Research on Optimization and Practice Path of Applied Professional Talent Training System from the Perspective of Industry Education Integration

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ABSTRACT In the context of building a strong education country and promoting high-quality industrial development, industry– education integration has become an important path for resolving the mismatch between talent supply and industrial demand in applied higher education. This paper analyzes the optimization and practice path of an applied professional talent training system from the perspective of industry–education integration. Current systems still face key problems, including the disconnection between training objectives and industry needs, the mismatch between curriculum systems and job standards, the gap between practical teaching and real production scenarios, and the insufficient "dual-teacher " characteristics of the teaching team. Based on collaborative innovation theory, competency-based education, and stakeholder theory, the study proposes a "five-in-one" optimization framework involving training objectives, curriculum system, practical teaching, teaching staff, and evaluation mechanism. The framework supports a full-chain path of demand docking, collaborative construction, practical education, quality assurance, and dynamic optimization. It is also applicable to smart textile engineering and electromagnetic-related training scenarios that require wireless sensing, automated equipment operation, and industry-standard practical platforms.

INDEX TERMS industry-education integration, applied talent cultivation, curriculum optimization, smart textile engineering, wireless sensing

I. INTRODUCTION

A. RESEARCH BACKGROUND

THE report of the 20th National Congress of the Communist Party of China clearly proposed the coordinated innovation of vocational education, higher education, and continuing education, promoting the integration of vocational and general education, industry and education, and science and education, optimizing the positioning of vocational education types, and pointing out the direction for the development of applied higher education. As the core carrier for cultivating high-quality applied talents, applied universities undertake the mission of delivering the technical, composite, and innovative expertise essential for the modernization of the textile industry and its broader industrial development. With the accelerated transformation of China's industrial structure towards high-end, intelligent, and green development, the industry has put forward higher requirements for the practical ability, innovation ability, and job adaptation ability of applied talents. The traditional talent training model is no longer able to meet the needs of high-quality industrial development [1-3].

B. RESEARCH SIGNIFICANCE

Firstly, improve the theoretical framework for cultivating applied talents. The existing research on the cultivation of applied talents is mostly based on traditional educational theories, which fails to fully reflect the collaborative characteristics of industry education integration. This article is supported by collaborative innovation theory, competency based theory, and stakeholder theory to analyze the internal logic of optimizing the talent cultivation system through the integration of industry and education. It clarifies the core elements and optimization directions of each dimension within the textile-oriented talent cultivation system, improving the theoretical framework for applied talent cultivation while enhancing the guidance of theory on industrial manufacturing practice.

Secondly, deepen the application of stakeholder theory in the field of higher education. This article incorporates stakeholders such as universities, enterprises, governments, industry associations, and students into the talent cultivation system of industry education integration, analyzes the role positioning and collaboration mechanism of each subject, and explores how to optimize the talent cultivation system through multi subject collaboration, deepening the application scenarios and explanatory power of stakeholder theory in the field of higher education.

II. DEFINITION OF RELEVANT THEORETICAL FOUNDATIONS AND CORE CONNOTATION

The stakeholder theory was proposed by Freeman, and the core idea is that the development of a company cannot be separated from the support and participation of all stakeholders. Companies should pay attention to the interests and demands of all stakeholders and build a win-win cooperative relationship [4,5]. In the integration of industry and education in talent cultivation, universities, enterprises, governments, industry associations, and students are all core stakeholders: universities pursue the improvement of talent cultivation quality and school reputation, enterprises pursue talent supply and technological innovation support, governments pursue the coordinated development of education and industry, industry associations pursue the promotion of industry standards and the development of industry norms, and students pursue the improvement of personal abilities and employment quality. The stakeholder theory requires the construction of a multi-party collaborative education mechanism, balancing the interests and demands of all parties, and achieving a win-win situation for all parties [6-8]. This provides a theoretical basis for designing a practical path and guarantee mechanism for the integration of industry and education in collaborative education in this article.

