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Research on the Optimization Path of Industry-Education Integration Model in Vocational Education from the Perspective of Lifelong Learning

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Abstract: In the context of the rapid development of new productive forces, the industry-education integration model in vocational education faces adaptive issues such as a mismatch of talent supply and demand, lack of coordination mechanisms, and lagging service systems. Based on the perspective of lifelong learning, this study analyzes the connotation of industry-education integration in a broad sense and constructs a three-dimensional optimization path of "time-space-technology." In the time dimension, it connects academic education with continuing education. In the spatial dimension, it integrates formal and informal learning environments. In the technical dimension, it promotes the collaborative development of digital technology and digitization, forming an industry-education integration ecosystem that covers the entire career cycle.

Keywords: Lifelong learning; Vocational education; Industry-education integration; Optimization path

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1. Introduction

With the continuous development of new productive forces, vocational education has assumed more important responsibilities for skilled talent cultivation. To better adapt to the demand for skilled talents in the modern economy, the new vocational education law points out that vocational colleges and enterprises need to establish more long-term cooperation mechanisms. The outline of the 14th five-year plan for national economic and social development and the long-range objectives through the year 2035 emphasizes promoting skill upgrading for all groups through the implementation of a lifelong learning system and building a learning society, further clarifying the important role of lifelong learning in continuously improving the quality of citizens and the skills of workers.

The United Nations Educational, Scientific, and Cultural Organization (UNESCO) believes that lifelong learning is an educational system designed to provide learning opportunities for people of all ages and from all walks of life [1]. As an important mechanism of vocational education, industry-education integration is a key mechanism to achieve deep alignment between education and industry. However, the traditional industry-education integration model focuses more on the cultivation of basic vocational skills on campus, lacking discussion on industry-education integration serving lifelong education and continuing education stages for vocational skill improvement, and thus cannot effectively connect the education chain with the industry chain. Therefore, exploring the optimization path of the industry-education integration model in vocational education from the perspective of lifelong learning is of great significance for optimizing the industry-education integration model and improving the adaptability and coverage of vocational education [2].

2. Significance of optimizing the industry-education integration model from the perspective of lifelong learning

Industry-education integration is one of the important paths for connecting the education chain with the industry chain. The connotation of industry-education integration can be divided into narrow and broad senses. In the narrow sense, industry-education integration focuses on the integration of on-campus education and industry, directly connecting with enterprise needs through school-enterprise cooperation, internships, and other on-campus practical activities to optimize on-campus teaching content and enhance students' competitiveness in the labor market. In the broad sense, industry-education integration expands in terms of cooperation subjects and spatiotemporal coverage. In addition to schools and enterprises, it includes multiple subjects such as governments, industry associations, and social groups to collaboratively build a resource-sharing and information-interconnected educational ecosystem [3]. In terms of spatiotemporal coverage, industry-education integration breaks through campus boundaries, extending on-campus education to various stages of career development, emphasizing real-time updates and feedback on industrial needs, and ensuring dynamic alignment between talent cultivation and industrial needs. Therefore, from the perspective of lifelong learning, industry-education integration has the connotative characteristics of full career cycle coverage, diversified subject cooperation, flexibility and adaptability combination, and innovation-driven development [4]. From the perspective of lifelong learning, optimizing the industry-education integration model has the following important significance.

2.1. It is conducive to leveraging the important role of vocational education in lifelong learning

A lifelong learning perspective on industry-education integration enables vocational education to no longer be limited to cultivating talents needed in the primary labor market. Instead, through the sharing and co-construction of industry-education resources, it provides full career cycle learning support for both on-campus students and in-service personnel, enabling knowledge updates, skill enhancement, and career development. Therefore, through industry-education integration, vocational colleges become centers for lifelong learning and continuing education resources, playing the role of a coordinator in the community of practice and providing a strong educational guarantee for the lifelong cultivation of vocational skills for all, becoming an important force in promoting the construction of a learning city and a learning society.

2.2. It is conducive to breaking through the spatiotemporal limitations of traditional industry-education integration

Traditional industry-education integration has obvious spatiotemporal limitations. The on-campus classroom learning stage and the off-campus practice stage cannot be integrated, and the on-campus training room also cannot fully exhibit the real production environment of the enterprise. Both on-campus teachers and enterprise mentors cannot comprehensively evaluate students' overall practical level. This spatiotemporal fragmentation leads to the problem of "disunity of knowledge and action" [5]. The industry-education integration model from the perspective of lifelong learning can promote the vertical and horizontal integration of educational resources, extending from vocational education to continuing education, and promoting the alignment of the education chain with the industry chain through co-research, co-construction, and sharing of resources between schools and enterprises.

