Vocational Undergraduate Education Facilitating China's Industrial Upgrading: Theoretical Framework, Practical Perspectives and Policy Proposals

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Abstract: Vocational undergraduate education, as a critical vehicle for achieving effective skills supply, plays an indispensable role in facilitating China's industrial upgrading. Grounded in human capital theory and new vocationalism, this study examines the allocation of human capital and the skill development of students. The findings reveal that vocational undergraduate education inherently supports China's industrial upgrading. However, in practice, there is an insufficient scale of high-skilled human capital at the macro level and suboptimal allocation efficiency at the micro level. Therefore, based on these insights, the following policy recommendations are proposed to enhance the role of vocational undergraduate education in supporting China's industrial upgrading: deepen the integration of industry and education, improve the vocational education system; optimize skills cultivation to enhance the quality of high-skilled talent training; strengthen lifelong education to broaden career development opportunities for high-skilled talents; expand development space and establish a treatment guarantee mechanism for high-skilled talents.

Keywords: Vocational undergraduate education; China's industrial upgrading; High-skilled talents; Human capital theory; New vocationalism

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Under the backdrop of new-quality productivity driving industrial transformation, China is at a pivotal juncture in transitioning from labor-intensive industries to technology-intensive ones. This transition fundamentally challenges the skill structure of the workforce: the standardized operational skills traditionally required are being displaced by technological advancements and intelligent production systems, while high-value-added industrial chains increasingly demand compound skills, innovation capabilities, and cross-border collaboration competencies. In this context, vocational education, as the cornerstone of China's skill formation system, has shifted its focus from mass-producing standardized blue-collar workers for assembly-line operations to cultivating highly skilled, adaptable talents who can meet the evolving demands of intelligent production systems and digital industrial ecosystems. This transformative shift necessitates that vocational undergraduate education enhance its capacity to develop high-level skilled talents, ensuring an effective supply of such talents to support industrial upgrading.

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Currently, research in China on the relationship between vocational undergraduate education and industrial transformation remains limited. Most studies employ logical deduction to design micro-level strategies for vocational undergraduate education to support industrial upgrading, and few integrate macro analysis with micro-level scrutiny to explore the underlying mechanisms through which vocational undergraduate education promotes industrial upgrading. Consequently, the influence mechanism of vocational undergraduate education in supporting industrial upgrading remains largely unexplored, akin to a "black box." Guided by human capital theory and new vocationalism, this study follows an analytical approach of theoretical mechanism explanation-observation of practical challenges-construction of supportive policies. It aims to elucidate the theoretical underpinnings of how vocational undergraduate education facilitates industrial upgrading, analyze the real-world challenges it faces, and propose actionable strategies to overcome these obstacles, thereby enhancing vocational undergraduate education's effectiveness in addressing China's China's industrial upgrading needs.

1. Theoretical Elaboration: How Does Vocational Undergraduate Education Facilitate China's Industrial Upgrading

Vocational undergraduate education serves as a crucial vehicle for nurturing high-skilled talents. Meeting the demand for the quantity and quality of skilled personnel necessary for China's economic and social development constitutes a significant manifestation of its contribution to China's industrial upgrading.

(1) The macro pathways of vocational undergraduate education in facilitating China's industrial upgrading

In accordance with the perspective of human capital theory, economic development primarily hinges on the accumulation of human capital. Human capital, as a form of capital embodied in workers, represents the aggregate value of their knowledge, techniques, capabilities, and health. Only by enhancing the comprehensive quality of individuals can a more efficient input-output ratio be attained. Evidently, higher education, burdened with the responsibility of cultivating advanced talents, emerges as the principal source of knowledge, methodologies, and technological innovation, and a significant creator of human capital. Fostering investment and development in higher education leads to a rapid accumulation of effective human capital[1]. Based on this reasoning, the development of higher education fundamentally propels rapid economic growth, and this transmission effect will become increasingly pronounced with the advancement of the knowledge economy. Therefore, the influence of higher education on economic growth is predominantly achieved through promoting technological innovation resulting from the accumulation of human capital; that is, the greater the accumulation of human capital[2], the larger the "residual value" of economic growth generated by innovation[3].

