

Exploration into the Development of "Integration of Production and Education" in Vocational Education in China

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Abstract In order to further clarify the function and important value of the integration of production and education for the development of vocational education, this paper combed the development context of the integration of production and education in China's vocational education from three dimensions: policy evolution, research evolution and practice promotion. Studies have shown that the integration of production and education, as a distinctive type characteristic of vocational education in China, has experienced four stages of evolution in policy: the period of combination of production and education, the preparation and presentation period, the full implementation period and the in-depth promotion period, and the initially-constructed institutional system reflects developmental characteristics. In academic research, there are obvious policy-driven characteristics. The theoretical framework tends to be perfect, and the concept connotation and promotion path are gradually getting clear, but the research on regional promotion modes is slightly insufficient. The empirical research is weak, and the operability of countermeasure research is not strong. Moreover, the problem of discussing integration based on education is more prominent. In practice and promotion, the characteristic of the integration of production and education is gradually highlighted and deepened in terms of talent training, school-running system and school-running mode, and the carriers and contents of the integration of production and education are gradually enriched.

Key words Integration of production and education; Policy evolution; Research evolution; Practice promotion

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In recent years, in order to promote the principles and institutional arrangements for the reform of vocational education system and mechanism and the reform of talent training mode, the integration of production and education has gone through a long period of evolution and exploration, both conceptually and practically. In order to fundamentally understand national strategic deployment and clarify the function and value significance of the integration of production and education for vocational education, it is necessary to sort out its development and practice and form a high-quality promotion of rational cognitive services^[1].

Policy Evolution of "Integration of Production and Education"

Policy is the basic premise and fundamental guarantee to promote the steady development of the cause. Policy formulation comes from actual needs, and it also leads, guides and regulates specific practice. Sorting out the policy evolution of integration of production and education and understanding its main developmental characteristics and realization forms in each stage will help to reach a deep understanding of the integration of production and education.

The period of "combination of production and education"

The development of combination of production and education presents a development process from "school-oriented, enterprise participation" to "combination of production and education, school-enterprise dual education". In 1991, it was proposed to

"actively develop school-based industries and establish production practice bases well." The combination of production and education and the combination of work and study were advocated.

In 1996, it was put forward that "vocational schools and vocational training institutions should combine production with education to serve regional economic construction, keep close contact with enterprises and cultivate practical talents and skilled workers." At that time, there was no unified development strategy for industry and education.

In 2005, it was pointed out that "we should actively support industrial enterprises and vocational schools to jointly recruit students and run schools, and implement the combination of production and education", and "we should actively promote the combination of production and education in secondary vocational schools, and implement 'order' training". The concept of the combination of production and education gradually matured.

The preparation and presentation period of "integration of production and education"

In 2010, it was put forward that "vocational education should be included in the economic and social development and industrial development plan, so as to make the scale and specialty setting of vocational education adapt to the needs of economic and social development". The school-running mechanism of vocational education led by the government, guided by the industry and participated by enterprises was clarified, and the policy provisions on the integration of production and education gradually got clear.

In 2011, the requirement of "promoting in-depth cooperation between production and education" was put forward. It was pointed out that the principle of "in-depth cooperation between production and education" was "resource sharing, mutual benefit and win-win", and the basic contents of cooperation were "talent

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demand analysis, sharing of high-quality teaching resources, teacher cultivation and training, student internship and employment, on-the-job training of enterprise employees and integration of production, teaching and research"^[2].

In 2013, the concept of "integration of production and education" was put forward for the first time, and the integration system of production and education was established as a vocational education school-running system. The specific contents included group school-running, industry guidance, participation of industrial enterprises in school-running, and joint development of courses by vocational schools and industrial enterprises, which highlighted the dominant position of industries and enterprises in running schools, changed "combination" into "linkage" and promoted "cooperation" to "integration".

Full implementation period of "integration of production and education"

Since the concept of "integration of production and education" was put forward in 2013, almost all documents on vocational education have taken "integration of production and education" as the guiding ideology, or the main goal, or the implementation path or the basic feature, and "integration of production and education" has become the basic concept of modern vocational education development. In 2017, from the height of promoting high-quality economic development and deepening comprehensive reform in the field of education, we made top-level design and scientific planning for the decision-making and work arrangement of deepening the integration of production and education in China in an institutionalized way, and extended the deep integration of production and education from vocational education to general education in an orderly manner^[3].

