curriculum system, it is necessary to systematically reconstruct it according to its inherent multiple logics. This chapter proposes a four-dimensional construction path with "Objectives-Content-Structure-Implementation" as the main line, aiming to implement the competency-based concept throughout the entire process and form a closely linked and coordinated curriculum system[8].

4.1 Construction of the Objectives System

Curriculum objectives are the navigation system of the curriculum system. In order to overcome the drawbacks of vague positioning and unclear ability stratification, the establishment of vocational undergraduate curriculum objectives should adopt a "two-domain, two-dimension" framework for precise definition. The "two domains" refer to the two fields of objective sources: one is "human development needs," which aims to promote the all-round development of students' knowledge, abilities, and qualities, and the formation of lifelong learning abilities; the other is "job work needs," which emphasizes that curriculum objectives must be aligned with specific job clusters in high-end industries and the high end of industries to meet the ability requirements of enterprises for high-level technical and skilled talents. These two fields together constitute the value foundation of curriculum objectives.

The "two dimensions" refer to the two dimensions of objective expression: the "objective content" dimension and the "objective degree" dimension. The objective content dimension needs to systematically plan three categories and their subcategories: knowledge, ability, and quality. The knowledge category can be subdivided into vocational basic knowledge, industry basic knowledge, target post core knowledge, and transfer post knowledge; the ability category should cover vocational general ability, industry basic skills, target post core technical skills, and cross-post transfer and innovation ability; the quality category needs to include ideological and political quality, physical and mental quality, cultural quality, and professional ethics. The objective degree dimension can draw on the revised Bloom's Taxonomy of Cognitive Objectives, from memory,

understanding, application, analysis, evaluation to creation, to clearly define the cognitive process level that each ability requirement should reach. Through the "two-dimension" framework, vocational undergraduate curriculum objectives can reflect the type difference from ordinary undergraduates in content and the level difference from higher vocational colleges in degree, so as to accurately depict the ability map of talent training.

4.2 Reconstruction of the Content System

Curriculum content is the carrier of ability cultivation. In order to ensure its standardization, advancement, and support, content setting must follow "four basic principles." First, the principle of mutual correspondence between curriculum and objectives: the selection and organization of all curriculum content must be closely centered on and directly support the specific ability objectives under the "two-domain, two-dimension" framework, establish a strong correlation matrix between content and objectives, and ensure that the teaching content does not deviate from the main line of ability cultivation. Second, the principle of basing on job work: the fundamental source of curriculum content should be the typical work tasks, process flows, and real cases of the target job cluster. Through the pedagogical transformation of the work system, the required theoretical knowledge, practical skills, and work attitudes are extracted and systematically integrated into the curriculum. Third, the problem-learning logic rule: Teachers should organize teaching content based on the complex technical problems encountered in enterprise production practice, forming a "problem chain" that leads to a "course content chain", and constructing a project-based course module that integrates theoretical exploration and practical practice. Students can construct knowledge and train skills by solving real problems. Fourth, the knowledge and environmental adaptation rule: Teachers should establish a dynamic update mechanism for course content, continuously track the cutting-edge developments in the industry technology, promptly incorporate new technologies, new processes, and new norms into teaching, decisively eliminate outdated and obsolete content, and ensure that the course content keeps evolving synchronously with the industrial technology environment.

4.3 Structural System Optimization

The curriculum structure is critical to the efficiency and effectiveness of competence development. Optimization should be carried out in both horizontal and vertical dimensions. Horizontal modular organization aims to strengthen the logical connections between courses. The core of this organization should be job competency clusters, with training objectives decomposed into each semester to form course modules on a semester basis. Each module integrates the disciplinary theoretical knowledge, individual skill training, and comprehensive project practice required for the target competencies at that stage, forming a "theory-practice integrated" micro-curriculum system. As a whole, a course group can be built according to the principle of "bottom-level sharing (group platform courses), mid-level separation (professional core courses), and high-level mutual selection (extension direction courses)," forming a close horizontal association network. Vertical spiral presentation focuses on the progressive development of competence. Core competencies and knowledge need to be deconstructed and allocated to different semesters, following the cognitive laws of simple to complex and single to integrated. By repeating and deepening these in subsequent semesters with greater complexity and more integrated situations, rolling repetition and spiral strengthening of knowledge and skills are achieved, promoting the continuous development and restructuring of students' cognitive structures, and ultimately achieving the solid formation of high-level capabilities.

4.4 Implementation System Innovation

Curriculum implementation is the key to transforming the curriculum plan into educational reality. The school's "unitary" implementation situation must be completely changed, and a real "school-enterprise dual system" collaborative education model should be built. First, jointly build a "mixed" dual-teacher team. Taking a major or course module as a unit, school professional teachers and enterprise technical experts/skilled craftsmen are mixed to form a teaching team, and a normalized collaborative teaching and research mechanism is established. This way, in the task allocation process, it can promote the deep integration of theoretical teaching and practical guidance, achieving the complementary capabilities and collaborative progress of school and enterprise teachers. Secondly, jointly build and share internship and training bases. Leveraging the school's research advantages and the production resources of enterprises, the school and enterprises can jointly establish high-level and intelligent internship and training bases and industrial colleges that integrate teaching, technological research, production-oriented training, and social services. This will provide a realistic engineering environment and technical support for project-based teaching. Finally, fully implement project-based teaching. Using real production cases from cooperative companies and technical problems to be solved as teaching project carriers, students "learn by doing" and "learn by researching," completely experience the work process of information acquisition, plan design, project implementation, and evaluation and reflection, so as to effectively cultivate their comprehensive professional abilities and innovative spirit in the real technical practice situation.

5. Conclusion

This study systematically explores the theoretical logic and practical pathways for constructing a competency-based vocational undergraduate curriculum system. The research clarifies the core connotation of the competency-based concept at the vocational undergraduate level, revealing its leading role as a comprehensive vocational competency perspective for the curriculum system. The study points out that the construction of a vocational undergraduate curriculum system needs to follow five inherent logics derived from the development of vocational education, the construction of subject knowledge, student cognitive development, school-enterprise symbiosis, and curriculum evaluation laws, forming a diverse and complex theoretical foundation. Addressing the practical difficulties, this study constructs a systematic solution with a "two-domain and two-dimension" goal framework, "four basic rules" content specifications, "modular and spiral" structural design, and a "school-enterprise dual-system" implementation model as its core. This pathway emphasizes the logical consistency and practical operability between the elements, providing a clear theoretical guidance and action framework for curriculum reform in vocational undergraduate institutions.

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