The cultivation of high-skilled talents through vocational undergraduate education can be regarded as skill-based human capital. High-skilled talents possessing specialized human capital provide intellectual support for advancing industrial upgrading. The quantity and quality of high-skilled talents impact the economic development and industrial upgrading of the entire society. Hence, vocational undergraduate education facilitates industrial upgrading along the following two paths:

Firstly, vocational undergraduate education perpetually augments the supply of high-skilled human capital and continuously elevates the stock of high-skilled human capital to facilitate industrial upgrading.

Secondly, vocational undergraduate education promotes the appreciation of skill-based human capital, enhances the extent to which the quality of human capital fulfills the requirements of industrial upgrading, and facilitates the attainment of high-quality career development for skilled talents to support industrial upgrading.

To analyze the macro pathways of vocational undergraduate education in facilitating industrial upgrading, it is feasible to commence from the two dimensions of the scale and structure of talent cultivation to scrutinize the actual circumstances of promoting human capital accumulation through vocational undergraduate education in China.

(2) The Microscopic paths for vocational undergraduate education to facilitate China's industrial upgrading

New vocationalism emerged as a vocational education theory in Western countries in the 1970s, mainly exploring how vocational education can cope with the challenges resulting from social and economic development changes. The "newness" of new vocationalism lies in its contrast to the old vocationalism, which was narrow and focused on training for specific jobs. Since World War II, profound alterations have occurred in British society and economy, rendering the old vocationalism unable to meet the new requirements of the professional world. The entire British society, including the government and employers, has witnessed an escalating call for a new educational system, thereby giving rise to new vocationalism[4]. New vocationalism serves as a theoretical tool guiding vocational education to adapt to the talent demands of the new professional life. It pays attention to the requirements of the new technological revolution for the quality of workers and how vocational education can cultivate workers to meet these requirements. Its fundamental strategy involves the imparting of "core skills" and the educational concept of "integration". The so-called core skills refer to the practical ability to complete tasks and solve problems, rather than the traditional, highly specialized, and narrow skills. They possess universality, transferability, and instrumentality. [5]Universality implies that these skills are ubiquitous in professional life; transferability indicates that the learning of one type of work ability will facilitate the learning of another; instrumentality suggests that these skills are practical and closely associated with the profession. [6]The educational concept of "integration" refers to the integration of academic education and vocational education, secondary education and higher education, as well as the establishment of potential connections with employers through work-based learning.[7]

At present, the fourth industrial revolution has brought about profound changes to the occupational structure: Firstly, occupations that follow fixed procedures are diminishing, and the requirements for workers' operational skills and professional knowledge exhibit a trend of integration. Secondly, the rapid pace of technological updates has accelerated the rate of changes in job types and job contents, demanding that workers in a certain industry constantly update their existing skills in accordance with new production requirements. Thirdly, fixed jobs are reducing, and occupational mobility is accelerating, requiring workers to possess skills for job transitions. Specifically, in the process of cultivating skilled talents, vocational undergraduate education mainly corresponds to three types of skill demands: professional skills, industrial skills, and personalized skills. Professional skills refer to the ability of workers to solve professional occupational problems or complete professional activities, which are highly specialized and have low transferability, including technical knowledge and theories, as well as practical skills combined with production reality. Industrial skills refer to the special skills required for workers to enter a certain industry, which are only valuable to specific industries. Personalized skills refer to abilities with individual subjective characteristics, mainly including innovation ability and job adaptability, which are unique and differentiated.

