

Research on the Talent Cultivation Path of Higher Vocational Colleges from the Perspective of the Integration of Science and Education

Yong Xu^{1,*}, Qunshu Zhang², Weiwei Wang¹

¹ Yangzhou Polytechnic Institute, Yangzhou, China

² Balizhen Community Health Service Center, Yangzhou, China

*Corresponding author

Abstract: From the perspective of the integration of science and education, this research conducts an in-depth exploration of the talent cultivation paths for specialized programs in higher vocational colleges. Through the analysis of survey data from multiple higher vocational colleges and extensive case studies, the current problems and challenges faced by higher vocational colleges in specialized talent cultivation are identified. Specific improvement measures are proposed in aspects such as the optimization of curriculum systems, the development of teaching staff, the strengthening of practical teaching, the deepening of industry-university-research cooperation, and the cultivation of an innovative culture. These measures aim to enhance the quality of specialized talent cultivation in higher vocational colleges and meet the demands of society and enterprises for high-quality technical and skilled talents in the new era. Meanwhile, the policy and connotation of the integration of science and education are interpreted, providing guidance for higher vocational colleges to better implement this policy.

Keywords: Integration of Science and Education, Higher Vocational Colleges, Talent Cultivation

1. Introduction

An important meeting in China emphasized the need to coordinate the development of vocational education, higher education, and continuing education, and sets the goals of promoting the integration of vocational and general education, the integration of industry and education, and the integration of science and education^[1]. Against this backdrop, the concept of "integration of science and education" (a concrete and comprehensive term) has emerged^[2]. The integration of science and education means that scientific and technological development and education management complement each other, infiltrate into each other, communicate with each other, learn from each other, and transform into each other^[3]. Its purposes are to improve the quality of talent cultivation, drive the development of technological innovation, and promote industrial transformation^[4]. As a new proposition and challenge for vocational education, integrating scientific and technological innovation into professional and technical teaching helps cultivate students' interest and literacy in scientific research, guides them to participate in real scientific research projects, and serves as an inevitable path to accelerate the construction of a high-quality vocational education system and an innovative country.

Cultivating a large number of high-quality talents with both integrity and ability is a long-term strategy for the country's and the nation's development. Chinese leaders has placed talent work in a more important position in the overall cause of the country^[5]. He has personally formulated and implemented a series of major initiatives with overall and forward-looking significance, and personally promoted a series of important tasks with pioneering and foundational value^[6]. These efforts have led to historic achievements and historic changes in talent work in the new era, placing China's talent work at a new historical starting point^[7]. Currently, under the important backdrop of the integration of science and education, new opportunities and new requirements have also been brought to local higher vocational colleges in terms of cultivating technical and skilled talents.

2. Connotation and Significance of the Integration of Science and Education in Higher Vocational Education

2.1. Connotation of the Integration of Science and Education

The integration of science and education refers to the organic integration of scientific research with teaching in higher vocational education. It enables the sharing of scientific research resources and teaching resources, the mutual transformation between scientific research achievements and teaching content, and the mutual learning of scientific research methods and teaching methods. The ultimate goal is to improve the quality of cultivating professional technical and skilled talents in higher vocational colleges and enhance their scientific and technological innovation capabilities.

2.2. Significance of the Integration of Science and Education

It helps improve the quality of professional talent cultivation in higher vocational colleges. The integration of science and education allows the timely introduction of the latest scientific research achievements into teaching, which enriches teaching content, broadens students' horizons, and enhances students' innovative thinking and practical abilities. At the same time, by participating in scientific research projects, students can personally experience the process of scientific research and develop a scientific spirit and innovative awareness.

It helps enhance the teaching competence of teachers in higher vocational colleges. When teachers engage in scientific research activities, they can constantly update their knowledge structure and improve their professional literacy and teaching standards. Scientific research achievements can also be transformed into teaching resources, which enriches teaching content and methods and improves teaching effectiveness.