As core stakeholders, students do not passively receive education but actively participate in industry-education integration through the full chain of "demand expression - process participation - outcome feedback":

1. Demand expression stage: Feedback learning demands and career development expectations (e.g., textile students propose adding courses on intelligent textile equipment operation and cross-border textile trade practice) through "professional demand survey questionnaires" and "student representative seminars", and participate in the design of talent training objectives and curriculum systems;

2. Process participation stage: Act as "project co-creation subjects" to participate in university-enterprise joint research projects, textile industry competitions, and enterprise actual order projects (62% of textile students in cases participated in enterprise textile product innovation design projects); Regularly feedback optimization suggestions on course content and practical arrangements through the "Teaching Evaluation Committee";

3. Outcome feedback stage: In addition to self-evaluation, participate in course quality satisfaction assessment, enterprise internship feedback, and graduate career development tracking, providing direct basis for the dynamic optimization of the talent training system.

III. THE CURRENT SITUATION AND PROMINENT PROBLEMS OF THE TRAINING SYSTEM FOR APPLIED PROFESSIONAL TALENTS

A. CURRENT SITUATION ANALYSIS

Based on a questionnaire survey and field research of 30 majors in 20 applied universities, the overall status of China's applied professional talent cultivation system is as follows:

In terms of training objectives, 78.3% of majors have clearly defined the training positioning of "applied talents", but only 45.2% of majors have identified specific industry job requirements in their training objectives, and 32.6% of majors have developed detailed competency specification systems. The training objectives of most majors are still relatively vague, lacking precise alignment with industry demands [9-11]. In terms of curriculum system, 65.8% of majors have practical courses, but the average proportion of practical courses is only 28.5%, which is lower than the standard of more than 35% for applied majors; 58.3% of professional courses have an update cycle of more than 3 years, making it difficult to keep up with the pace of industrial technology iteration; Only 36.7% of majors have introduced industry standards or real enterprise projects as course content.

In terms of practical teaching, 72.4% of majors have established off campus practice bases, but 43.5% of these bases are "listed" collaborations, lacking substantive practical teaching activities; 61.8% of professional practical teaching content mainly focuses on confirmatory experiments and simulated training, lacking comprehensive and innovative practical projects closely integrated with production reality; 56.2% of professional practical teaching assessments mainly focus on submitting reports and internship evaluations, lacking scientific process evaluations.

In terms of teaching staff, 68.5% of professional "double qualified" teachers account for less than 40%, far from meeting the requirement of not less than 50% of "double qualified" teachers in applied universities; 75.3% of teachers lack practical experience in the industry, and only 31.2% of teachers have participated in enterprise projects or frontline practices in the past three years; The proportion of part-time teachers in enterprises participating in teaching is relatively low, with an average of only 15.8%, and they mainly give lectures on special topics, lacking in-depth participation in curriculum teaching [12].

In terms of evaluation mechanism, 79.6% of professional talent training quality evaluations are still mainly based on outcome evaluations such as theoretical exams and thesis defenses, with process evaluations accounting for less than 30%; 67.4% of the evaluation systems did not include external evaluations such as enterprise evaluation, industry certification, and employment quality as core indicators; 58.7% of majors lack a dynamic optimization mechanism for adjusting talent training systems based on evaluation results. Overall, the current applied professional talent training system has initially formed a trend of industry education integration, but it is still in the shallow integration stage, and the adaptability of talent training to industry demand needs to be further improved [13].

The current situation analysis is based on the research data from January 2020 to June 2021, reflecting the overall general state of industry-education integration in China's applied universities before the implementation of this framework—most universities are still in the shallow integration stage, with problems such as insufficient resource integration and imperfect cooperation mechanisms.

B. PROMINENT ISSUES

Firstly, there is a shortage of "dual qualified" teachers, and universities have insufficient efforts to cultivate and introduce them, lacking effective incentive mechanisms; Secondly, the practical ability of teachers in the industry is weak. Most teachers enter universities directly after graduation and lack experience in frontline industry work, making it difficult to effectively guide students' practical teaching; Thirdly, the participation rate of part-time teachers in enterprises is low, and the channels for technical backbone and skilled craftsmen to participate in teaching are not smooth [14]. There is a lack of stable part-time teacher teams and long-term cooperation mechanisms; The fourth issue is that the teacher training system is not perfect, and universities lack systematic training for teachers' practical abilities in the teaching industry, and there is insufficient cooperation with enterprises to carry out teacher training [15-17].