To analyze the microscopic paths for vocational undergraduate education to facilitate China's industrial upgrading, it can be conducted from three dimensions: specialization, industrialization, and personalization. Specialization examines the cultivation of students' professional skills through majors and courses; industrialization examines the cultivation of students' industrial skills through teaching; personalization examines the cultivation of students' personalized abilities through guarantee systems.

2. Realistic Observation: The Challenges of Vocational Undergraduate Education in Facilitating China's Industrial Upgrading

Theoretically, vocational undergraduate education is positioned to effectively support and facilitate China's industrial upgrading by producing a sufficient number of highly skilled professionals who can meet the evolving skill demands while promoting their high-quality career development. However, this educational sector faces a series of pragmatic challenges in its efforts to contribute to China's industrial advancement.

(1) Macro challenges facing vocational undergraduate education in facilitating China's industrial upgrading

Vocational education serves the dual purpose of cultivating both "professional individuals" and "socially responsible citizens." Historically, an employment-oriented approach has been a significant hallmark guiding the developmental trajectory of vocational education. Nevertheless, with the evolution of contemporary development concepts and the strengthening institutional framework surrounding vocational education, there has emerged a multifaceted orientation towards talent cultivation that encompasses serving national development strategies, addressing economic and societal needs, as well as accommodating diverse individual talents.

The objective for talent cultivation within the vocational undergraduate education system is predicated on clearly defined positioning within vocational education; it aims to develop versatile professionals capable of adapting to the developmental requirements characteristic of the new era—individuals endowed with advanced technical skills and innovative capabilities.

On June 16, 2014, the Ministry of Education along with five other governmental departments released the "Modern Vocational Education System Construction Plan (2014-2020)," which explicitly articulated that "We should vigorously promote modern agricultural vocational education." This initiative emphasizes cultivating new types of professional farmers as its focal point while advocating for establishing a public welfare training system for farmers. Furthermore, it encourages ongoing educational projects aimed at farmers and seeks innovative models that integrate agricultural practices into broader educational frameworks.In accordance with the strategic deployment of developing advanced manufacturing in China, and based on the requirements of modern production methods and industrial technological progress, prioritize the cultivation of high-quality technical and skilled talents who master new technologies and possess high skills. Accelerate the cultivation of talents for modern service industries. Focus on strengthening vocational education that serves financial, logistics, business, medical, health, and high-tech service industries, cultivating new-type service talents with high cultural and technical skill qualities. Deepen reforms in cultural and artistic vocational education, prioritizing the cultivation of cultural and creative talents and grassroots cultural talents, inheriting and innovating national culture and crafts, and promoting the cultural industry to become a pillar industry of the national economy. Urgently meet the demand for talents in social construction and management. Leverage the important role of vocational education in being rooted in and serving communities, promote vocational colleges to face grassroots needs, actively offer majors such as urban management, rural construction, social security, community work, culture and sports, environmental hygiene, and elderly care services, and cultivate high-quality social management and service workers who are willing to work at the grassroots level, can stay there, are educated, skilled, and good at communication." It also presents the talent cultivation directions for relevant industries in key economic and social fields in a special column format.

The Chinese government has repeatedly emphasized that the social atmosphere that respects skills and labor will be further strengthened, the scale of skilled talents will continue to grow, their quality will steadily improve, their structure will be continuously optimized, and their incomes will increase steadily. The proportion of skilled talents in the total employed population will reach over 30%, and the proportion of high-skilled talents among skilled talents will reach one-third. In eastern provinces, the proportion of high-skilled

talents among skilled talents will reach 35%. By 2035, it is strived that the scale of skilled talents will continue to expand, their quality will significantly improve, and the number and structure of high-skilled talents will align with the requirements of basically achieving socialist modernization.

However, the reality is that the talent cultivation of China's vocational undergraduate education is inadequately adapted to industrial demands.

