AN ANALYSIS OF THE CURRENT STATUS OF CHARACTERISTIC MAJOR CONSTRUCTION IN HIGHER VOCATIONAL COLLEGES IN CHINA UNDER THE CONTEXT OF INDUSTRY-EDUCATION INTEGRATION – A CASE STUDY OF HENAN VOCATIONAL AND TECHNICAL COLLEGE

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AN INDEPENDENT STUDY SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF MASTER OF BUSINESS ADMINISTRATION
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This Independent Study Has Been Approved as a Partial Fulfillment of the Requirements for the Degree of Master of Business Administration

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ABSTRACT

As an important part of the talent training system, higher education shoulders the important mission of cultivating high-quality technical and skilled talents. In the context of deepening industry-education integration, the effectiveness of industry-education collaborative education is related to the market supply quality of high-quality technical talents. Taking Henan Vocational and Technical College as a typical case, this study focused on the interactive relationship between the government, industry, and universities, and the current status of CNC （Computerized Numerical Control） technology major. It analyzes the current status of the construction of characteristic majors in higher vocational colleges under the context of industry-education integration of Henan Vocational and Technical College and provided optimization suggestions for the construction of characteristic majors in higher vocational colleges.

This study adopted a qualitative research method. Through stratified sampling, 12 graduates of Henan Vocational and Technical College, 15 students and 9 representatives of cooperative enterprises were selected as the research subjects. Semi-structured interviews were conducted to obtain qualitative data. Descriptive statistics were used on the differences in the actual experiences of the three parties, and key contradictions were identified based on relevant literature data.

The interview results show that there is a gap between the ideal state of industry-education integration and the actual realization, including the disconnection between courses and industry needs, the imbalance of school-enterprise cooperation mechanism,

and significant policy dependence. The conclusion provides suggestions from five dimensions: perception and construction of professional characteristics, practical teaching resources and industry-education integration, school-enterprise cooperation and policy coordination, internship model and knowledge application, and management and improvement suggestions, which can save as reference for other colleges and universities.

Keywords: integration of industry and education, characteristic major construction, Triple Helix Theory, school-enterprise cooperation, Henan Vocational and Technical College

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LI SHUO

DECLARATION

I, Li Shuo, hereby declare that this Independent Study entitled "An Analysis of the Current Status of Characteristic Major Construction in Higher Vocational Colleges in China under the Context of Industry-education Integration – A Case Study of Henan Vocational and Technical College" is an original work and has never been submitted to any academic institution for a degree.

(LI SHUO)
Jun 24, 2025

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Chapter 1 Introduction

1.1 Background of the Study

Higher vocational education is an important part of Chinese's higher education and shoulders the important mission of cultivating high-quality technical and skilled personnel. Through systematic vocational education, students can acquire the necessary theoretical knowledge and practical skills and shoulder the mission of cultivating high-quality technical and skilled personnel for Chinese's social and economic development. In 1998, the State Education Commission issued the Notice on the Principles of Deepening Vocational Education and Teaching Reform for the 21st Century, pointing out that it is necessary to implement the spirit of the 15th National Congress of the Communist Party of China, deepen the reform of vocational education, improve the quality of teaching and the efficiency of running schools, and clearly state that the purpose of vocational education is to cultivate applied talents who are compatible with Chinese's socialist modernization construction, have comprehensive professional abilities and comprehensive qualities, and work directly in the front line of production, service, technology and management to adapt to the market and industry (Zhang & Li, 2023). Higher vocational education is expected to connect with the needs of economic and social development and provide strong talent support for industrial upgrading and transformation.

After a period of exploration, China's higher vocational education has performed well, but there is still a gap with the actual development needs of the real society. According to the "Industrial Digital Talent Research and Development Report (2023)" and the data of the National Bureau of Statistics, the overall gap in China's digital talents is about 25 million to 30 million. In 2023, the added value of China's core digital economy industries accounted for 10% of GDP, while the supply of digital talents is far less than the growth in demand. According to the "Manufacturing Talent Development Planning Guide", by 2025, the talent demand gap in the top ten key areas of China's manufacturing industry will be close to 30 million, with a gap rate of 48%. The global talent gap in digital and intelligent technology is 60 million, of which China's ICT talent gap will exceed 20 million. It can be seen that there will be a large gap in talent in China's manufacturing industry in the future, and supply-side structural reforms are urgently needed (Li & Wang, 2023). At present, China is in a critical period of decisive victory in building a well-off society in an all-round way and building a socialist modern power. In the face of the current urgent need for skilled talents, deepening the

reform process of modern vocational education to effectively alleviate the shortage of high-skilled talents in the industry is of immeasurable value for promoting the construction of a socialist modern power in China, and has become an urgent requirement for the development of the times.

1.2 Problems of the study

After the founding of the People's Republic of China, the government attached significant importance to the development of vocational education and regarded it as an important way to cultivate talents for socialist construction. After the reform and opening, China's economy developed rapidly, the industrial structure was constantly adjusted and upgraded, and the demand for technical and skilled talents increased. The government attached immense importance to the development of vocational education and incorporated it into an important part of the national education system. Through the implementation of the "science and education to revitalize the country" strategy and the "talent to strengthen the country" strategy, the reform and development of vocational education are promoted. However, structural problems have emerged, that is, the supply and demand sides of the talent market may be equal in quantity, but there is a significant mismatch in quality, structure, or geographical distribution. It manifests itself as a disconnect between education, training, and the employment market (Davis & Taylor, 2021).

To solve the problem, the Chinese government attaches great importance to the development of vocational education and has introduced a series of policy measures to promote reform and improve the quality of higher education, such as the "National Vocational Education Reform Implementation Plan" (Vocational Education 20 Articles) and the "Vocational Education Quality Improvement Action Plan (2020-2023)", which clearly define the development goals and paths of vocational education. The government's financial investment in vocational education has increased year by year, supporting vocational colleges to improve school conditions and improve teaching quality. The "Double High Plan" was launched to launch a plan to build high-level vocational colleges and majors with Chinese characteristics and support a number of excellent vocational colleges and specialty majors to take the lead in development (Lee & Wang, 2022). The "1+X Certificate System" was promoted to promote the talent training model that combines academic certificates with vocational skill level certificates to enhance students' professional ability and employment competitiveness.

However, social awareness is not high, and some people have prejudices against vocational education, believing that vocational education is not general education. For China's actual development needs, how to give full play to the role of higher vocational colleges, highlight their advantages, promote industrial upgrading and transformation, provide talent support, promote sustainable and healthy economic development, cultivate skilled talents needed by the region, and enhance regional economic competitiveness has become an important topic for the development of higher vocational colleges (Zhang & Chen, 2023).

(1). What is the current status of the construction of characteristic majors in Henan Vocational and Technical College?

(2). Under the current industry-education integration environment of Henan Vocational and Technical College, what optimization suggestions can be provided for the construction of characteristic majors in higher vocational colleges?

1.3 Objectives of the Study

Through the following two research objectives, this study systematically analyzes the challenges and optimization paths faced by the characteristic majors of higher vocational colleges in the current context of industry-education integration and provides useful reference and direction for improving the quality of higher education in China.

1. To investigate the current status of characteristic major construction in higher vocational colleges under the context of industry-education integration of Henan Vocational and Technical College.

2. To provide optimization suggestions for the construction of characteristic majors in higher vocational colleges in the current industry-education integration environment of Henan Vocational and Technical College.

1.4 Scope of the Study

This study focuses on Henan Vocational and Technical College in Central China, and deeply explores how higher vocational colleges can build characteristic majors in the context of industry-education integration to adapt to the needs of economic and social development and industrial transformation. The research content covers the

development history and policy background of Chinese's education industry and analyzes in detail the specific measures and innovative measures of higher vocational colleges in the integration of industry and education. Combined with the triple helix theory framework, the construction of characteristic majors in the context of industry-education integration was examined, and Henan Vocational and Technical College was analyzed to understand its overall configuration and the current status of cooperation with local industry and academia. In order to understand the real situation and have a more comprehensive understanding of the construction of characteristic majors from different dimensions, the study conducted open interviews with nine corporate personnel, fifteen students, and twelve graduates to collect qualitative for data analysis.