2.3. It is conducive to improving the flexibility and adaptability of vocational education

Through multi-subject collaborative industry-education integration and tracking the skill enhancement needs of in-service personnel, vocational colleges can timely capture industry development trends and technological progress needs, learn and absorb enterprise cases and experiences, and dynamically optimize professional settings and course content to improve the flexibility and adaptability of talent training programs and curriculum systems. On this basis, school-enterprise co-research can upgrade industry-education integration courses, forming a virtuous cycle.

Therefore, in the process of optimizing the industry-education integration model, vocational colleges need to face the complexity and uncertainty brought about by technological development by enhancing the collaborative interaction of multiple subjects, improving the ability to adapt to external changes, reserving space for innovation and trial and error, and promoting the sharing of resources and information.

3. Current situation and problem review of industry-education integration from the perspective of lifelong learning

In recent years, policies such as the vocational education law of the People's Republic of China, the implementation plan for reforming vocational education in China, and the action plan for improving the quality of vocational education have been implemented to strengthen industry-education integration and promote diverse cooperation between schools and enterprises. School-enterprise cooperation has gradually shifted from the traditional order model to deep cooperation. However, industry-education integration still faces many difficulties. The current situation and problem review of industry-education integration from the perspective of lifelong learning roughly include:

3.1. Talent supply and demand mismatch: Talent cultivation is difficult to quickly adapt to the needs of new productive forces

The mismatch between talent cultivation and industrial needs has been a long-standing issue in industry-education integration. In the context of new productive forces development, technological changes have accelerated changes in industrial needs, resulting in a mismatch between talent supply and industrial needs in terms of structure, quality, and level [6]. The lack of a long-term and effective information communication mechanism between vocational colleges and enterprises, as well as information asymmetry, has caused delays

in professional research, talent cultivation program adjustments, and training room construction compared to market demand. Even if schools capture changes in technological and market demand, there is still a time difference between the training cycle of vocational education and the iteration of industrial technology, further exacerbating the mismatch between talents and positions. Therefore, vocational colleges have long been in a passive state of chasing technology with insufficient systematic planning and construction.

3.2. Lack of coordination mechanisms: Incomplete industry-education integration mechanisms lead to difficulties in deep cooperation

Currently, due to the lack of scientific and long-term cooperation mechanisms in industry-education integration, issues such as cost sharing and delayed benefits have led to vagueness in the distribution of benefits and cooperation models between schools and enterprises, resulting in insufficient motivation for cooperation. The cooperation model is also relatively single, with more school-enterprise cooperation staying at the level of internship base construction. Some industry-education integrations only exist at the agreement level or employment level, and it is difficult to carry out substantive cooperation in terms of curriculum systems and internships, making it difficult to form a long-term mechanism. Therefore, industry-education integration is difficult to deepen, and there are implementation difficulties and the phenomenon of "one-sided enthusiasm", with the depth and breadth of cooperation still needing improvement [7].

3.3. Lagging service system: The industry-education integration system fails to cover lifelong education effectively

The existing industry-education integration system still focuses on full-time academic education and lacks a comprehensive lifelong learning service system. Educational resources are unevenly distributed, with more resources concentrated on full-time academic education, while resources for technical education and vocational skill enhancement are relatively scarce. Additionally, the curriculum is not flexible enough. For example, there is a lack of modular courses that support continuous learning for diverse social personnel during online course development, as well as a shortage of "loose-leaf" textbooks and "work manual" textbooks suitable for employee training. These factors hinder in-service personnel and adult learners from accessing adequate learning resources and platform support. Simultaneously, the absence of a comprehensive vocational skill assessment, certification, and enhancement system leaves students without systematic skill improvement support after graduation. This lack of support for lifelong learning mechanisms not only impacts individual career development but also limits the long-term effectiveness of industry-education integration in promoting lifelong learning and technical skill enhancement.

4. Optimizing the path of industry-education integration in vocational education from the perspective of lifelong learning

Lifelong learning is a complex historical process, and its unique dynamic mechanism can be deeply analyzed from three dimensions: time, space, and technology. This paper constructs a theoretical framework for optimizing the path of industry-education integration in vocational education from these three dimensions, reflecting the balanced, coordinated, and inclusive characteristics inherent in the development of industry-education integration [8].

4.1. Focusing on the collaborative optimization path of formal education and continuing education in the time dimension

Time is the primary dimension of lifelong learning theory and the first path for optimizing the industry-education integration model from a lifelong learning perspective. Industry-education integration under the lifelong learning lens places greater emphasis on the social time spanning from childhood to adulthood, requiring a balance between short- and long-term goals. Short-term goals should focus on enhancing students' practical abilities and employment competitiveness, while long-term goals need to consider changes in industrial structure and continuous technological development, with a focus on the continuing education stage after graduation to improve vocational skill levels sustainably.