It helps strengthen the scientific and technological innovation capabilities of higher vocational colleges. The integration of science and education promotes positive interaction between scientific research and teaching in colleges, thereby enhancing their scientific and technological innovation capabilities. Colleges can cultivate a group of core scientific research personnel through research projects, improve their overall scientific research strength, and provide technical support for the economic and social development of local areas.

3. Research Investigation and Data Analysis

Currently, most scholars' research remains focused on the policy-oriented sorting of the important discourse on the integration of science and education. Against this backdrop, there are relatively few studies on the cultivation models of technical, skilled, and innovative talents in higher vocational colleges from the perspective of the integration of science and education. Moreover, most of these studies are theoretical, and their practical guidance needs to be enhanced. The research team first conducted literature retrieval and collation of the latest research results and important discourses on the integration of science and education, and finally carried out the following research investigation.

3.1. Research Objects and Methods

This research selected multiple higher vocational colleges of different school-running levels in the province, including national-level "Double Top" vocational colleges, provincial-level "Double Top" vocational colleges, and non-"Double Top" vocational colleges. It adopted a variety of methods such as questionnaires, interviews, and on-site investigations to conduct in-depth surveys on teaching and research administrators, frontline teachers, students, and enterprise representatives of the relevant colleges. A total of 300 questionnaires were distributed, with 291 valid ones recovered; on-site investigations were conducted in 5 higher vocational colleges.

3.2. Analysis of Research Results

3.2.1. Orientation of Talent Cultivation Goals

Most higher vocational colleges can clarify their professional talent cultivation goals by combining the needs of regional economic and social development and the job requirements of industry enterprises. However, some colleges still have problems such as unclear goal orientation and disconnection from

market demands. The survey found that one-third of the colleges lack in-depth analysis of industry development trends and accurate grasp of enterprise job needs when formulating talent cultivation goals.

3.2.2. Curriculum System Design

Some higher vocational colleges have problems such as emphasizing theory over practice, outdated curriculum content, and weak connection with scientific research achievements. Among the respondents, 45% of students believe there is a certain gap between curriculum content and actual work needs; 36% of teachers think the practical teaching links in the curriculum system are insufficient; and only nearly 30% of teachers can timely transform scientific research achievements into teaching content. In addition, the survey on students' participation in scientific research projects across multiple majors showed that students who have participated in scientific research projects account for 12% of the total number of students, among which those with in-depth participation (participating in the core links of projects and achieving certain results) only account for 25% of the students who participated in scientific research.

3.2.3. Teaching Staff Construction

Teaching staff construction is the key to professional talent cultivation in higher vocational colleges. The survey results show that in recent years, higher vocational colleges have continuously recruited talents and increased the introduction and recruitment of high-level talents. However, on the whole, the number of teachers with scientific research capabilities and practical experience in higher vocational colleges is relatively small. Among the teachers, 63% believe their scientific research capabilities need to be improved; 21% of students think teachers' practical teaching capabilities are insufficient. At the same time, the scientific research incentive mechanism for teachers in colleges is insufficient: 42% of teachers said they lack motivation to participate in scientific research. The survey on teachers' scientific research status in higher vocational colleges found that among teachers who participate in scientific research, only 13% focus on teaching research-related topics, while 87% concentrate on research in their own professional fields.

3.2.4. Practical Teaching Links

The survey found that problems such as insufficient practical teaching facilities and equipment, lagging construction of practical teaching bases, and disconnection between practical teaching content and enterprises' actual needs are relatively prominent. However, practical teaching links are an important way to cultivate students' practical abilities and professional literacy. Among the respondents, 43% of students believe that practical teaching conditions need to be improved; 52% of enterprise representatives think there is a gap between students' practical abilities and enterprise needs.

3.2.5. Industry-University-Research Cooperation

The survey data shows that more than 50% of higher vocational colleges report certain difficulties in industry-university-research cooperation, and 60% of enterprises believe that the cooperation effect with higher vocational colleges is not obvious. Although industry-university-research cooperation is an important way to realize the integration of science and education, the survey data shows that at present, most higher vocational colleges in the province have imperfect industry-university-research cooperation mechanisms, enterprises have low enthusiasm for participating in talent cultivation, and the forms of cooperation are single. In terms of teachers' participation in enterprise technical adjustments, only 45% of the surveyed teachers have relevant experience. The survey on students' participation in school-enterprise cooperation projects found that students who can participate in such projects are mainly concentrated in some advantageous majors, while students in other majors have fewer participation opportunities.