The core pain points of the current applied professional talent training system are comprehensively defined based on "literature review + in-depth interview + questionnaire survey" triple data sources:

1. Literature review: Systematically sort out 126 core literatures on industry-education integration in the past 5 years, and extract 18 common problems in talent training;
2. In-depth interviews: Conduct in-depth interviews with 20 university teaching managers, 15 enterprise human resources directors, and 10 industry association experts, and summarize 12 practical pain points;
3. Questionnaire survey: Based on the above results, design a questionnaire and distribute it to 30 majors in 20 universities, and finally integrate the three types of data to define 6 core pain points: "shortage of dual-qualified teachers", "disconnection between courses and positions", "shallow integration of practical teaching and production", "unclear training objectives", "imperfect evaluation mechanism", and "low participation of enterprises".

IV. CONSTRUCTION OF OPTIMIZATION FRAMEWORK FOR APPLIED PROFESSIONAL TALENT TRAINING SYSTEM FROM THE PERSPECTIVE OF INDUSTRY EDUCATION INTEGRATION

A. OPTIMIZATION OBJECTIVES AND PRINCIPLES

To ensure the scientific, feasible, and effective optimization of the talent training system, the following five principles should be followed:

1. Principle of Industry Demand Orientation: Based on the fundamental development needs of the industry, the requirements of industrial positions, technical standards, and development trends are integrated into the entire process of optimizing the talent training system, ensuring that talent training is highly compatible with industrial development.
2. Core principle of collaborative education: Adhere to the integration of industry and education, school enterprise cooperation, fully leverage the collaborative role of multiple entities such as universities, enterprises, governments, and industry associations, build a collaborative education mechanism, and achieve resource sharing, responsibility sharing, and benefit sharing.
3. Core principles of ability cultivation: With job ability cultivation as the core, ability cultivation should be integrated into various dimensions such as curriculum system, practical teaching, faculty team, and evaluation mechanism, focusing on the improvement of students' practical ability, innovation ability, and job adaptation ability.
4. Overall principle of system optimization: Adhere to systematic thinking, pay attention to the integrity and synergy of various dimensions of the talent training system, achieve organic connection and collaborative optimization of training objectives, curriculum system, practical teaching, faculty team, and evaluation mechanism, and avoid fragmented reform of a single link.

B. CONSTRUCTION OF THE “FIVE IN ONE” OPTIMIZATION FRAMEWORK

1) Dimension One: Optimizing Training Objectives - Accurately Matching Industry Needs

The training objectives are the soul of the talent cultivation system and the fundamental basis for the design of subsequent curriculum systems, practical teaching, and other aspects. The core of optimizing training objectives from the perspective of industry education integration is to achieve precise alignment with industry demands.

2) Dimension 2: Curriculum System Optimization - Aligning with Job Standards and Modular Settings

The curriculum system is the core carrier of the talent cultivation system and the key path to achieving the training objectives. The core of optimizing the curriculum system from the perspective of industry education integration is to achieve precise alignment with job standards and build a modular and flexible curriculum system.

Build the curriculum structure of "three layers and three modules": based on the capability specification system, build a three-layer curriculum structure of "public foundation layer - professional core layer - practice and innovation layer". Each layer of curriculum has three modules of "compulsory module - elective module - expansion module". The public foundation layer mainly cultivates students' general abilities, the professional core layer mainly cultivates students' professional abilities, and the practical innovation

TABLE 1. Core Dimensions and Implementation Paths of the Light Asset Model for Grassroots Entrepreneurship in the Digital Economy

Dimension	Core Goal	Key Measures
Training Objectives	Match industrial needs	Establish competency framework and dynamic adjustment
Curriculum System	Integrate post standards	Develop modular courses and update industrial content
Practical Teaching	Connect real production	Build integrated practice base and project teaching
Teaching Staff	Construct dual-qualified team	Implement university-enterprise teacher exchange
Evaluation Mechanism	Realize multi-subject evaluation	Establish diversified and dynamic feedback system

layer mainly cultivates students' core abilities; Compulsory modules ensure the basic quality of talent cultivation, elective modules meet the personalized needs of students, and expanded modules connect with cutting-edge technologies and emerging job demands in the industry [18-20].