In-depth promotion period of "integration of production and education"

In 2019, China defined vocational education as a type education, which is as important as general education. The mode of production and education integration has become the most distinctive and fundamental type feature of vocational education, and corresponding vocational education organization modes and school-running modes are all based on the integration of production and education.

In 2022, the new vocational education law was promulgated, which once again determines and guarantees the integration of production and education in vocational education. In 2023, the Development and Reform Commission of China and other departments issued *Implementation Plan for Empowerment and Promotion Action of Production and Education Integration in Vocational Education* (2023–2025), which promotes the integration of production and education towards standardization and materialization with the mode of "platform + pilot".

Research Evolution of "Integration of Production and Education"

With the theme of "integration of production and education",

we searched on China Knowledge Network, and analyzed annual quantity and research content of relevant academic documents, so as to get a glimpse of the effectiveness of its policy implementation and practice promotion and reflect the law of career development.

High consistence between the number of documents issued and policy evolution

Before 2012, the thinking about industry and education was mainly at the level of "integration of production and education", and there were only 8 documents about "integration of production and education". The number of related studies has gradually increased since 2011, and the research in subsequent years has not stagnated, so 2007 can be regarded as the starting point of the research on the integration of production and education, and 2011 is the first year of the research on the integration of production and education. In 2013, there were 35 academic research papers on the integration of production and education, but only 6 of them were titled "integration of production and education", and all of them elaborated on specific practical cases, that is, they mainly focused on the summary of practical experience, and did not conduct theoretical research on the theme of "integration of production and education". It could be seen that at this stage, there was still some ambiguity in the understanding of the concept of "integration of production and education" in the academic community. However, in terms of the number of documents, the research on the integration of production and education achieved a breakthrough in 2013, with more than four times the total number of documents in previous years. From 2014 to 2016, the academic research on the connotation and mode of "integration of production and education" began to increase, and start to take "integration of production and education" as the development concept of vocational education to examine the development and specific practical measures of vocational education, mainly from two aspects: talent training mode and school-running mode. The concept connotation of "integration of production and education" was enriched, which indirectly reflected that "integration of production and education" had become an important concept guiding the development of vocational education.

From 2017 to 2022, a large number of academic research results on the integration of production and education emerged, and new trends such as policy research, mechanism research, international comparative research and evaluation system research appeared, which opened a new historical orientation for the research on the integration of production and education.

Gradually-enriched research content, slightly insufficient leading role

With the establishment of the school-running mode of integrating production and education for vocational education and the gradual consolidation of its position, the academic research on the integration of production and education has gradually enriched and deepened, and the initial concrete practice exploration has gradually turned to the research on its connotation, mechanism and talent training mode. Moreover, the integration of production and

education appears more and more as the macro background or guiding concept of special research such as specialty construction, teaching reform and teacher team construction, which shows that the integration of production and education has penetrated into all aspects of vocational education as a school-running mode.

With regard to the integration of production and education, domestic scholars basically agree on the direction of talent training. It is generally believed that the integration of production and education is to better cultivate high-quality technical and skilled talents needed by industrial enterprises, but the understanding of its connotation is different, and can be roughly summarized as a cooperative relationship or an educational activity, organizational form and strategic layout^[4]. An overview of the relevant literature on the integration of production and education, especially relevant research overviews, reveals that the current research on the integration of production and education presents some problems, such as less empirical research, weak operability of countermeasure research and insufficient research perspective, which reflects that there is some ambiguity in the understanding and practice of the integration of production and education in China at the emerging stage.

The forward-looking and leading role of the academic circles in the research on integration of production and education is not obvious. The research shows the characteristics of "policy-driven", that is, the publication of relevant policies induces the research on it, and the research results gradually increase with the establishment of policy concepts and the gradual clarification of requirements. Before 2017, the research on the integration of production and education was mainly carried out from the concept analysis and specific operation mode, but the expression of operation mode did not well reflect the characteristics of the integration of production and education. It was still discussed from the level of schools and enterprises, and did not rise to the level of production and education. The research content was too micro, and there were many studies on the practical level. It shows that the application of the concept of integration of production and education is still superficial, and a global impact has not been formed on vocational education. Since 2017, especially in 2018, research on the macro-level integration of production and education has begun to increase, and the mechanism, mode and theoretical framework of the integration of production and education began to be built and improved. However, as an institutional design, the research on the integration of production and education is either a theoretical discussion at the macro level or specific practice based on vocational colleges, and there are few studies on practical measures and implementation modes at the regional level, which shows that the integration of production and education has not yet become a "potential" in the practical promotion level, and it needs to be further explored and improved as an institutional design.