1.5 Significance of the Study

On the one hand, this study reveals and explains the practical challenges of the construction and development of regional specialty in vocational education, explains the requirements of the practical application of the Triple Helix Theory of Education, promotes the implementation of the Triple Helix Theory of Education in production and teaching practice, and enriches the theoretical connotation of vocational education to adapt to the rapid iteration of regional industries. On the other hand, it can change the current dilemma that the regional specialty majors offered in vocational education are out of touch with industry needs and the training efficiency is low. This study also explores cooperation paths, encouraging enterprises to deeply participate in curriculum development, real production environment training, and industry-wide competency certification to simultaneously improve educational effectiveness and industrial benefits. At the same time, it will drive vocational schoolteachers to optimize teaching methods, and ultimately achieve the three-party coordinated development of high-quality employment for students, efficient employment for enterprises, and high-level education in colleges.

1.6 Definition of Key Terms

Industry-education integration refers to a talent training model that organically connects the education chain, industrial chain, and innovation chain through the collaborative mechanism of government, industry, and school. Its essence is the two-way link between the education system and the industrial system: on the one hand, it meets the demand for high-quality technical and skilled talents in economic and social development through supply-side structural reform, and on the other hand, it promotes

industrial upgrading and the realization of national strategic goals through knowledge spillover effects. Specifically, it is manifested in the joint construction of curriculum systems, sharing of practical training resources, and joint research of technical standards by schools and enterprises, forming a dynamic balance of "education supply-industry demand-policy guidance" (Chen et al., 2014).

Characteristic Major Construction refers to the process wherein higher education institutions develop specific academic majors with distinctive features in educational philosophy, talent cultivation objectives, training models, and educational quality. These features must demonstrate comparative superiority—not only excelling over other aspects within the same major at the institution but also surpassing equivalent aspects of the same major at peer institutions (Li et al., 2008).

Triple Helix Theory emphasizes the spiral interactive relationship between government, industry and schools in knowledge production and innovation. In the field of education management, the government's responsibility is to build a collaborative platform through policy leverage and institutional design, the industry's responsibility is to feedback talent specifications in the form of technology demand white papers and participate in the formulation of teaching standards, and the school's responsibility is to reconstruct teaching materials, establish skill master studios, and realize the knowledge transmission of "laboratory-production line"

Chapter 2 Literature Review

2.1 Review of Key Concepts

2.1.1 Major

According to the explanation in Volume 3 of the 12-volume Dictionary of Education published by Shanghai Education Press in 1992, "major" refers to the various professional fields in which students are trained in higher vocational schools in China, the Soviet Union, and other countries. The earliest paper on the establishment of higher education majors included in CNKI after the founding of the People's Republic of China was the "major" establishment issue of higher education institutions published by Zeng Zhaoyu in People's Education on September 27, 1952. The paper pointed out that "major" is a specialized profession or a specialty. According to the Soviet higher education system, "major" is the goal of cultivating senior professionals, emphasizing "correspondence of social division of labor" and "specialization of knowledge system". Its essence is to cultivate senior professionals in specific fields through systematic courses. Major is a specific social profession. Both profession and major are the product of social division of labor, but profession is universal, and major is special. Major is the result of further differentiation of social professions and is a profession with higher knowledge and technology content. These knowledge and technologies often need to be obtained through certain professional education. Based on the research objective of this study, "major" is defined as: an academic category established by higher education institutions or secondary vocational schools according to the needs of social professional division of labor.

2.1.2 Characteristic Major

The professional characteristics of higher education institutions have the basic characteristics of the concept of characteristics. They are relatively stable, lasting, unique and high-quality development methods that are gradually formed by the professional points of higher education institutions under the guidance of certain school-running ideas and through long-term school-running practices. They are reflected in the main elements of professional construction such as talent training goals, talent training models, talent training plans, faculty quality, hardware facilities, and

ultimately reflected in the quality of talent training. Therefore, the characteristic majors of higher education institutions can be summarized as: fully reflecting the school's school-running positioning, having a high school-running level and distinctive school-running characteristics in terms of educational goals, faculty, curriculum system, teaching conditions and training quality, and gaining social recognition and a high social reputation. Characteristic majors are formed after long-term construction and are a concentrated reflection of the school's advantages and characteristics in running schools (Niu & Wang, 2009).

2.1.3 Characteristic Major Construction

Some scholars believe that the construction of characteristic majors is a "differentiation management strategy" in management This differentiation is a strategic means for it to gain competitive advantages in the education market. First, internal and external surveys are conducted at the beginning of the establishment of characteristic majors, and the advantages, disadvantages, opportunities, and threats of the majors are found in combination with the SWOT analysis method. The strengths are strengthened, and the weaknesses are avoided. The professional direction is subdivided in combination with social talent needs. Some scholars also believe that the construction of characteristic majors refers to the process of higher vocational colleges opening and adjusting characteristic majors according to the professional catalog provided by the education authorities and industry authorities. Its construction includes nine aspects of construction content, including discipline and major setting, training programs and teaching plans, professional course systems, teaching staff, professional textbooks, practical teaching, teaching and research institutions and systems, teaching equipment and quality monitoring and evaluation. This study defines "characteristic major construction" as the strategic behavior of higher vocational schools in seeking differentiated survival and development space in the educational ecological niche avoids homogeneous competition through unique positioning and resource allocation; In line with the goal of talent training, schools and enterprises jointly build and systematically design and optimize core elements such as professional training programs, curriculum systems, teaching staff, teaching conditions, and evaluation mechanisms, promote in-depth interaction and collaboration among the government, industry, and schools, and ensure that professional construction is closely connected with regional development needs and industrial technology frontiers. Just like brand IP,

characteristics majors should have unique value propositions, core competitiveness and market influence.

2.1.4 Industry-education Integration

In 2013, the Ministry of Education issued the "Ministry of Education 2013 Work Points" notice, which officially appeared "industry-education integration", but there was no specific definition. With the continuous research of subsequent scholars, there has been a gradual in-depth understanding and recognition: First, industry-education integration is defined as the cooperation between the industrial system and the education system. To improve the quality of training students in higher vocational colleges, higher vocational colleges and industry enterprises have in-depth cooperation. Second, it is believed that industry-education integration regards education and industry as a system, and is a fusion body produced for the overall development of society. Industry-education integration is the process of integrating the industrial system and the education system. Its symbol is that new economic growth points are formed through industry-education integration or new industry-education integration bodies are generated. In this study, the "industry-education integration" means that colleges and universities, or secondary vocational schools are driven by supply-side structural reforms, through the three-helix collaboration of government-industry-university, and deep integration of regional resources with industry enterprises to build a talent training model with an organic connection of "education chain-industry chain-innovation chain". Its essence is the two-way empowerment of the education system and the industrial system, which not only meets the needs of social and economic development for high-quality technical and skilled talents, but also promotes industrial upgrading and the realization of national strategic goals through knowledge spillover effects (Brown & Davis, 2017).

2.2 Related Theories

2.2.1 Triple Helix Theory of Education

The Triple Helix Theory of Education was proposed by American scholars Henry Etzkowitz and Loet Leydesdorff in 1995. They first systematically expounded the theory in their book "Universities and the Global Knowledge Economy: The Triple Helix of University-Industry-Government Relationships". The Triple Helix Theory was

originally used to explain the interactive relationship between universities, industries, and governments in the innovation system, and then gradually expanded to the field of education management, becoming an important framework for analyzing government-industry-university collaboration (Carayannis & Campbell, 2009).

The core idea is that the Triple Helix Theory of Education believes that the government, industry, and schools form a spiral interactive relationship in the process of knowledge production and innovation, and maximize the educational value, industrial value, and social value through collaborative cooperation. It makes the concept of education management shift from single-subject management to multi-subject collaborative governance. It emphasizes the equal participation of the three parties of government, industry and academia in talent training, scientific research innovation and social services. It promotes the in-depth development of school-enterprise cooperation and industry-education integration. It builds a management system integrating the three chains of "education chain-industry chain-innovation chain". It introduces multiple evaluation indicators, such as enterprise satisfaction, scientific research results conversion rate, social contribution, etc.