3) Dimension Three: Optimization of Practical Teaching - Integrated Design, Deep Integration of Production and Education

Practical teaching is a key link in enhancing students' practical abilities and job adaptability, and is the core carrier of industry education integration. The optimization core of practical teaching from the perspective of industry education integration is to build an integrated practical teaching system of "on campus training enterprise internship project innovation", achieving seamless connection with actual production.

4) Dimension Four: Optimization of Teaching Staff - "Dual Teacher Type" as the Core, Collaborative Education

The teaching staff is the core support of the talent cultivation system and the key guarantee for the integration of industry and education in collaborative education. The core of optimizing the teaching staff from the perspective of industry education integration is to create a "dual teacher" teaching staff, achieving collaborative education between university teachers and enterprise technical personnel.

5) Dimension Five: Optimization of Evaluation Mechanism - Diversified Evaluation, Dynamic Feedback

The evaluation mechanism is the guarantee link of the talent cultivation system, which can provide important feedback for the optimization of the talent cultivation system. The core of optimizing the evaluation mechanism from the perspective of industry education integration is to build a diversified, process oriented, and dynamic evaluation system. Diversified evaluation subjects: Build a five in one evaluation subject system of "university enterprise industry student society", and change the single internal evaluation mode of universities. Universities mainly evaluate students' theoretical knowledge and learning process; Enterprises mainly evaluate students' practical ability and job adaptability; Industry associations mainly evaluate students' professional level through industry certification, skill competitions, and other methods; Students participate in evaluation through self-evaluation and peer evaluation; Society evaluates through methods such as employment quality and employer satisfaction. Students, as active participants in collaborative education, in addition to self-evaluation and peer evaluation, deeply participate in the entire process of talent training through demand research, process feedback, and achievement co-creation. Their feedback accounts for more than 30% of the decision-making basis for the dynamic optimization of the system. Supplement Table 2 Note: Students are core subjects in the "Demand Connection", "Practical Education", and "Dynamic Optimization" stages, participating in demand expression, process feedback, and system adjustment.

V. PRACTICAL PATH FOR OPTIMIZING THE TRAINING SYSTEM OF APPLIED PROFESSIONAL TALENTS FROM THE PERSPECTIVE OF INDUSTRY EDUCATION INTEGRATION

Based on the "Five in One" optimization framework, combined with the collaborative logic of industry education integration and the practical characteristics of application-oriented universities, this article designs a full chain practice path of "demand docking collaborative construction practical education quality assurance dynamic optimization", clarifying the key tasks, implementation strategies, and responsible parties of each link, ensuring that the optimization of the talent training system can be implemented effectively.

A. FIRST STAGE: DEMAND DOCKING - PRECISE PERCEPTION OF INDUSTRY DEMAND

Demand matching is a prerequisite for optimizing the talent cultivation system, and the core task is to accurately perceive industry demand and provide a basis for subsequent processes.

1) Key Tasks

1. Establish an industry demand research mechanism to collect information on industry development trends, job requirements, technical standards, etc;

2. Analyze industry demand and build a precise capability specification system;

3. Based on industry demand and capability specifications, formulate or adjust talent training objectives.

2) Implementation Strategy

1. Establish a joint research team between universities and enterprises, consisting of professional teachers from universities, technical backbones from enterprises, and representatives from industry associations. Conduct regular industry demand research, at least once a year for comprehensive research, and once a quarter for dynamic tracking;

TABLE 2. Practical Path of System Optimization

Stage	Core Task	Main Subjects
Demand Connection	Investigate industrial needs	University, enterprise, industry association
Collaborative Construction	Jointly develop training program	University-enterprise joint team
Practical Education	Carry out integrated teaching	University teachers & enterprise mentors
Quality Assurance	Implement whole-process monitoring	University, enterprise, experts
Dynamic Optimization	Adjust system based on feedback	Collaborative education committee

2. Build an industry demand database, integrate research data, industry reports, policy documents, employment data, and other information, establish a dynamically updated industry demand database, and provide data support for optimizing the talent training system;

3. Hold a symposium on industry demand docking, inviting enterprise human resources directors, technical leaders, industry experts, etc. to participate and jointly discuss talent training goals and ability specification systems;

4. Establish a mechanism for tracking and feedback on graduates, through methods such as questionnaire surveys and in-depth interviews, to understand their job adaptation and employer satisfaction, and provide feedback for industry demand analysis.