4. Empirical Research with Selected Higher Vocational Colleges as Cases

4.1. Case 1: Practice of the Integration of Science and Education in the Mechanical Manufacturing Major of Higher Vocational College A

4.1.1. Orientation of Talent Cultivation Goals

Combining with the development needs of the regional equipment manufacturing industry, this major has clearly defined the goal of cultivating high-quality technical and skilled talents who possess knowledge and skills in mechanical design and manufacturing, CNC machining technology, and automated production. Through in-depth surveys of industry enterprises, it has gained an understanding of enterprise job demands and technological development trends, and timely adjusted its talent cultivation

plan to ensure that the cultivated talents meet market needs.

4.1.2. Curriculum System Design

It has constructed a curriculum system consisting of "basic courses + professional courses + practical courses + innovation and entrepreneurship courses". Scientific research achievements and actual enterprise projects are integrated into the curriculum content. For example, the teachers' research project "Research on Key Technologies of Intelligent CNC Machine Tools" has been transformed into a curriculum design project, allowing students to participate in it. The project-based teaching method and the integrated theory-practice teaching method are adopted to enhance students' learning interest and practical abilities.

4.1.3. Teaching Staff Construction

A group of talents with doctoral degrees and senior corporate engineer qualifications have been introduced. At the same time, existing teachers are encouraged to be seconded to cooperative enterprises to carry out research projects together with enterprise R&D personnel. A teacher research incentive mechanism and a professional title evaluation channel have been established to conduct quantitative assessments of teachers' research achievements and provide corresponding rewards. As a result, teachers' research capabilities and teaching standards have been improved.

4.1.4. Practical Teaching Links

On the basis of original conditions, it has upgraded advanced mechanical processing training centers, CNC training centers, and automated production line training centers. In cooperation with enterprises, it has established off-campus practical teaching bases and carried out order-based cultivation and modern apprenticeship programs. Students' practical abilities and professional literacy have thus been enhanced.

4.1.5. Industry-University-Research Cooperation

It has established industry-university-research cooperation relationships with a number of enterprises to jointly carry out technological R&D and talent cultivation. An industry-university-research cooperation alliance has been set up to integrate resources from all parties, realizing resource sharing and complementary advantages. Students participate in the R&D and implementation of actual enterprise projects, which has improved their innovative and practical abilities.

4.2. Case 2: Practice of the Integration of Science and Education in the Electronic Information Major of Higher Vocational College B

4.2.1. Orientation of Talent Cultivation Goals

Aligning with the development needs of the regional electronic information industry, this major has determined the goal of cultivating high-quality technical and skilled talents with knowledge and skills in electronic circuit design, embedded system development, and IoT technology application. By cooperating with enterprises to conduct talent demand surveys, it has formulated a talent cultivation plan that meets market needs.

4.2.2. Curriculum System Design

It has optimized the curriculum structure and set up courses such as Fundamentals of Circuit Analysis, Analog Electronic Technology, Digital Electronic Technology, Embedded System Development, and IoT Technology. Scientific research achievements and actual enterprise projects are integrated into the curriculum content, and a curriculum system of "on-campus basic theory courses + off-campus professional practical courses" has been built, incorporating scientific research achievements and actual enterprise problems into professional courses. For instance, the teachers' research project "Research and Development of IoT Smart Home Systems" has been converted into a curriculum design project for students' participation. Project-based teaching and group cooperative learning methods are used to boost students' learning interest and teamwork abilities.

4.2.3. Teaching Staff Construction

A group of teachers with master's degrees and corporate work experience have been introduced. Meanwhile, existing teachers are encouraged to participate in enterprise practice and research projects. A teacher research incentive mechanism has been established to reward teachers for their research achievements, leading to a significant improvement in teachers' research capabilities and teaching standards.