Combined with the current background, the advantages of this theory are emphasizing the overall coordination of the government, industry, and school, avoiding the limitations of a single subject perspective. It reveals the spiral interaction of the three parties in knowledge production and innovation, which has a strong explanatory power. It provides an operational theoretical framework for educational practices such as industry-education integration and school-enterprise cooperation (Campbell & Carayannis, 2016). It shows the law of subject coordination: the government, industry, and school form a complementary and coordinated relationship in knowledge production and innovation. Through resource sharing and achievement transformation, the educational value, industrial value, and social value are maximized. The tripartite relationship is dynamically adjusted with the economic environment and technological development, forming a spiral upward coordination model. It has been widely used in vocational education, higher education, regional economy, and other fields, providing a replicable paradigm for promoting the coordinated development of education and industry.

2.2.2 Collaborative Governance Theory

The cooperative governance theory is a composite governance model between government governance and self-governance. The research on cooperative governance

in Chinese's academic circles began in the early 20th century. In the article "Governance Transformation and Competition-Corporatism", it is proposed that the transformation of China's governance model requires the government to further delegate power and cultivate social organizations with autonomy and self-governance. At the same time, it also requires the government to further transform its roles and functions from "helmsman" and "rower" to "helmsman". That is to say, on the one hand, it requires diversified competition and power differentiation, and on the other hand, it emphasizes diversified cooperation and power integration. The cooperative governance theory excludes any government-centric orientation, which is manifested in the fact that public policy goals are affected by multiple value factors and thus appear in the form of a complex goal system. This determines that the government needs to conduct extensive cooperation with social non-profit organizations, private organizations, and ordinary people in the process of achieving policy goals. Jing Yijia, a professor at the School of International Relations and Public Affairs of Fudan University in Chinese, proposed that the emergence of cooperative governance is an indispensable part of China's public governance transformation after the reform in 1978. Its essence is the power sharing and collaboration between the public and private sectors to achieve the purpose of public governance. In terms of its function, it is similar to the triple helix theory of education.

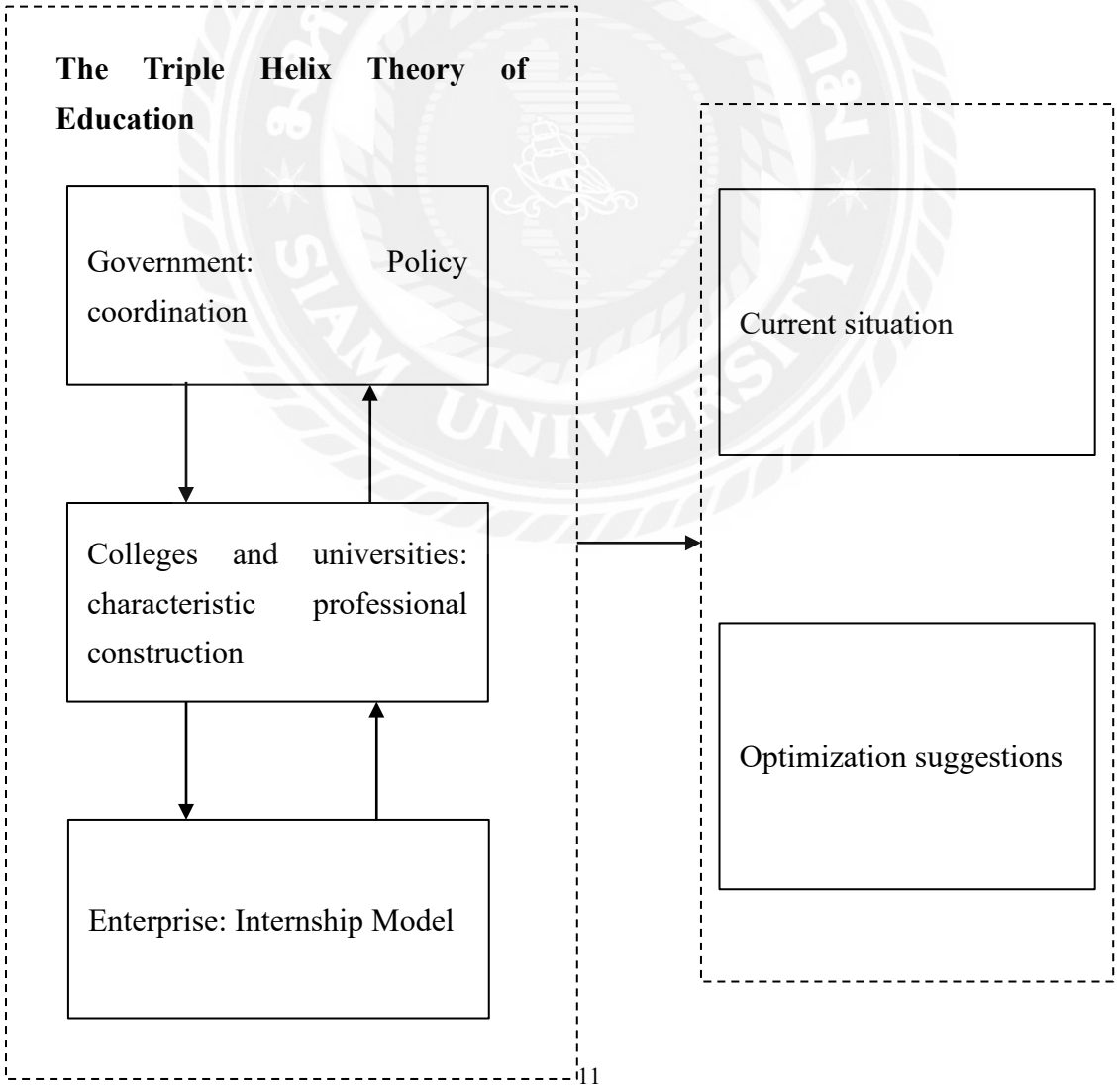
2.3 Henan and Zhengzhou Vocational and Technical College

Zhengzhou, where Henan Vocational and Technical College is located, is not only the capital of Henan Province, but also located in the central region of the country. With regional advantages and policy support, it has developed rapidly. Zhengzhou insists on manufacturing as the main direction of urban economic development. There are large manufacturing companies such as Foxconn, SAIC, Yutong, Haima, Dongfeng Nissan, BYD, and well-known food processing companies such as Haoxiangni, Sanquan, and Synear. It has formed several major industrial clusters such as electronic information, automobiles, equipment manufacturing, new materials, modern food, and processing. It is the core of the Central Plains urban agglomeration and is known as the "Textile City" and the "Capital of Quick-Frozen Products". At the same time, Henan Province proposed in the 2022 National Economic and Social Development Plan to accelerate the construction of a modern industrial system, not only to improve the quality of traditional industries, cultivate and expand emerging industries, accelerate digital transformation, promote electronic information manufacturing, software and

information technology services and other digital economy core industries, strive for the digital economy core industries to account for 4.8% of GDP, but also to promote high-quality development of development zones, accelerate the reform of development zone systems and mechanisms. The province selected 30 development zones to carry out pilot work, focused on 1 to 2 leading industries to attract a number of major upstream and downstream projects in the industrial chain, and strived to add 2 development zones with an industrial scale of over 100 billion yuan and 5 development zones with a scale of over 50 billion yuan (People's Government of Henan Province, 2022). All these have provided a good economic foundation for the development and professional construction of Henan Vocational and Technical College.

2.4 Conceptual Framework

Figure 1: Conceptual Framework



Chapter 3 Research Methodology

3.1 Research Design

This study adopted a qualitative research design, with Henan Vocational and Technical College as a case study. Through interviews with enterprise representatives, graduates, and student totalling36, an policy literature analysis were designed based on the resource layer, teaching layer, effectiveness layer, and system layer to obtain the current status of characteristic specialty construction in Zhengzhou Vocational and Technical College, Henan. Based on the triple helix theory and the collaborative governance theory, the relevant data on the construction process of school-enterprise cooperation, and the effectiveness of the teaching process and transformation were obtained. The data were analyzed to find the pain points of cooperation between the school and the enterprise and improvement suggestions were put forward.

3.2 Population and Sample

- Interviewee introduction:

- This study focused on CNC technology as a representative specialty. The study's population included current students, graduates, as well as representatives from partner enterprises involved in the industry–education collaboration.

- The research was geographically focused on Henan Province and specifically on this institution during key phases of its teaching reform and characteristic major development.

- Sampling Method:

- The sample was selected based on internal data from the institution, interviews, and questionnaire responses. Students were chosen from various grades and different specialized tracks.

- Purposive sampling was adopted to ensure that participants who play significant roles in characteristic ed major development and industry–education integration are included, thereby ensuring the representativeness and depth of the data.