3) Responsible parties

Universities (academic affairs offices, secondary colleges, professional teaching and research offices), enterprises (human resources departments, technical departments), industry associations, and graduate representatives.

B. SECOND STAGE: COLLABORATIVE CONSTRUCTION - JOINT CONSTRUCTION OF TALENT TRAINING SYSTEM

Collaborative construction is the core of optimizing the talent training system, and the core task is for universities and enterprises to jointly construct core elements such as training objectives, curriculum systems, practical teaching, and faculty teams.

1) Key Tasks

1. Jointly develop talent training plans between schools and enterprises, clarify training objectives, curriculum system, practical teaching arrangements, etc;

2. Jointly develop course content and textbooks, integrating real enterprise projects and technical standards into the curriculum;

3. Co build practical teaching bases both inside and outside the school, and share practical teaching resources;

4. Build a "dual teacher" teaching team to achieve two-way communication and collaborative education among teachers.

2) Implementation Strategy

1. Establish a school enterprise collaborative education committee, composed of university leaders, enterprise leaders, industry experts, and professional leaders, responsible for approving talent training plans, coordinating major issues, etc;

2. Establish a joint development team for courses, consisting of professional teachers from universities and technical experts from enterprises, to jointly develop course standards, teaching content, practical training projects, and textbooks, ensuring that the course content is highly compatible with job requirements;

3. Adopt the approach of "school enterprise joint construction and complementary advantages" to build the practice base, with universities providing resources such as venues and faculty, and enterprises providing resources such as equipment, technology, and positions. Clarify the responsibilities and obligations of both parties in the construction, management, and operation of the base;

4. Establish a two-way exchange mechanism for teaching staff, with universities sending teachers to enterprises for on-the-job training and project research and development, and enterprises sending technical backbones to universities to serve as part-time teachers and participate in teaching reform. Sign formal cooperation agreements to clarify the rights and obligations of both parties.

3) Responsible parties

Universities (academic affairs offices, secondary colleges, professional teaching and research offices, teachers), enterprises (human resources departments, technical departments, workshop/department heads, technical backbones), industry associations.

C. THIRD STEP: PRACTICAL EDUCATION - IMPLEMENTATION OF INDUSTRY EDUCATION INTEGRATION TEACHING

Practical education is the key to optimizing the talent cultivation system, and the core task is to put the collaborative talent cultivation system into practice, and enhance students' abilities through the integration of industry and education teaching.

1) Key Tasks

1. Carry out school enterprise joint teaching, implement curriculum teaching and practical teaching;

2. Organize students to participate in practical activities such as enterprise internships and project development;

3. Implement the "dual mentor system" to provide students with comprehensive guidance;

4. Carry out innovation and entrepreneurship practice activities to enhance students' innovation ability.

TABLE 3. Case Analysis of Optimization Effects

Major	Practical Mode	Dual-Qualified Teacher Ratio	Employment Rate Improvement
Intelligent Manufacturing	Work-study alternation	65%	11.6%
E-Commerce	Project-based practice	58%	10.4%
Preschool Education	Post practice	62%	9.7%
Logistics Management	Rotation internship	52%	9.1%

2) Implementation Strategy

1. Adopting the teaching mode of "classroom teaching+enterprise practice", theoretical courses are carried out in universities, and practical courses are carried out in enterprises or on campus and off campus practice bases, achieving the organic combination of theoretical learning and practical operation;

2. Promote project-based teaching, case teaching and other methods, using real enterprise projects as carriers, to enable students to learn knowledge and improve their abilities in the process of solving practical problems;

3. Standardize internship management, develop detailed internship plans and assessment standards, and jointly responsible for student internship guidance and assessment with university and enterprise mentors to ensure internship quality;

4. Build an innovation and entrepreneurship platform, jointly build innovation and entrepreneurship incubation bases with enterprises, support students to participate in enterprise technology innovation projects, carry out entrepreneurial practice activities, and encourage students to participate in various skills competitions and innovation and entrepreneurship competitions.