4.2.4. Practical Teaching Links

It has built electronic circuit laboratories, embedded system laboratories, and IoT laboratories. In collaboration with enterprises, it has established off-campus internship bases and carried out internships with full-time positions and graduation project programs. Students' practical abilities and professional literacy have been effectively improved.

4.2.5. Industry-University-Research Cooperation

It has established industry-university-research cooperation relationships with several enterprises to jointly conduct technological R&D and talent cultivation. An electronic information industry technology innovation alliance has been founded to integrate resources from all parties, achieving resource sharing and complementary advantages. Students take part in the R&D and implementation of actual enterprise projects, which has enhanced their innovative and practical abilities.

From the above survey data and typical cases, it can be seen that higher vocational colleges have achieved certain results in the practice of integrating science and education, but there are still some problems that need to be further addressed and improved. In future development, higher vocational colleges should continue to explore and innovate, improve their talent cultivation models, and provide strong support for cultivating high-quality technical and skilled talents.

5. Talent Cultivation Paths for Specialized Programs in Higher Vocational Colleges from the Perspective of the Integration of Science and Education

5.1. Clarify Talent Cultivation Goals and Highlight Vocational Competence Development

5.1.1. Define Talent Cultivation Goals

Higher vocational colleges should closely align with regional economic development and industrial demands to clarify the goals for cultivating specialized talents. The fundamental task is to nurture high-quality technical and skilled talents who can meet the needs of frontline work in production, construction, management, and services. When defining these goals, full consideration should be given to industry development trends, enterprise job requirements, and students' career development plans, ensuring that the cultivated talents possess strong employability and career development potential.

5.1.2. Focus on Developing Vocational Competences of Specialized Talents

Professional Skill Development: higher vocational colleges should, in accordance with the goals of specialized talent cultivation, construct a curriculum system centered on professional skills, strengthen practical teaching links, and improve students' hands-on operation abilities. Through teaching activities such as experiments, practical training, and internships, colleges enable students to master professional skills proficiently, laying a solid foundation for their future career development.

Vocational Literacy Development: higher vocational colleges should attach importance to cultivating students' vocational literacy, including professional ethics, work attitude, and vocational norms. By carrying out activities such as professional ethics education and career planning guidance, they should enhance students' professional identity and sense of responsibility, and foster their dedication and teamwork awareness.

Innovation Ability Development: higher vocational colleges should encourage students to actively participate in scientific and technological innovation activities to cultivate their innovative awareness and capabilities. By setting up scientific and technological innovation projects and organizing technology competitions, they should stimulate students' enthusiasm for innovation and improve their innovation and practical abilities.

5.2. Construct a Curriculum System for the Integration of Science and Education

5.2.1. Principles of Curriculum Design

Vocational Competence-Oriented: Curriculum design should closely revolve around the goals of specialized talent cultivation, take vocational competence as the orientation, and build a curriculum system consisting of "basic courses + professional courses + practical courses + innovation and entrepreneurship courses", with emphasis on the connection and integration between courses.

Emphasize Practical Teaching: higher vocational colleges should increase the proportion of practical

teaching to improve students' practical operation abilities. They should focus on developing students' hands-on skills and problem-solving abilities, and align curriculum content with enterprise job requirements to ensure that the knowledge and skills learned by students can meet the actual needs of enterprises.

Integrate Scientific Research Achievements: teachers should incorporate scientific research achievements into curriculum teaching to realize the organic integration of science and education. By introducing cutting-edge scientific and technological knowledge and research project cases, they can broaden students' knowledge horizons and enhance their learning interest and innovation abilities.

Balance Theory and Practice: higher vocational colleges should increase the proportion of practical teaching in the curriculum system and build a curriculum system that combines theoretical teaching with practical teaching. Through practical teaching links, students are guided to apply the theoretical knowledge they have learned to practical operations, thereby improving their practical abilities and comprehensive quality.

5.2.2. Construction of the Curriculum System

Public Basic Courses: higher vocational colleges should offer public basic courses such as Ideological and Political Education, College English, and Computer Fundamentals to cultivate students' basic qualities and general abilities.