In terms of scale, high-skilled talents are in short supply. By the end of 2021, the total number of skilled talents in China exceeded 200 million, with over 60 million high-skilled talents. The proportion of skilled talents in the total employed population exceeded 26%, and the proportion of high-skilled talents among skilled talents reached 30%.8Among Japan's entire industrial workforce, senior technicians account for 40%, while in Germany, this figure reaches 50%. China has a shortage of skilled workers, especially senior technicians, and there is still a gap compared to developed countries like Japan and Germany[9]. Although the enrollment scale of vocational undergraduate education has been expanding in recent years, the gap in talent cultivation remains large compared to the needs of social development. For example, data shows that by 2025, the enrollment scale of vocational undergraduate education is planned to be no less than 10% of the enrollment scale of higher vocational education, but this proportion still falls significantly short of the current social demand for high-quality technical and skilled talents.

In terms of structure, China's secondary industry, represented by manufacturing, faces a shortage of skilled talents. In terms of quantity, as China's economy transitions from manufacturing to services, the employment share of the secondary industry continues to decline, and a large number of skilled laborers are shifting to the tertiary industry, resulting in involuntary shortages of skilled labor in manufacturing enterprises[10]. In the short term, Chinese manufacturing enterprises still face difficulties such as "skilled labor shortages" and "chronic labor shortages," and due to factors such as periodic and seasonal fluctuations in order volumes and high turnover rates among frontline operators, manufacturing enterprises have the greatest demand for frontline operators. In Guangdong Province, over one-third of surveyed enterprises have shortages of general workers[11].

(2) Micro challenges of vocational undergraduate education in facilitating China's industrial upgrading

In terms of professional setting, vocational undergraduate education struggles to fully align with the requirements of economic and social development as well as industrial transformation and upgrading. Some vocational undergraduate institutions have overly conventional professional setups, failing to keep up with the development of emerging industries promptly, thereby causing an imbalance in the supply and demand of talents. According to relevant statistics from the Ministry of Education, in recent years, the demand for high-quality technical and skilled talents in emerging industries in China has been on the rise continuously, yet the professional settings of some vocational undergraduate institutions have failed to respond in a timely fashion. For instance, in popular domains such as artificial intelligence, big data, and new energy, the quantity of related professional settings is far from meeting market demands. During the talent cultivation process, there are instances where vocational undergraduate institutions simply extend or directly transplant the curriculum systems of original vocational junior college education or ordinary undergraduate education when formulating talent cultivation plans[12].

From the aspect of teaching, investigations reveal that the teaching model of vocational undergraduate education is misaligned with industrial demands, manifested in insufficient teaching capabilities of teachers, monotonous teaching methods, inadequate integration of industry and education, and a lack of practical abilities. This misalignment constrains the quality of talent cultivation in institutions, failing to meet the objectives of vocational undergraduate education development and the requirements of the market economy and industrial development[13].

Regarding the connection of talent cultivation levels, there is a deficiency in effective connection and gradient with secondary vocational education, vocational junior college education, and ordinary undergraduate education. This limits the multi-level and all-round talent supply capacity of vocational undergraduate education in the construction of a skill-oriented society. According to data from the Ministry of Education, in 2023, the enrollment of vocational undergraduate education in China was 89,900, accounting for merely 0.8% of the total enrollment in higher education[14], which remains relatively low. Compared with ordinary undergraduate education, the gradient in talent cultivation levels of vocational undergraduate education is not distinct enough. This leads to vocational undergraduate education being unable to exert its due role in the supply of high-end technical and skilled talents. Taking Germany as an example, its vocational education system encompasses multiple levels such as secondary vocational education, higher vocational education, and applied undergraduate education, with close connections among different levels, forming a comprehensive talent cultivation gradient. In contrast, the gradient in talent cultivation levels of vocational undergraduate education in China still needs enhancement.