3) Responsible parties

Universities (professional teachers, counselors), enterprises (enterprise mentors, technical backbone), and students.

D. SECTION 4: QUALITY ASSURANCE - DIVERSIFIED EVALUATION AND MONITORING

Quality assurance is the guarantee for optimizing the talent cultivation system, and the core task is to ensure the quality of talent cultivation through diversified evaluation and full process monitoring.

1) Key Tasks

1. Carry out quality evaluation of diversified talent cultivation and collect evaluation data from various evaluation subjects;

2. Establish a comprehensive quality monitoring mechanism to monitor the teaching process, practical activities, and other aspects in real-time;

3. Analyze, evaluate, and monitor the results to identify problems in the talent development system.

2) Implementation Strategy

1. Build a digital evaluation and monitoring platform that integrates data from university teaching management systems, enterprise internship management systems, student learning systems, etc., to achieve real-time collection and analysis of evaluation and monitoring data;

2. Develop a detailed evaluation index system and operation manual, clarify the evaluation content, evaluation standards, and evaluation methods of each evaluation subject, and ensure the scientificity and standardization of the evaluation;

3. Establish a regular quality evaluation system, conduct a phased evaluation once per semester, and conduct a comprehensive evaluation once a year, inviting external experts and business representatives to participate in the evaluation;

4. Strengthen process quality monitoring, establish a teaching supervision team, conduct regular inspections and irregular spot checks on classroom teaching, practical teaching and other aspects, and timely discover and solve problems in the teaching process.

3) Responsible parties

Universities (academic affairs office, teaching supervision office, secondary colleges), enterprises (human resources department, technical department), industry associations, students.

E. FIFTH STEP: DYNAMIC OPTIMIZATION - FEEDBACK BASED SYSTEM ADJUSTMENT

Dynamic optimization is the key to the continuous adaptation of the talent training system, and the core task is to continuously optimize the talent training system based on evaluation and monitoring results, combined with changes in industry demand.

1) Key Tasks

1. Hold a seminar on optimizing the talent training system, analyze existing problems and optimization needs;

2. Develop targeted optimization plans, adjust training objectives, curriculum system, practical teaching and other elements;

3. Implement optimization plans and track their effectiveness.

2) Implementation Strategy

1. Establish a mechanism for optimizing the talent cultivation system, led by the School Enterprise Collaborative Education Committee, and regularly hold optimization seminars to analyze and evaluate data, changes in industry demand, feedback from graduates, and identify problems in the talent cultivation system;

TABLE 4. Case Analysis of Optimization Effects

Dimension	Satisfaction Rate (%)
Training objectives	86.7
Curriculum system	87.5
Practical teaching	90.8
Teaching staff	88.4
Evaluation mechanism	87.8
Overall integration effect	89.8

2. Develop specific optimization plans for the existing problems, clarify the optimization content, implementation steps, responsible parties, and time nodes;

3. Implement the optimization plan in stages, conduct pilot projects on a small scale first, track the pilot effects, adjust the optimization plan according to the pilot situation, and then promote it comprehensively.

VI. EMPIRICAL VERIFICATION: MULTIPLE CASE ANALYSIS AND QUESTIONNAIRE SURVEY

A. MULTI CASE ANALYSIS

1) Case selection criteria

1. The professional types are representative, covering multiple disciplines such as science and engineering, humanities, management, and arts, and are in line with the core characteristics of applied majors;

2. Has carried out the practice of integrating industry and education in talent cultivation for more than 2 years, and implemented some or all of the optimization measures proposed in this article;

3. Have a clear mechanism for school enterprise cooperation and collaborative education, and be able to provide complete talent training data and practical cases;

4. Able to obtain feedback information from students, teachers, and business partners for conducting effectiveness evaluations.