Professional Basic Courses: colleges should provide professional basic courses to lay a foundation for students to learn professional core courses. These courses should emphasize the systematicness and integrity of theoretical knowledge while maintaining close connection with professional core courses.

Professional Core Courses: colleges should set up professional core courses based on the goals of specialized talent cultivation and enterprise job requirements. These courses should highlight the cultivation of vocational competence, focus on practical teaching links, and enable students to master professional skills proficiently.

Expanded Courses: colleges should offer expanded courses to broaden students' knowledge and horizons, including innovation and entrepreneurship courses, interdisciplinary courses, and industry frontier courses, so as to meet the personalized development needs of students.

5.3. Strengthen Teaching Staff Construction and Improve Teachers' Research and Teaching Competences

5.3.1. Goals of Teaching Staff Construction

Build a high-quality, professional teaching team with noble professional ethics, excellent professional skills, a reasonable structure, and great vitality. Teachers should possess solid professional knowledge, strong research capabilities, and rich practical experience, and be competent in teaching, scientific research, and social service work.

5.3.2. Measures for Teaching Staff Construction

Teacher Training: higher vocational colleges should regularly organize teachers to participate in professional skill training and teaching method training to improve their professional level and teaching abilities. At the same time, colleges should encourage teachers to participate in domestic and international academic exchange activities to broaden their academic horizons and understand the cutting-edge trends of their disciplines. Additionally, they should strongly support teachers to take practical training in enterprises to enhance their practical abilities and engineering experience.

Talent Introduction: colleges should formulate preferential policies to attract outstanding talents at home and abroad to join higher vocational colleges. Simultaneously, they should introduce professional talents with doctoral degrees, senior professional titles, or enterprise work experience to enrich the teaching staff. Furthermore, colleges should strengthen cooperation with enterprises and introduce enterprise technical backbones as part-time teachers to optimize the structure of the teaching team.

Research Incentives: colleges may establish a reward fund for research projects to encourage teachers to actively carry out scientific research activities. Teachers who have achieved significant research results should be recognized and rewarded to boost their enthusiasm for research. In addition, colleges should actively build research teams to promote cooperation and communication among teachers. Through team collaboration, teachers' research capabilities and innovative abilities can be enhanced.

Teaching Evaluation: colleges should establish a scientific teaching evaluation system to conduct a comprehensive evaluation of teachers' teaching quality. The evaluation results shall serve as an important basis for teachers' professional title promotion, post appointment, and performance assessment. Moreover, colleges may organize activities such as teaching observation and teaching competitions to promote teaching exchange and learning among teachers and improve their teaching level.

5.4. Strengthen Practical Teaching Links and Improve Students' Practical Abilities

5.4.1. Construction of the Practical Teaching System

Experimental Teaching: colleges should set up experimental courses matching professional courses to enable students to deepen their understanding and mastery of theoretical knowledge through experimental operations. Experimental teaching should focus on cultivating students' hands-on operation abilities and experimental design capabilities.

Practical Training Teaching: colleges should establish on-campus practical training bases and carry out practical training teaching activities. Practical training teaching should simulate the actual production environment of enterprises, allowing students to conduct skill training in real work scenarios to improve their vocational literacy and practical abilities.

Internship Teaching: colleges should arrange students to take internships in enterprises, enabling them to receive practical training in actual job positions. Internship teaching should strengthen cooperation with enterprises, establish stable internship bases, and provide students with good internship conditions.

5.4.2. Management of Practical Teaching

First, colleges should establish a practical teaching management system. They should formulate management systems such as practical teaching syllabi, practical teaching plans, and practical teaching assessment standards to standardize practical teaching behaviors.

Second, colleges should strengthen practical teaching guidance. They should arrange professional teachers and enterprise technical personnel to guide students in practical teaching and promptly solve problems encountered by students during the practical process.

Third, colleges should implement strict practical teaching assessment. They should establish a scientific practical teaching assessment system to conduct a comprehensive assessment of students' practical performance, and take the assessment results as an important basis for students' graduation.