In terms of guarantee mechanisms, the quality guarantee mechanism of vocational undergraduate education is not yet perfected, with obvious deficiencies. Among the existing vocational and technical universities in the country, the majority have been upgraded from private vocational colleges or resulted from the merger and transformation of independent colleges. As of May 2024, there are 51 vocational undergraduate institutions in the country, among which 43 have been upgraded from vocational colleges and 7 have emerged from the merger and transformation of vocational colleges and independent colleges. Many institutions have development shortcomings in aspects such as course settings and teaching methods, resulting in the skills and professional qualities of graduates not reaching the expected standards of enterprises and failing to meet the actual demands of the market[15]. Vocational undergraduate education still confronts predicaments such as the disconnection in professional construction among institutions, poor alignment of courses, a single level of talent cultivation, and an incomplete guarantee mechanism, which has become a significant obstacle to its contribution in facilitating China's industrial upgrading.

3. Policy Recommendations: How Vocational Undergraduate Education Facilitates China's Industrial Upgrading

To overcome the bottleneck constraints of vocational undergraduate education in China's industrial upgrading, targeted strategies need to be proposed in the aspects of the integration of industry and education for skills, skills training, and lifelong education.

(1) Deepen the integration of industry and education and improve the vocational education system

Firstly, enhance the industry-education integration system and innovate the skills formation system. Vocational undergraduate education still faces issues such as mismatch with industrial development in enhancing the skills of industrial workers, which hinders the formation of the industry-education integration system. The improvement of the industry-education integration system mainly lies in promoting the establishment of a spiral mechanism of mutual support between education and industry. The key to innovating the skills formation system is the unification of the external skills accumulation methods represented by schools and the internal skills accumulation methods represented by enterprises. Secondly, smooth the training channels and educational career paths for skilled talents. Vocational education must raise its educational standards, extend the period of talent cultivation, and establish seamless connections among vocational education at the junior college level, vocational undergraduate level, and applied master's degree level. In terms of talent cultivation goals, discipline and professional construction, and teaching

course design, the level of skills training should be enhanced. Additionally, the connection channels between vocational undergraduate education and applied postgraduate education should be gradually established to create opportunities for the academic advancement and further study of skilled talents, promote their entry into the main labor market for employment, and enhance the attractiveness of vocational education. Thirdly, improve the construction and development mechanism of high-level professional clusters and establish an organic connection between the education chain, talent chain, and industrial chain. Professional clusters are established to serve the development of industrial clusters and represent a concentrated manifestation of the advantages of multi-party education in school-enterprise cooperation and industry-education integration. They are the form and path for promoting the high-level development of specialties and an important measure for establishing an organic connection between the education chain, talent chain, and industrial chain. The construction and development of professional clusters should be coordinated with local industrial development and be consistent with regional industrial layout. At the same time, they should reflect the advantages of professional clusters and become a model for the innovation of skills training models. Fourthly, increase financial investment and support the infrastructure construction of vocational undergraduate education. The government should enhance financial investment in vocational undergraduate education and support its infrastructure construction, including the construction and renewal of laboratories, training bases, and library resources. At the same time, encourage social capital to participate in the development of vocational undergraduate education and form a diversified investment mechanism to provide sufficient development funds for vocational undergraduate education.

(2) Optimize skills training and enhance the quality of high-skilled talent cultivation

Although skill accumulation is a continuous value-added process, different jobs have varying requirements for the types, depths, and complexities of skills. Therefore, only by systematically optimizing each link of skills training, including implementation and evaluation, can we accelerate the consolidation of the talent foundation for a skills-based society. Firstly, the talent cultivation goals of vocational undergraduate schools should emphasize the cultivation of professional skills. In the process of talent cultivation, schools should fully embody the educational attributes of vocational education and not merely focus on the operational skills that enable students to "directly enter the workforce". Instead, they should strengthen the cultivation of students' cultural literacy, key professional skills, and transferable skills. Secondly, vocational education institutions need to attach greater importance to the cultivation and certification of vocational skills. This includes providing more opportunities for students to acquire and enhance practical vocational skills and encouraging them to participate in skill certification procedures. By enhancing students' practical skills and providing them with certification opportunities, vocational education can better prepare students for their future careers and improve their market competitiveness. Finally, vocational education institutions should commit to providing more personalized educational services. This means not only paying attention to the specific needs and career interests of each student but also providing targeted guidance and support. Personalized educational services not only involve the selection of course content and the diversification of teaching methods but also include personalized planning for students' career development paths. In this way, vocational education can better meet the specific needs of students and help them achieve their career goals more effectively.