Therefore, centering on the collaboration between formal education and continuing education, several steps should be taken. Firstly, dynamically adjust the industry-education integration curriculum system by regularly updating teaching content and methods based on industrial needs and technological advancements. Encourage the development of modular course resources and the compilation of loose-leaf and work manual textbooks to ensure that students' knowledge and skills align with the latest trends in industry development. Secondly, establish a collaborative and seamless mechanism between vocational education and continuing education to promote lifelong learning, facilitate talent growth pathways, and achieve dual integration and enhancement of academic qualifications and vocational skill levels. This enables students to adapt to the constantly changing professional environment and continuously enhance their competitiveness. Finally, establish a graduate career development tracking mechanism through platforms such as alumni associations and industry forums to maintain regular contact with graduates and enterprises, understand their latest needs and feedback, and develop relevant national vocational skills training programs to guide students and promote the development of graduates' continuing education [9].

4.2. Focusing on the collaborative optimization path of formal and informal learning in the space dimension

Space is the second path for optimizing the industry-education integration model from a lifelong learning perspective. Space can be divided into private and social spaces. This dimension liberates learning from fixed spaces (such as schools) and places it within a broader social learning space, where formal and informal learning environments collaborate to optimize the industry-education integration model.

Specifically, several measures can be taken. Firstly, establish a mutual exchange mechanism between schools and enterprise teachers, appointing enterprise experts as "industry professors" on campus and promoting school experts to serve as "technology vice presidents" in enterprises. This achieves two-way flow and effective integration of teacher resources between schools and enterprises. Enterprise teachers can start teaching on campus early, and school teachers can also engage in industry-education integration learning and improvement in enterprises, eliminating barriers formed by field restrictions. Secondly, dynamically develop industry-education talent training programs that break the limitations of traditional academic systems such as "2+1" or "2.5+0.5." By establishing more flexible industry-education integration learning mechanisms, such as a "5+1" month or even a "4+1" day learning schedule per semester, the combination of learning and practice becomes more flexible and closely integrated. Encourage the utilization of student clubs to facilitate more flexible participation in multi-industry enterprise practices. Thirdly, promote on-campus innovation and entrepreneurship by introducing enterprises into schools, breaking the spatial limitations of traditional

school-enterprise cooperation. Establish on-campus enterprise practice bases and innovation laboratories to attract enterprises to introduce production, research and development, and other links into the campus. By leveraging the school's resources and facilities for technological innovation, students can gain more practical experience through participation in real enterprise projects. Strengthen school-enterprise interaction by holding technology exhibitions, project roadshows, and other exchange activities, achieving a win-win situation.

4.3. Collaborative optimization path of digital technology and digital teaching in the technical dimension

Lifelong learners are technological learners with rich prior learning experiences and life histories. Technology will be integrated into learners' perceptual experiences, becoming an organic component of learners and enabling them to develop themselves fully. Therefore, in the process of optimizing industry-education integration, it is essential to focus on both the cultivation of digital technology application abilities and the promotion of digital technology use in teaching.

Specifically, several steps should be taken. Firstly, innovate and collaborate on digital teaching paradigms by actively introducing advanced educational technologies such as AI and AIGC. Develop digital teaching platforms such as virtual training and virtual research offices to promote the development of digital teaching methods like online learning, virtual training, and virtual research, thereby enhancing teaching quality and efficiency. Secondly, focus on cultivating digital technology application abilities by integrating digital technology application practices into the industry-education integration training plan. Combine job skills with digital skills to improve students' proficiency in applying cutting-edge professional technologies and cultivate general technical abilities such as data mining and analysis. Thirdly, encourage interdisciplinary technology integration and industry-education collaborative innovation. By combining knowledge and skills from different disciplines, such as engineering, design, and business management, students' ability to solve complex problems can be enhanced, thus meeting the demand for cultivating compound talents.

5. Conclusion and outlook

Starting from the broad connotation of industry-education integration, this paper clarifies the significance of optimizing the industry-education integration model from a lifelong learning perspective. It reviews the current status and existing problems of industry-education integration. Based on this, it constructs an optimized path for the industry-education integration model in vocational education from three dimensions: time, space, and technology. The paper proposes that optimizing the industry-education integration model requires achieving collaboration between academic and technical education in time, integrating formal and informal learning environments in space, focusing on digital technology application in technology, and simultaneously building digital teaching platforms and promoting digital teaching methods. The three-dimensional optimization path of "time-space-technology" is conducive to enhancing the flexibility and adaptability of vocational education, providing strong support for the construction of a learning society system.

Meanwhile, this study still has limitations, such as the need for further validation of implementation effects and the possibility of applicability differences across industries and regions. Future research can

further focus on the actual needs of a specific industry, explore the implementation effects of optimized paths in different contexts, and conduct follow-up evaluations of the implementation effects.

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