Practice of "integration of production and education"

With the policy evolution and research evolution, China's vocational education has been exploring the integration of production and education in practice, which has injected new vitality into the

reform and development of China's vocational education and a number of new experiences and new paradigms that can be replicated and popularized have been formed. Here, we can get a glimpse of some major practical measures and achievements of the integration of production and education from aspects of talent training, school-running system and school-running mode.

School-enterprise dual education has achieved a breakthrough in talent training, from entrusted and ordered training to the full implementation of modern apprenticeship system Order-based talent training is the traditional mainstream mode of school-enterprise cooperation in China's vocational education. It is an important measure for solving the mismatch between talent training in vocational colleges and the needs of enterprises, and it helps to solve the practical problems of labor shortage and difficulty in employment in enterprises in a certain period of time. However, with economic and social development and industrial transformation and upgrading, the employment demand of enterprises has changed fundamentally, and the order-based talent training model has gradually exposed some problems such as "low level of school-enterprise cooperation, little content" and "high loss rate of students in order-based classes"^[5], and "the starting point and interest demands of enterprises and schools are inconsistent". Therefore, the order-based talent training has received many criticisms. In order to further improve the education mechanism of school-enterprise cooperation and innovate the training mode of technical talents, the Ministry of Education launched the pilot work of modern apprenticeship in 2014, and carried out in-depth exploration and practice in the integration of enrollment and recruitment, the construction of standard system, the construction of double-tutor team, the construction of teaching resources, the reform of training mode and the construction of management mechanism. In 2019, *Notice from the General Office of the Ministry of Education on Comprehensive Promotion of Modern Apprenticeship System* was issued, which enriches and improves the education mode of school-enterprise cooperation in vocational education in China. At present, the pilot program of modern apprenticeship system in China covers more than 1 000 professional points, benefiting more than 100 000 students (apprentices), and a new situation of school-enterprise cooperation with specialty co-construction, talent co-education, process co-management, resource sharing and responsibility sharing is gradually forming.

Of course, the implementation of modern apprenticeship system is by no means a kind of transcendence or abandonment of order-based talent training, but a kind of enrichment and perfection of the school-enterprise dual education mode in form and path. More choices are provided for enterprises and schools in the form of talent training. Enterprises can choose the way of cooperation with schools according to the characteristics of their industries and their own development, and schools can choose the best growth path for students according to their professional characteristics and talent training objectives. In terms of talent training content, there are more possibilities for enterprises to deeply participate in

professional planning, curriculum setting, teaching design, practice and training in vocational colleges, and school-enterprise dual education enters a substantive "dual-subject" stage.

The cooperation modes integrating production and education are gradually enriched in the school-running system, and the participation of enterprises and social forces in running public vocational colleges is becoming essential

China has always encouraged and supported enterprises and social forces to participate in vocational education, and given many support to private vocational colleges in policy, which is the basic path and method to realize the integration of production and education and the cooperation between schools and enterprises. However, due to institutional barriers, there has been no substantial progress in the participation of enterprises and social forces in organizing public vocational colleges for a long time, and cooperation between enterprises and schools has only been limited to the surface. Although Jiangsu, Guangxi, Shandong and other places have carried out practical exploration, it is only limited to individual institutions. It was not until 2014 that the State Council issued *Decision of the State Council on Accelerating the Development of Modern Vocational Education*, proposing to "explore the development of joint-stock and mixed-ownership vocational colleges, and allow capital, knowledge, technology, management and other elements to participate in running schools and enjoy corresponding rights". Then, enterprises and social forces obtained a clear policy basis to participate in running public vocational colleges, and Shandong, Hebei, Jiangxi and other places successively carried out pilot exploration. For example, in January 2016, the Education Department of Shandong Province issued *Notice on the Announcement of Pilot Projects for Mixed Ownership Reform in Vocational Colleges*, and established nine projects including mixed-ownership school running of Shandong Maritime Vocational College as pilot projects for "mixed ownership reform", which promoted the exploration process of running mixed-ownership schools.