(3) Strengthen lifelong education and broaden the career development space for highly skilled talents

The rapid advancement of technology and the continuous increase in the total amount of knowledge have accelerated the depreciation rate of existing knowledge and the shortening of the knowledge application cycle, leading to changes in the social industrial structure, talent structure, technical structure, educational structure, and occupational structure. This complex technological iteration-based change has imposed higher requirements on the knowledge and ability structure of vocational workers, manifested as stronger

professional adaptability, adaptability, and high-level thinking ability. Correspondingly, it necessitates the lifelong nature of vocational education. Vocational undergraduate education should not only focus on the accumulation of human capital before employment but also on the accumulation of skills after employment, playing a crucial role in the accumulation of skills after employment. Therefore, to achieve the goal of building a skill-based society where "everyone has skills", it is not only necessary to strengthen "pre-employment" school education but also to establish and improve the "post-employment" continuing education feedback system and realize a lifelong education connection mechanism that integrates "before and after".

(4) Broaden the development space and establish a treatment guarantee mechanism for highly skilled talents

The support and guarantee system and mechanism for human capital allocation are important prerequisites for effective human capital allocation.[16] Therefore, optimizing human capital allocation requires effective policy intervention. The government needs to adjust the remuneration of highly skilled human capital, establish a treatment guarantee mechanism for highly skilled talents to assist in skill transformation, and broaden the career development space for talents. Firstly, improve the social status and treatment of highly skilled talents. The government should take measures to enhance the social status and treatment of highly skilled talents, including raising salary levels, improving the social security system, and providing housing subsidies. Secondly, the government should broaden the career development channels for highly skilled talents and provide them with more promotion opportunities and career development space. By establishing a complete vocational qualification certification system and vocational skills competition mechanism, it can provide a platform and opportunities for highly skilled talents to showcase their talents. Thirdly, the government and all sectors of society should collaborate to create a favorable social atmosphere, respect highly skilled talents, and promote the spirit of craftsmanship. Through holding vocational skills competitions and commending outstanding skilled talents, the social popularity and influence of highly skilled talents can be enhanced. At the same time, strengthen public opinion propaganda to guide society to form a favorable trend of respecting labor, respecting knowledge, respecting talents, and respecting creation.

4. Conclusion

Vocational undergraduate education plays a pivotal role as a critical instrument for ensuring an adequate supply of skills and is essential for China's industrial upgrading. Grounded in human capital theory and new vocationalism, this study investigates the allocation of human capital and students' skill development, revealing both the intrinsic strengths and practical challenges faced by vocational undergraduate education in supporting industrial upgrading.

The findings demonstrate that while vocational undergraduate education has the potential to significantly support China's industrial upgrading, certain areas still require focused attention and improvement. Specifically, the insufficient scale of high-skilled human capital at the macro level and suboptimal allocation efficiency at the micro level hinder the full realization of its potential.

The proposed policy recommendations—such as deepening industry-education integration, optimizing skill cultivation pathways, reinforcing lifelong learning systems, and expanding development opportunities through a treatment guarantee mechanism—provide actionable directions for enhancing the role of vocational undergraduate education. Future research could further examine the implementation and effectiveness of these recommendations, as well as explore additional factors influencing the relationship between vocational undergraduate education and industrial upgrading. Overall, sustained efforts in refining and implementing these strategies are indispensable to ensure that vocational undergraduate education contributes more effectively to China's industrial upgrading and the cultivation of a high-quality workforce.

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