- The interviews were conducted with personnel from the college and enterprises, students and graduates within five years. The managers were between 30 and 40 years old, the students were between 20 and 25 years old, and the graduates were between 26 and 30 years old.

-The number of participants was 36, including 9 corporate personnel, 15 students and 12 graduates.

3.3 Research Instrument

Table 1 Interview Outline

Core Requirements	Respondent's Identity	Interview Outline
Focus on policy implementation, school-enterprise cooperation mechanism, dynamic coordination of curriculum and industry needs	Management	1. What unique advantages do you think the university has in professional teaching? When formulating courses and teaching models, how can we combine industry needs and government policies for collaborative innovation? 2. What are the highlights of the university's practical teaching? How to improve the quality of the practical part through cooperation with enterprises and government support? 3. Does the university arrange internships for students in partner companies? Please introduce the rotation or fixed position mechanism involved in internship arrangements, as well as the connection with relevant policies of enterprises and governments. 4. Where do you think there is room for improvement in teaching management? How can the university fully integrate government support and industry feedback into the management system to achieve better teaching quality?
Focus on teaching experience, practical training facilities, internship matching	Students	1. How do you evaluate the characteristics of the university's professional teaching? 2. Do you think the university's training classrooms and facilities can meet practical needs? 3. Did the university arrange for you to intern at a partner company? During the internship, was it a rotation system or a fixed position arrangement? How do you think this arrangement can help you improve your professional skills? 4. From a student's perspective, what suggestions do you have for the university in terms of teaching management? How can we better utilize industry and government resources to optimize the teaching and practice system?
Emphasis on the connection between education	Graduates	1. What do you think are the characteristics of the university's professional teaching? Can these characteristics meet the current industrial

and employment, and the actual results of school-enterprise cooperation		development needs and government industry standards? 2. How did your internship experience at a company during your school years help you acquire professional knowledge? How did this internship model promote your work? 3. During your employment process, what kind of support and resources do you think the collaboration between schools, enterprises and the government has provided you with? What positive effects does this model have on improving your competitiveness in the workplace? 4. Based on your experience in school and work, what shortcomings do you think the university has in teaching management? How to better integrate industry needs and government policies to promote in-depth cooperation between schools and enterprises?

3.4 Data Collection

Interview Outline: Designed with open-ended questions addressing aspects including curriculum arrangement, cooperation models with enterprises, faculty development, and the effectiveness of practical training. The question design is based on the triple helix theory framework, emphasizing the dynamic interaction of the government, industry, and school, and covering multiple subjects. The respondents were divided into three different groups: managers, students, and graduates, and differentiated questions were designed to ensure that the three perspectives of "government-industry-school" are covered. Key variables included participants, evaluations of the strengths and weaknesses of the characteristic major development, as well as their satisfaction with school–enterprise cooperation, including educational philosophy, curriculum structure, teacher recruitment, the construction of internship bases, and alignment with industry needs. Guiding questions are set under each topic to elicit detailed responses.

Value: Interview not only obtains qualitative feedback at the macro level (such as the overall evaluation of industry-education integration), but also captures micro-operational problems (such as long equipment update cycle and formalization of dual-qualified teacher certification).

The questions cover key aspects of curriculum, faculty, internship, and policy, and are linked to the literature review (Sections 2.1-2.2) and the theoretical framework (Triple Helix). The dimensions include curriculum design, faculty structure, school-enterprise cooperation, training base, policy, and tripartite collaboration.

The interview focus on understanding the university's strengths and characteristics in professional teaching, its emphasis on students' actual work and the construction of training sites, students' internship arrangements and internship results, as well as suggestions for the university's future teaching management.

3.5 Data Analysis

Through qualitative research, this study systematically analyzed the keyword summary expressions of the interviewees: first, based on the interview text, keywords were extracted and factors were classified to find the differences in focus of different groups; second, the logical relationship between data was identified through content comparison method; finally, the interview conclusions were verified in combination with school data such as school curriculum. Interviews, school archives, and policy documents confirmed the objectivity of the research findings and strengthened the credibility of the data.

Chapter 4 Findings and Discussion

4.1 Findings

Interview Summary:

The attitudes obtained through the interviews can be summarized into two aspects: on the one hand, the feasibility of industry-education integration is recognized, and the value of hardware facility investment and school-enterprise joint training model is recognized. On the other hand, due to existing problems including the contradiction between resource allocation and job matching and the imbalance of risk-taking caused by the imbalance of school-enterprise cooperation mechanism, it is urgent to deepen the reform of the cooperation mechanism.

From the results of the interviews, the interviewees, whether they are managers, students, or graduates, all believe that the university has its own unique characteristics in professional teaching and attaches significant importance to students' practical operations. However, due to various conditions such as funds and equipment, the practical operation equipment is tight and cannot be provided to each student. At the same time, the university also arranges for students to intern in enterprises. Professional internships are of significant help to students in better absorbing and mastering the knowledge they have learned. In terms of teaching suggestions for the university, they all hope that the university can further improve students' practical ability in future teaching, transform the knowledge they have learned into hands-on ability as much as possible, and improve students' competitive advantage in the talent market. In summary, both managers and students believe that improving students' practical operation ability is the top priority of professional teaching. At present, the university still has deficiencies in teaching equipment and student internship management, and this aspect of management needs to be further strengthened in future teaching.

Combined with the analysis of the triple helix theory, it is concluded that the Chinese government has issued a number of policies to promote the integration of industry and education and strive to build a school-enterprise cooperation platform and a common development mechanism. However, in actual operation, schools often show high enthusiasm, while enterprises are less enthusiastic about participating, resulting in a situation where school-enterprise cooperation is "hot on one end and cold on the other end". In addition, although the government provides guidance and financial support

when formulating policies, how to establish a long-term cost-sharing and incentive mechanism is still an issue that needs to be improved.

4.1.1 Current status of Computerized Numerical Control (CNC) technology specialty construction

The CNC (Computerized Numerical Control) focuses on knowledge and skills in CNC principles, CNC machine tool application and maintenance, CNC processing technology, etc. After graduation, students of this major enter the manufacturing industry to perform equipment operation, program compilation, process implementation, etc., which is highly compatible with the industrial structure of Zhengzhou City and has an overly broad development space. However, the current cooperation stays at the level of teaching activities, lacking in-depth cooperation in teaching management and curriculum development. This limits the rapid response and adaptability of vocational education to industrial needs. In terms of professional standardization construction, there is a lack of a mechanism to jointly formulate and update standards with enterprises, resulting in a gap between curriculum settings and the actual needs of enterprises. The cooperation between the university and enterprises in technological innovation and project development is not in-depth enough, and the technical advantages and resources of enterprises have not been fully utilized to improve the level of teaching and research. There is a lack of a scientific teaching result evaluation system, which cannot effectively measure the actual effect of industry-education integration and the improvement of students' professional abilities. Despite policy support, in actual operations, the cooperation mechanism between the university and enterprises is not perfect, and resource integration is insufficient, which affects the in-depth development of industry-education integration. The existence of these problems limits the university from fully exerting its potential for education and talent training in a rapidly developing industrial environment.

4.1.2 The course design covers mainly theoretical courses, with fewer practical courses.

According to the school's official website on the CNC technology major at Henan Vocational and Technical University, students are required to complete 133.5 credits, totaling 2,776 class hours, to graduate. Among these, practical skills courses account for 60.5 credits, representing 45.32% of the total credits, and 1,372 class hours,

constituting 49.42% of the total class hours. Notably, the proportion of practical skills courses in both credits and class hours falls below 50%. Additionally, out of the 73 credits allocated to theoretical courses, only 34 credits are related to the major, accounting for 46.58% of the theoretical credits, which is also below the 50% threshold. This indicates that the curriculum design for the CNC technology major at Henan Vocational and Technical University remains predominantly theoretical, with limited emphasis on practical training. As a discipline that directly engages with production line operations, the CNC technology major demands that students possess a thorough understanding of production machinery and equipment, as well as a prominent level of hands-on proficiency. Graduates are expected to directly operate equipment, program, and implement processes in their professional roles. Consequently, it is imperative to incorporate more skill-based practice courses into the curriculum. This would provide students with increased opportunities for direct experience, thereby enhancing their job readiness and adaptability in the workplace (Wang & Zhang, 2021).