In 2020, the General Office of the Ministry of Education and the General Office of Ministry of Industry and Information Technology jointly issued *Guidelines for the Construction of Modern Industrial Colleges (Trial)*. In 2020 and 2023, two batches of modern industrial college construction work have been launched, and effective practical explorations have been carried out in the management system and mechanism of industrial colleges, thereby promoting the implementation of integration of production and education at the level of education. At present, the Industrial College has achieved substantial breakthroughs in the existing vocational education public school system, management methods, and personnel training models, and has become an important lever for implementing the integration of industry and education in vocational education. At present, industrial colleges have achieved substantial breakthroughs in existing public school system, management methods and talent training models in vocational education, and have become an important lever for implementing the integration of production and education in vocational education.

Carriers for integration of production and education are gradually diversified in school-running modes and upgraded from group running to building of industry-education consortia and industry-education integration systems

Group school running is an effective mode to deepen the integration of production and education and the cooperation between schools and enterprises in various regions. At present, more than 1 500 vocational education groups (alliances) have been established nationwide, covering more than 45 000 member units including enterprises, schools, industries and scientific research institutions^[6]. It has effectively improved the quality of running vocational colleges and the ability to serve the economic, social and industrial development, and trained a large number of high-quality technical and technical talents for the society. However, with the gradual advancement of this model, the disadvantages of its imperfect system construction and mechanism construction are gradually highlighted, and the construction planning is unclear and the long-term goals are neglected, which leads to "loose membership structure and lack of vitality in operation" and "governance results in the state of gathering without unity and unifying without power". Although the national level is actively encouraging and promoting the substantive operation of vocational education groups, the inherent "alliance attribute" of the groups at the beginning of its establishment makes it difficult to achieve substantive results in this reform. We will build a municipal industrial-educational consortium that is promoted by the government and based on industrial parks, and has the functions of talent training, innovation and entrepreneurship, and promoting the high-quality development of the industrial economy. We will set up a board with the participation of the government, enterprises, schools, scientific research institutions and other parties and implement a substantive operation mode. Meanwhile, it is proposed to support leading enterprises, high-level higher education institutions and vocational schools to take the lead in forming cross-regional industry-education integration communities that involve schools, research institutions and upstream and downstream enterprises. Compared with vocational education groups, municipal industry-education union and the inter-regional industry-education integration communities have upgraded and surpassed vocational education groups in terms of form, function and promotion mode, and systematically integrated superior resources of government, industry, enterprises, schools and scientific research institutions. They are bound to lead the integration of production and education in China.

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Discussion and Conclusions

The fresh weights of aboveground part, underground part and whole plant and SPAD are important reference indexes for measuring the growth strength and biomass accumulation of watermelon. The results of this study showed that the functional organic material composed of garlic straw and chicken manure and the functional organic material composed of onion straw and sheep manure could significantly increase the fresh weights of aboveground part, underground part and whole plant and the SPAD value of watermelon leaves compared with simple application of garlic straw or onion straw, and the functional organic materials composed of garlic straw and chicken manure had the greatest promotion effect on the fresh weight of watermelon. It might be because the application of sheep manure on the basis of garlic straw and chicken manure on the basis of onion straw increased the mineral nutrients such as nitrogen, phosphorus and potassium and organic matter such as humic acid in the soil, which provided more abundant mineral elements for watermelon plant growth, chlorophyll synthesis and plant fresh weight.

The nutritional quality of watermelons determines the commercial value of watermelons. Appropriate peel thickness and peel hardness directly affect the taste for consumers, and higher single-melon weight directly affects the final economic benefits. Therefore, peel thickness, peel hardness and single-melon weight are important reference factors for evaluating the quality and yield of watermelons. The results of this study showed that compared with the application of garlic straw or onion straw, the combination of garlic straw and chicken manure and the combination of onion straw and sheep manure could significantly reduce the thickness and hardness of watermelon peel, increase the edible part and reduce the increase of peel hardness caused by peel thickening, which indicated that the compounded functional organic materials were more conducive to the improvement of watermelon fruit quality. In addition, the combination of garlic straw and chicken manure and the combination of onion straw and sheep manure could significantly increase the weight of single watermelon. It might be because chicken manure could reduce soil bulk density, increase

organic matter content, and improve soil enzyme activity^[8], thereby promoting watermelon plant growth and improving the weight of single watermelon; and sheep manure increased the contents of available potassium, available phosphorus, hydrolyzable nitrogen and organic matter in soil, and improved the secondary salinization of soil^[9], creating a suitable environment for the growth of watermelon and thus improving the weight of single watermelon.

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