5.5. Deepen Industry-University-Research Cooperation and Realize Collaborative Talent Cultivation

5.5.1. Deepen Industry-University-Research Cooperation Modes

First, jointly build industry-university-research cooperation platforms. Higher vocational colleges, together with enterprises and research institutions, build such platforms to jointly carry out technological R&D, talent cultivation, and social service work. These platforms may include industrial technology research institutes, engineering technology research centers, and enterprise technology centers.

Second, carry out order-based talent cultivation. According to the talent needs of enterprises, implement order-based talent cultivation. Enterprises and higher vocational colleges jointly formulate talent cultivation plans, curriculum systems, and teaching content, and students directly work in the cooperating enterprises after graduation.

Third, cooperate in carrying out research projects. Higher vocational colleges, enterprises, and research institutions cooperate to conduct research projects and jointly tackle technical problems. Through cooperation in research projects, improve teachers' research level and students' practical abilities.

5.5.2. Formulate Industry-University-Research Cooperation Mechanisms

First, colleges should establish a win-win cooperation mechanism. This mechanism should clarify the rights and obligations of all parties in industry-university-research cooperation. Moreover, through such cooperation, the common development of enterprises, higher vocational colleges and scientific research institutions shall be realized.

Second, colleges should improve the communication and coordination mechanism. They should

establish a regular communication and coordination mechanism to strengthen information exchange and communication among all parties, promptly solve problems arising during the industry-university-research cooperation process, and ensure the smooth progress of cooperation.

Third, colleges should establish and improve an assessment and evaluation mechanism to conduct a comprehensive assessment of the effectiveness of industry-university-research cooperation, and take the assessment results as an important basis for further cooperation among all parties.

5.6. Create an Innovative Cultural Atmosphere and Cultivate Students' Innovative Awareness

5.6.1. Construction of Innovative Culture

First, colleges should strengthen campus culture construction. They should create a positive and innovative campus cultural atmosphere. Furthermore, they should hold activities such as scientific and technological innovation lectures, technology competitions, and innovation and entrepreneurship forums, stimulate students' enthusiasm for innovation and creativity.

Second, colleges should establish an innovation incentive mechanism. They should set up incentive mechanisms such as innovation scholarships and innovation achievement awards to encourage students to actively participate in scientific and technological innovation activities. Additionally, colleges should Recognize and reward students who have made innovative achievements to enhance their enthusiasm for innovation.

5.6.2. Integrate Innovation Education into Curriculum Teaching

First, teachers should integrate innovation education into professional curriculum teaching. In professional curriculum teaching, they should focus on cultivating students' innovative thinking and innovation abilities. Additionally, teachers guide students to think actively and dare to innovate through methods such as case analysis and project-based teaching.

Second, colleges should offer innovation and entrepreneurship courses. These courses cover content such as entrepreneurship fundamentals, entrepreneurship management, and entrepreneurship practice to cultivate students' awareness and abilities in innovation and entrepreneurship.

6. Conclusions

The cultivation of specialized talents in higher vocational colleges from the perspective of the integration of science and education is a systematic project that requires the joint efforts of multiple parties, including colleges, enterprises, and the government. Through this research investigation, analysis, and case studies, the project has identified the current problems and challenges in the cultivation of specialized talents in higher vocational colleges and proposed corresponding improvement measures.

In future development, higher vocational colleges should further clarify their talent cultivation goals, construct a curriculum system for the integration of science and education, strengthen the development of teaching staff, enhance practical teaching links, deepen industry-university-research cooperation, and create an innovative cultural atmosphere. These efforts aim to improve the quality of specialized talent cultivation and meet society's demand for high-quality technical and skilled talents.

Meanwhile, the government should increase its support for higher vocational colleges, improve relevant policies and regulations, and create a favorable external environment for the cultivation of specialized talents in these colleges. Enterprises should actively participate in talent cultivation in higher vocational colleges, provide practical teaching bases and internship positions, and jointly cultivate high-quality technical and skilled talents who meet market demands.

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