4.1.3 The teacher structure is unreasonable and there is a shortage of teachers with industry practice.

According to the official website, the school has more than 1,100 full-time teachers, including 63 professors, 181 associate professors, 5 State Council subsidies, 1 national "Ten Thousand People Plan" teaching master, 1 new era vocational school national master, 2 national outstanding teachers, 4 members of the Teaching Committee, 1 national university ideological and political theory teaching expert, 1 national skill master, 3 national technical experts, 8 vocational education experts in Henan Province, 22 provincial teaching masters, 9 provincial outstanding teachers, 5 provincial academic and technical leaders, 20 provincial technical experts, 8 provincial skill masters, 7 provincial senior talents, and 4 special allowances from the provincial government. The school has won 1 advanced collective in the national education system, 1 Huang Danian-style teacher team in national universities and universities, 2 national professional title industrial education teacher teaching innovation teams, 1 "Huang Danian-style" teaching team in Henan Province, 4 provincial teacher teaching innovation teams, and more than 93% of "double-qualified" teachers participate. The overall teaching task of the CNC technology major in Henan Vocational and Technical University is completed by full-time teachers, external teachers, and part-time teachers. Full-time teachers focus on theoretical teaching, while external and part-time teachers focus more on practical teaching, which is the "1+4+1" talent training model

implemented by the university. This model can indeed provide effective guidance to students in theory and practice, but due to diversified teaching, students face multiple teachers. Once the communication between teachers is not in place, or the content of theoretical teaching and practical teaching is not consistent, it is easy to cause students' theoretical courses and practical courses to be misaligned and unable to be effectively connected. Although the school emphasizes that "dual-qualified" teachers participate in 93%, there is a lack of specific description of teachers' industrial practical ability (such as China's vocational education reform (such as the "National Vocational Education Reform Implementation Plan") requires "dual-qualified" teachers to have real industrial experience, but many university and universities' "dual-qualified" certification is a formality, relying only on certificates rather than actual ability. Teacher honors are academic conferences (professors, provincial experts), and the proportion of enterprise technical backbones or industry engineers is not mentioned, which may affect the connection between courses and industrial needs. At the same time, the teacher honor system is mainly based on traditional indicators such as "famous teacher" and "academic and technical leader" and lacks assessment of industry service capabilities (such as enterprise technical consultants and patent transformation). This is different from the evaluation standards of "industry-education integration teachers" required by the Vocational Education Law. As a result, the incentive mechanism is not inclined towards industrial practice, and teachers may pay more attention to papers and professional title promotion rather than solving practical problems of enterprises (Zhang & Li, 2023).

4.1.4 The return rate of training base construction is low.

Combined with the collected relevant literature, it can be deduced that China's industry-education integration faces the problem of low return rate in the construction of training bases. The main reasons can be inferred: large capital investment and long return cycle. The construction and operation of training bases require a lot of capital investment, including infrastructure construction, equipment procurement and maintenance. Even if the research object combines the geographical environment of the Central Plains with the cooperation of enterprises relatively smoothly, the characteristics of vocational education determine that its economic return cycle is long, and it is difficult to see direct economic benefits in the short term. This mismatch between capital investment and return cycle makes many enterprises and schools cautious when investing in training bases, thereby increasing the difficulty of trust in

cooperation between the two parties. At the same time, although the government and education departments encourage school-enterprise cooperation, in actual operation, the coordination between enterprises and schools in resource sharing, curriculum design and equipment use are still insufficient. This lack of coordination may lead to waste of resources, such as idle equipment or repeated investment, which in turn reduces the utilization efficiency and economic returns of training bases. Although there are policies to support industry-education integration, at the local level, the implementation and implementation of policies may be lagging or inadequate. This has led to the inability of some training bases to fully utilize policy advantages in construction and operation, affecting their economic benefits and long-term development. So far, the integration of industry and education is transitioning from the policy-driven 1.0 stage to the data-driven 2.0 stage. However, many training bases have no relevant experience, their talent pool is not standardized, and they have not yet established a sound data management and analysis system, making it impossible to accurately evaluate and optimize resource allocation and utilization efficiency (Bolli & Renold, 2017). This management model lacking data support limits the operational efficiency and return rate of the training base. These problems need to be solved by strengthening policy support, promoting in-depth cooperation between schools and enterprises, optimizing resource allocation, and introducing data management systems.

4.2 Discussion

4.2.1 Establish a dynamic course update mechanism and introduce industry experts to participate in course design

According to the theory of the law of internal and external relations of education and the triple helix theory of education, higher vocational education is a subsystem, while society is a large system. The two are mutually reinforcing and mutually influential. The core of the subsystem is the interaction and cooperation between universities, industries, and governments. Universities provide innovative talents and research support, industries provide practice platforms and market demand, and governments provide policy support and resource allocation. The interaction between the three is not static, but a dynamic spiral progressive process formed through continuous feedback and adjustment. The triple helix model pays special attention to the problems existing in the cultivation of innovative talents and entrepreneurial education ecosystem, such as imperfect policy system, difficulty in sharing educational

resources, single training model, lack of effective linkage mechanism, etc. Through the collaborative cooperation of the three parties, we will explore the path to solve these problems with demand as the guide. The development of higher vocational education is inseparable from the large system of society. Therefore, we must take the initiative to go to society and integrate into society, understand the demand for talents in social production, and actively innovate management mechanisms, training models, teaching methods, etc. according to the demand. We cannot cultivate qualified talents needed for social production by working behind closed doors. At present, the management of higher vocational universities in Chinese is still dominated by the university, which plans the teaching direction, curriculum arrangement, teacher allocation, internship operation, etc. of the university's majors. However, after graduation, students need to face the society and enter the actual production environment. Relying only on the university will gradually make professional teaching separate from social production, and the educated students will not be able to seamlessly connect with the society. Therefore, higher vocational university should take the initiative to break the limitations of the inherent model, continuously promote the reform of the management mechanism, and introduce a cooperative governance model based on the professional characteristics of the university and the regional economic advantages (Huang, 2020).

4.2.2 Deep coupling between educational institutions and the industry

First, educational institutions actively unite the industry and the government to build a professional co-construction mechanism for tripartite collaboration, discuss teaching management and curriculum design with industry associations and advanced enterprises, adjust courses every 1-2 years according to industry changes, introduce enterprise production cases and technical indicators in line with reality, invite enterprise engineers and project managers to participate in course design meetings, directly propose skills required for positions, give full play to the school's teaching resources and the potential of "technician-shaped talents" on the enterprise side, apply the advanced management experience of enterprises to actual teaching, improve teaching efficiency and effectiveness, add interdisciplinary courses to combine knowledge in different fields, and at the same time, enterprises need to participate in the entire process of educating people, from course design to graduation assessment, so that students can receive systematic theoretical knowledge, master the future development direction and development needs of industry enterprises, and make professional course arrangements as close to the production needs of enterprises as possible. Finally, participate in the

formulation of graduation ability standards such as "1+X certificate", the school certifies students' theoretical ability, and the enterprise certifies students' practical ability, so as to achieve double checks. Ensure that students can seamlessly connect to social practice after leaving school (Zhang. & Li., 2022).

Second, relying on government policy support to build training base equipment so as to purchase close to production needs, the school and the enterprise jointly formulate graduation assessment standards for theory + practice dual evaluation, and also evaluate the teaching equipment to be purchased with the enterprise, buy machinery and equipment that meet the real production needs, so that students' training operations are closer to the real production environment, collect the latest technical directions through questionnaires and enterprise visits, participate in the market, and turn the research results of university laboratories into marketable products or services, ensure that they are parallel to the actual development of society, and achieve a benign profit return, so as to effectively avoid the problem of unfavorable capital turnover caused by lagging behind the market (Wang, 2020).

4.2.3 Create an industry-education integration community and build a chain ecological cooperation

The chain ecological cooperation among colleges and universities, enterprises and governments are an important model to promote scientific and technological innovation, economic development, and social progress (Zhang. & Wang., 2021). The three parties have formed an innovative ecosystem with knowledge production, technology transformation and industrial application as the core through resource complementarity, goal coordination and interest sharing. At present, many higher vocational colleges in Chinese have been conducting industry-education integration experiments for some time, with some achievements and some shortcomings. The schools often recognize the importance of industry-education integration to the development of higher vocational education, so they actively cooperate with enterprises in teaching, such as inviting senior personnel from enterprises to teach students, coach students in practical training, and give students the opportunity to go to enterprises for on-the-job internships. However, due to the different purposes of higher vocational colleges and enterprises, it is difficult to establish a solid interest relationship, and many cooperations are often formalistic, resulting in many shortcomings in the in-depth development of industry-education integration between higher vocational colleges and enterprises. Therefore,

higher vocational colleges should take positive actions, take the initiative to create an industry-education integration community, build chain ecological cooperation, and achieve a win-win situation for all parties.

First, enterprises are economic organizations with the purpose of profit, while universities are social organizations with the purpose of cultivating talents. If a win-win situation is to be achieved, it is necessary to find the intersection of the interests of both parties. Based on this fact, the advantages of the school and the enterprise can be fully combined to give full play to their strengths. In the organizational structure of the two, universities assume the role of innovation source and talent pool, undertake basic research and innovative technology breakthroughs, provide a steady stream of students for enterprise research, and play the role of talent "reservoir". Enterprise development fits market application, and logically considers profit returns. In the cooperation between the two, they assume the role of value transformation and market engine, which can effectively reduce the phenomenon of scholars "closed-door development" and help them liberate from the "ivory tower". In the cooperation between the two, universities help to transform their technical prototypes into commercial products, and enterprises provide application scenarios and data resource support. They cooperate around "products", earn profits in the market, realize industrial feedback, and form a positive cycle.

Second, under the framework of China's socialist system, the benign interaction between universities and enterprises has distinct institutional advantages and policy-oriented characteristics. This interaction is guided by national strategic needs, and through government policy design, resources are integrated, interests are coordinated, and value is co-created, forming a collaborative innovation model of industry, academia, and research with Chinese characteristics. For example, through the five-year plan, key areas are clarified, such as the "14th Five-Year Plan" layout of artificial intelligence, quantum information and other innovative directions. Universities and enterprises can adjust their research and development directions according to national needs to obtain targeted support from national policies, which is in line with the pace of social development. Under the institutional guarantee of public ownership as the main body, state-owned enterprises assume the main responsibility for innovation, mixed ownership reform promotes the flow of factors, and the reform of public institutions stimulates the vitality of universities, so that production needs are optimized. On this basis, universities should make full use of their relatively close ties with the government,

actively seek government help in the process of industry-education integration with enterprises and make innovative use of the government policy toolbox to strive for regional preferential policy support for the cooperation between the two parties, strive for policy subsidies, and enhance the brand image of enterprises. Combined with the Ministry of Education's inclusion of the transaction amount of technology contracts into the discipline evaluation system, the "service industry contribution" indicator is added to the evaluation of universities to better stimulate technological innovation. Collaborative innovation under this institutional framework not only avoids the short-term profit-seeking tendency under the pure market mechanism, but also overcomes the rigid drawbacks of the traditional planning system. For example, the practice of Beijing Zhongguancun shows that under the guidance of government policies, the regional total factor productivity can be increased by 2.3-3.1 percentage points for every 10% increase in the density of school-enterprise cooperation. In the future, it is necessary to further give play to the advantages of the socialist system of "concentrating forces to accomplish major tasks", build a three-dimensional collaborative system of "original innovation of universities-integrated innovation of enterprises-government organization innovation" in key areas, and inject continuous momentum into high-quality development.

Third, combining regional geo-economic advantages to develop majors with high matching of regional industrial structures is an important path to achieve high-quality development of regional economy (Schulte, 2019). This development model can give full play to the multiple advantages of regional resource endowment, industrial foundation, and market demand, and promote the deep integration of education chain, talent chain and industrial chain. The development of enterprises is inseparable from the consideration of the market environment, and the size of the market is inseparable from the industrial development of the local area. Regional assessment is in three aspects: resource endowment orientation, industrial foundation drive, and market demand traction. For example, Shanxi is rich in coal resources → Taiyuan University of Technology focuses on the development of mining engineering and clean energy technology; Suzhou Industrial Park biopharmaceutical industry → Xi'an Jiaotong-Liverpool University offers biopharmaceutical engineering majors; Chengdu leisure tourism industry → Sichuan Tourism College strengthens hotel management and cultural tourism planning majors. In combination with the regional economy, a dynamic adjustment mechanism for professional settings will be established, an evaluation system for the matching degree between professional settings and industrial needs will

be established, the local employment rate of graduates will be included in the performance evaluation indicators of colleges and universities, a professional certification and industry standard docking system will be implemented, a model will be constructed to predict future demand, the regional economic structure and development advantages will be analyzed, regular follow-up visits will be made to practitioners, the development prospects and talent demand status of important regional industries will be understood, and the focus will be on developing industries that are in line with regional prospects to ensure one's own unique advantages in the market environment. This development model fully reflects the principle of "adapting measures to local conditions and implementing policies based on production" (Li, 2023). For example, the practice of Suzhou Industrial Park shows that for every 10% increase in the matching degree between professional settings and industries, the regional total factor productivity can be increased by 1.5-2.0 percentage points. By continuously optimizing the professional structure, innovating the training model, and improving policy support, it will effectively promote the high-quality development of the regional economy and achieve the coordinated progress of education, industry, and cities.

4.2.4 Deep integration and characteristic development

The "National Vocational Education Reform Implementation Plan" issued by the State Council in 2019 pointed out that standardization construction should be used as a breakthrough to lead the development of vocational education. The "National Standardization Development Outline" issued by the Party Central Committee and the State Council in 2021 pointed out that standards are the technical support for economic activities and social development and are an important aspect of the country's basic system. The document proposes to improve the level of industrial standardization, and at the same time strengthen the construction of standardization talent teams, build a multi-level training system for practitioners, carry out standardization professional talent training and comprehensive education for national quality infrastructure, and point out the direction for the standardization of higher vocational education in the future. According to the 21st item of education statistics in the "China Statistical Yearbook 2021" compiled by the National Bureau of Statistics, the situation of schools, faculty and full-time teachers at all levels (2020), we can see that there are a total of 1,468 higher vocational (technical) colleges in Chinese, distributed across the country. If there is no unified standard to lead, there may be a phenomenon of blind development of various colleges and universities, and the students trained are also uneven. Therefore,

higher vocational colleges should realize that standardization and specialization are dialectically unified, interconnected, and mutually reinforcing. Under the guidance of standardization, they should explore their own characteristics and advantages and take the path of specialization development. In the context of industry-education integration, cooperation between colleges and enterprises is an important way to achieve the deep integration of education chain, talent chain and industrial chain. Specialization development is one of the core goals of this cooperation, which requires colleges and enterprises to create unique cooperation models and results based on their own advantages.

First, enterprises help promote the standardization of higher vocational education, actively participate in the government's standardized professional talent training and construction, and improve talent training standards and talent output quality (Marginson, 2016). College offer majors according to the national "Catalogue of Vocational Education Majors" and use unified textbooks to teach basic skills. In the field of education, standardization construction is to formulate a set of "general rules" for vocational education, such as how to set up majors, what courses to teach, how teachers teach, and how students are assessed, to ensure that the talents trained by higher vocational colleges across the country meet basic quality requirements and avoid "some schools teach how to make hamburgers, some teach how to make pizza, but companies need people who can make hamburgers". As an important driving force for social and economic development, higher vocational education should actively participate in the construction of national standardization, hold meetings and agreements with enterprises, list "standards that must be achieved" and "characteristics that can be brought into play", rely on local economies, explore their own advantages, and ensure that the students trained not only meet the national standardization requirements for professional talents, but also have core competitiveness that cannot be imitated and replaced, truly highlighting the ability and advantages of higher vocational education in serving social and economic development and national strategies.

Second, enterprises, colleges and government jointly establish an "Internet + standard co-construction" collaborative mechanism, use the Internet to establish a real-time collaboration platform for governments, industry associations, enterprises, and colleges and universities, and jointly formulate unified industry standards, capability frameworks, and evaluation systems. The three parties jointly establish enterprise technical specifications, dynamically generate professional teaching

standards, analyze enterprise recruitment needs, and job skill change trends through big data, and dynamically adjust vocational education standards, such as directly connecting CNC technology majors to the "Intelligent Manufacturing Job Competency Standards." Create an "online and offline integration" teaching resource system, develop 3D virtual workshops, equipment disassembly and assembly interactive programs, and cover high-risk and high-cost training scenarios; digitize the resource library, and jointly build a "granular" teaching video library between schools and enterprises to support retrieval and learning by skill points, so that students can supplement key abilities in a timely manner. Model of instruction adopt the "MOOC factory" model, and enterprise engineers and teachers jointly record production line real-life courses, so that students' learning time and place are not restricted by the physical environment, achieving "ubiquitous learning" (Billett, 2020). Online theoretical learning + offline practical assessment improves the pass rate of theoretical exams and ensures the practical foundation; in the assessment indicator setting, the Internet of Things devices are used to record the practical training operation trajectory, compare the industry standard action library, generate a real-time skill compliance rate report, automatically judge student operations, and jointly develop a "micro-certificate" system with industry associations to support the acquisition of subdivided skill qualifications at any time. Through information construction, the utilization rate of practical training resources has increased by 60%, and the matching degree between the student skill compliance rate and the enterprise job requirements has reached more than 85%. Effectively solve the pain points of traditional vocational education "equipment updates are slower than industrial iterations" and "teaching standards lag behind technological development".

Third, based on meeting the standardization, college should be based on reality, take the path of characteristic development, build a "regional adaptation" professional cluster, and accurately connect the industrial map based on the regional economic characteristics, such as the Yangtze River Delta smart manufacturing, Chengdu-Chongqing automobile industry, and the Greater Bay Area digital economy (Chen & Taylor, 2021). College should dynamically adjust the professional settings, eliminate lagging majors, and add new majors in scarce fields (Li, 2023). College will jointly establish a professional committee with local governments and leading enterprises and publish the "Regional Industry-Professional Adaptation White Paper" every quarter. We will adhere to the concept of serving regional economic development, find our own positioning, and build core competitiveness. In terms of the implementation path of

curriculum reform, college will modularize and package characteristic courses, embed regional technical characteristics within the framework of national standards, develop localized teaching materials, and compile the "Regional Industrial Technology Case Collection", so as to develop practical training modules based on local actual needs. At present, the achievements that can be highlighted through practical cases include the co-construction of "factory-in-school" by regional leading enterprises, the integration of "teaching-research and development-production", and the real participation of students in real enterprise projects, to achieve a closed loop from industrial chain to education chain and realize the implementation of education (Pilz, 2016). College should balance the national unified standards with the personalized needs of the region and solve the problem of "one school for all schools".

4.3 Summary

Through semi-structured interviews, this study deeply explored the current status of the construction of characteristic majors in Henan Vocational and Technical College under the context of industry-education integration. The typical representative case is the core problems faced by the CNC technology major, especially its implementation results. The interview results show that although the college recognizes the value of industry-education integration in concept and takes action in hardware investment and cooperation forms, the depth and practical effect of its industry-education integration are still significantly insufficient, and it has failed to effectively stimulate students' deep participation and meet the dynamic needs of the industry, resulting in students' mastery of professional knowledge and skills remaining at a relatively superficial level.

In specific practice, the disconnection of key links such as curriculum design, faculty structure and training base operation has seriously restricted the cultivation of students' practical ability and industrial adaptability. Current status of characteristic specialty construction The curriculum system of CNC technology major is still dominated by theory, and the proportion of practical class hours is less than 50%, which does not match the strong hands-on ability required for front-line production; at the same time, there are formal problems in the certification of "dual-qualified" teachers, and there is a shortage of teachers with deep industrial practical experience, and the evaluation system does not tend to solve the actual problems of enterprises; in addition, the construction of training bases has a large investment but a low return rate, low resource utilization efficiency, and a lack of data-driven dynamic optimization mechanism. These problems make it difficult for students to understand the core

connotation of the major and transform theoretical knowledge into practical skills, making it difficult to achieve seamless connection with industrial positions.

Based on these findings, this study proposes targeted optimization suggestions to deepen curriculum collaboration, establish a dynamic curriculum update mechanism, and frequently review and adjust the course content in conjunction with industry associations and leading enterprises. Integrate real production cases and the latest technical standards into teaching, significantly increase the proportion of practical courses, ensure that they are closely connected with theoretical courses, and introduce enterprise engineers to deeply participate in course design and practical teaching evaluation, and reshape teacher evaluation standards.

On the basis of following the national vocational education professional standards and catalogs, a characteristic professional group of "regional adaptation" is constructed. Accurately match the needs of Zhengzhou's equipment manufacturing, electronic information, and other industrial clusters. Embed regional industrial technology characteristics into course modules and develop localized case teaching materials and practical training programs.

Chapter 5 Conclusion and Recommendation

5.1 Conclusion

Based on the discussion of the vocational education path of the triple helix theory of education, it can be summarized that structured collaborative approach between government, business and college, the government adjusts the fiscal lever through policy innovation to maintain institutional thrust; enterprises directly put forward talent training specifications to vocational colleges by publishing white papers on technical needs to achieve demand-driven education, provide technical open production lines and resource sharing to maintain resource attraction; college transform the real work orders of enterprises into teaching projects to reconstruct the curriculum system, reshape the teaching staff of enterprise technicians, and continuously release high-quality students through enterprises to inject fresh blood into the market to ensure transformation tension. The new ecology constructed by the three will transform the knowledge production model, innovate the talent growth path, and improve the efficiency of technology diffusion. The government will reduce the institutional transaction costs of school-enterprise cooperation through policy tools; the industry will obtain customized technical labor through resource investment; and the school will improve the quality of education service supply through knowledge transformation. From linear cooperation to three-dimensional collaboration, vocational education can truly become a "reactor" for industrial upgrading, an "incubator" for technological innovation, and an "alchemy furnace" for human capital. In this ecology, vocational college teachers are not only professors on the podium, but also "technical doctors" in the workshop, and "knowledge conductors" connecting laboratories and production lines.

However, in actual teaching activities, each higher vocational college may have differences in resource acquisition capabilities, professional settings, faculty strength, and the industrial structure of the region where they are located. These factors will have a certain impact on the construction of characteristic majors in higher vocational colleges. Therefore, higher vocational colleges need to combine their own reality in the process of characteristic major construction, conduct characteristic construction under the guidance of standardization, highlight their own advantages, and coordinate the three to achieve long-term development.

5.2 Recommendation

Based on interviews with faculty, students, and industry partners at Henan Vocational College, this study proposes solutions to the three core problems of outdated curriculum that does not meet industry needs, teachers lack practical experience, and weak school-enterprise cooperation.

5.2.1 Strengthen industry-university-research cooperation

The school-enterprise cooperation is superficial and lacks deep integration. By establishing a regional education committee, the government, enterprises and universities jointly manage the project, and the leadership rotates every year to ensure balanced investment. Both parties jointly create dynamic curriculum updates, enterprises provide annual skill demand reports, and industry experts assist in redesigning courses every year. In terms of policy, persuade the government to provide training support tax incentives, and enterprises that open training stations can enjoy tax exemptions.

5.2.2 Modern practical courses

For the problem of too many theoretical courses and insufficient practical training for students, the intelligent curriculum system should be planned to track industry trends, increase the proportion of practical courses, and record students' performance on real equipment in combination with corporate opinions, issue industry-recognized micro-certificates, and match majors with local industries.

5.3 Further Study

The main objective of this study is on the current status of regionalized characteristic major construction of colleges and universities based on the triple helix theory of education. The ultimate goal of the teaching model guided by the integration of industry and education is to transform vocational education from "knowledge transfer" to "skill incubation". By connecting classrooms with local factories, ensuring that every graduate becomes an economic asset rather than a job seeker, the teaching model of colleges and universities has a great impact on students' learning outcomes, and is also the key to affecting teachers' teaching and corporate employment. Finally, future research directions can also compare different regions to gain a deeper understanding of the school-enterprise cooperation model.

References

Billett, S. (2020). Learning through practice: Beyond workplace pedagogies. *International Journal of Lifelong Education, 39*(2), 119–132.

Bolli, T., & Renold, U. (2017). Comparative advantages of school and workplace environment in skill acquisition: Empirical evidence from a survey among professional tertiary education students in Switzerland. *Evidence-based HRM: A Global Forum for Empirical Scholarship, 5*(1), 6–29.

Bowers, A. J., & Wiggins, A. (2018). Cooperative school governance: Linking resources for sustainable education. *International Journal of Educational Management, 32*(4), 663–675.

Braunerhjelm, P., & Hellerstein, J. K. (2019). The role of regional innovation systems in fostering regional advantages. *Research Policy, 48*(1), 156–170.

Brown, P., & Davis, J. (2017). Talent supply chain management: Ensuring alignment with industrial needs. *Education and Training, 59*(7), 772–786.

Busemeyer, M. R., & Trampusch, C. (2012). *The political economy of collective skill formation*. Oxford University Press.

Campbell, D. F. J., & Carayannis, E. G. (2016). *Conceptual framework of knowledge and innovation systems*. Palgrave Macmillan.

Carayannis, E. G., & Campbell, D. F. J. (2009). Mode 3 and Quadruple Helix: A proposed model of knowledge production and innovation. *The Journal of Technology Transfer, 34*(3), 330–335.

Chen, D., & Taylor, R. (2021). An empirical analysis of China's vocational education policy in the context of industry upgrading. *International Journal of Educational Development,* 81, 102331.

Chen, N. Y., Zhou, C. Q., & Wu, Z. P. (2014). The connotation and realization pathways of industry-education integration. *China University Science & Technology,* (8), 40–42.

Davis, L., & Taylor, R. (2021). Overcoming the mismatch: Strategies to align education, training, and the job market. *Vocational and Technical Education, 14*(1), 56–72.

Deissinger, T. (2015). The German dual vocational education and training system: An institutional approach. *International Journal of Training and Development, 19*(3), 197–208.

Dutz, A. M., & Knoll, M. (2020). Strengthening vocational education: Lessons from Germany's dual system. *European Journal of Education, 55*(3), 315–330.

Etzkowitz, H., & Leydesdorff, L. (2000). The dynamics of innovation: From national systems and "Mode 2" to a triple helix of university–industry–government relations. *Research Policy, 29*(2), 109–123.

Etzkowitz, H. (2002). *MIT and the rise of entrepreneurial science.* Routledge.

Feng, Y., & Zhao, X. (2022). Evaluating the effectiveness of interdisciplinary programs for developing composite talents. *International Journal of Educational Research,* 112, 101845.

Gao, L., & Sun, X. (2020). The role of information platforms in enhancing organizational communication. *International Journal of Information Management,* 50, 218–227.

Gessler, M., & Howe, F. (2015). From the reality of work to grounded work-based learning in German vocational education and training: Background, concept, and tools. *International Journal for Research in Vocational Education and Training, 2*(3), 214–238.

Huang, J. (2020). Exploration of the "factory-in-college" practice model for industry-education integration in higher vocational colleges. *China Vocational and Technical Education,* (12), 33–38.

Lee, C., & Wang, M. (2022). Excellence in vocational education: A case study of leading institutions in Asia. *International Journal of Educational Development,* 83, 102314.

Li, D. (2023). A study on the coordination mechanism between regional economic development and higher vocational education: Empirical evidence from Henan Province. *Vocational Education Forum,* (3), 33–40.

Li, J. L., Lin, J. H., & Hu, F. (2008). Reflections on how universities can develop characteristic major programs. *China University Teaching,* (4), 59–61.

Li, M. (2021). Policy evolution and practical path of vocational education standardization construction. *Educational Development Research,* 41(14), 78–85.

Li, W., & Liu, J. (2022). Enlightenment of Germany's "dual system" for school-enterprise cooperation in China's higher vocational colleges. *Vocational Education and Regional Development,* (5), 45–52.

Li, Y. (2008). Strengthening characteristic specialty construction to improve talent cultivation quality. *China Higher Education,* (17), 25–27.

Li, Y., & Wang, S. (2023). Research on the impact of supply-side structural reform on industrial upgrading in China. *Economic Research Journal, 58*(3), 12–24.

Marginson, S. (2016). The worldwide trend to high participation higher education: Dynamics of social stratification in inclusive systems. *Higher education*, *72*, 413-434.

Niu, G. Q., & Wang, H. J. (2009). Reflections on the construction of characteristic specialties in universities. *Journal of Henan Polytechnic University (Social Sciences), 10*(2), 329–332.

Pilz, M. (2016). Transferability of the German dual system. *International Journal of Training Research, 14*(1), 42–56.

Pugh, K. (2019). Relationships in decentralized education networks. *Journal of Educational Administration, 57*(2), 134–150.

Rauner, F., & Smith, E. (2010). Rediscovering apprenticeship: *Research findings of the International Network on Innovative Apprenticeship (INAP)*. Springer.

Schulte, P. (2019). The integration of academic and vocational learning in Denmark and Germany for hospitality and tourism education. *European Journal of Education, 54*(2), 253–265.

Shen, J., Xu, S., & Xie, W. (2021). *Logical framework, realistic dilemmas, and practical approaches for the construction of industry-education integration communities*. Higher Education Exploration.

State Council of the People's Republic of China. (2019). *Implementation plan for national vocational education reform (Guo Fa [2019] No. 4).* General Office of the State Council.

Sun, L., & Yu, W. (2020). Building a system for professional standardization: Approaches and practices. *International Journal of Educational Management, 34*(6), 1079–1093.

UNESCO. (2016). *Strategy for Technical and Vocational Education and Training (TVET) (2016–2021).* UNESCO.

Wang, J., & Zhang, W. (2021). Research on the professional construction of higher vocational colleges under the background of industry-education integration. *China Higher Education Research,* (6), 63–69.

Wang, X. (2020). Practical challenges and countermeasures for the pilot of the "1+X" certificate system in higher vocational colleges. *China Vocational and Technical Education,* (26), 14–20.

Wolter, A., & Schippers, C. (2016). The increasing relevance of higher education for dual vocational training in Germany. *Research in Comparative and International Education, 11*(2), 131–146.

Yang, G. (2021). A localized study of the enterprise mentor system in higher vocational colleges under the "dual system" background. *Vocational and Education,* (4), 47–53.

Zhang, H., & Feng, J. (2019). Developing competencies through industry-education integration: Evidence from vocational schools. *Vocational Education and Training Journal, 45*(2), 145–162.

Zhang, L., & Li, P. (2023). Practical exploration of professional cluster construction in higher vocational colleges under the "Double High" plan. *Vocational and Technical Education, 44*(7), 17–24.

Zhang, W., & Li, J. (2023). Cultivating applied talents for the 21st century: A case study of China's vocational education. *Journal of Vocational Education and Training, 65*(1), 78–92.

Zhang, X., & Li, C. (2022). A multi-party collaborative mechanism for industry-education integration in higher vocational colleges from the perspective of Triple Helix theory. *Vocational Education Research, 9*(2), 22–29.

Appendix

Interview Outline

Core Requirements	Respondent's Identity	Interview Outline
Focus on policy implementation, school-enterprise cooperation mechanism, dynamic coordination of curriculum and industry needs	Management	1. What unique advantages do you think the university has in professional teaching? When formulating courses and teaching models, how can we combine industry needs and government policies for collaborative innovation? 2. What are the highlights of the university's practical teaching? How to improve the quality of the practical part through cooperation with enterprises and government support? 3. Does the university arrange internships for students in partner companies? Please introduce the rotation or fixed position mechanism involved in internship arrangements, as well as the connection with relevant policies of enterprises and governments. 4. Where do you think there is room for improvement in teaching management? How can the university fully integrate government support and industry feedback into the management system to achieve better teaching quality?
Focus on teaching experience, practical training facilities, internship matching	Students	1. How do you evaluate the characteristics of the university's professional teaching? 2. Do you think the university’s training classrooms and facilities can meet practical needs? 3. Did the university arrange for you to intern at a partner company? During the internship, was it a rotation system or a fixed position arrangement? How do you think this arrangement can help you improve your professional skills? 4. From a student's perspective, what suggestions do you have for the university in terms of teaching management? How can we better utilize industry and government resources to optimize the teaching and practice system?
Emphasis on the connection between education	Graduates	1. What do you think are the characteristics of the university's professional teaching? Can these characteristics meet the current industrial

and employment, and the actual results of school-enterprise cooperation		development needs and government industry standards? 2. How did your internship experience at a company during your school years help you acquire professional knowledge? How did this internship model promote your work? 3. During your employment process, what kind of support and resources do you think the collaboration between schools, enterprises and the government has provided you with? What positive effects does this model have on improving your competitiveness in the workplace? 4. Based on your experience in school and work, what shortcomings do you think the university has in teaching management? How to better integrate industry needs and government policies to promote in-depth cooperation between schools and enterprises?