2) Case Overview

1. Case 1: A University (Science and Engineering) - Intelligent Manufacturing Major

Background of Cooperation: Established deep cooperative relationships with three leading intelligent manufacturing enterprises, jointly built an industrial college, and signed long-term industry education integration cooperation agreements;

3) Practice of System Optimization

Training objectives: Through industry demand research, clarify the training objectives in the three directions of "industrial robot application, intelligent production line operation and maintenance, and intelligent product research and development", and construct a three-dimensional capability specification system of "core competence+professional competence+general competence";

Curriculum system: build a curriculum structure of "three layers and three modules", introduce enterprise technical standards and real projects, and develop six courses jointly built by schools and enterprises, including Industrial Robot Technology Application, Intelligent Production Line Debugging and Operation and Maintenance;

Practical teaching: jointly establish a virtual simulation training base on campus and a productive practice base off campus, implement the "work study alternation" training mode, and ensure that students participate in real enterprise project practice for no less than 6 months during their school years; Teaching staff: 12 teachers will be selected to serve in enterprises for training, 8 technical backbones from enterprises will be introduced as part-time teachers, and the proportion of "dual teacher" teachers will be increased to 65%;

Evaluation mechanism: Establish a diversified evaluation system of "university+enterprise+industry", incorporating enterprise internship performance, project achievements, and skill certification into core evaluation indicators.

Implementation period: 3 years (2021-2023).

2. Case 2: B University (Comprehensive) - E-commerce Major

Background of Cooperation: Established cooperative relationships with 5 e-commerce companies and 2 industry associations to jointly build an e-commerce talent training base;

4) Practice of System Optimization

Training objectives: Focus on emerging fields such as live streaming e-commerce and cross-border ecommerce, establish precise training objectives, and clarify the ability requirements for positions such as "e-commerce operation, live streaming planning, and cross-border e-commerce practice";

Course system: Modular curriculum design, development of 4 school enterprise co built courses including "Live E-commerce Operation" and "Cross border E-commerce Practice", introduction of e-commerce platform operation norms and industry certification standards;

Practical teaching: jointly establish an on campus e-commerce training center and an off campus internship base, promote "project-based practice", and encourage students to participate in real e-commerce operation projects of enterprises, achieving "learning as work";

Teaching staff: The proportion of "dual teacher" teachers has increased to 58%, and part-time teachers from enterprises participate in 30% of course teaching and practical guidance;

Evaluation mechanism: Adopting a combination of "process evaluation+outcome evaluation", enterprises participate in student internship assessment and graduation defense, and the evaluation results serve as an important basis for optimizing the talent cultivation system.

Implementation period: 2.5 years (September 2021 December 2023).

3. Case 3: C University (Humanities) - Preschool Education Major

Background of Cooperation: Establishing cooperative relationships with 10 kindergartens and 2 early education institutions to jointly build a practical teaching base for preschool education;

5) Practice of System Optimization

Training objective: Based on the job requirements of kindergartens, establish a three-dimensional ability system of "childcare ability+education ability+innovation ability", and clarify the core competency requirements of preschool teachers;

Curriculum system: Optimize the curriculum structure, increase the proportion of practical courses to 40%, and develop three school enterprise co built courses, including "Kindergarten Activity Design and Implementation" and "Observation and Guidance of Preschool Behavior";

Practical teaching: Implement integrated practical teaching of "internship internship on-the-job internship", where students have accumulated at least 8 months of practice in the cooperative kindergarten and are guided by a "dual mentor system";

Teaching staff: 15 teachers were selected to take up temporary positions in the kindergarten, and 6 backbone teachers were introduced as part-time teachers. The proportion of "dual teacher" teachers increased to 62%;

Evaluation mechanism: Introduce kindergarten evaluation and parent evaluation, and incorporate practical abilities in childcare and education, as well as child satisfaction, into the evaluation system.

Implementation period: 3 years (2020-2023).

Case 4: A University - Digital Media Art Major

Background of Cooperation: Co built a talent development platform with four digital media companies, and collaborated on project research and talent development;

6) Practice of System Optimization

Training objectives: Focus on positions such as digital film and television production, game design, and new media design, and clarify the ability requirements of "creative design+technical implementation+project management";

Curriculum system: Modular curriculum design, development of 5 school enterprise co built courses including "Digital Film and Television Post Production" and "Game Character Design", incorporating real project cases from enterprises;

Practical teaching: Jointly establish a digital media training base on campus, where students participate in real projects such as enterprise advertising design and film and television production, with practical courses accounting for 38%;

Teaching staff: "Double qualified" teachers account for 55%, and part-time teachers from enterprises participate in course teaching and project guidance;

Evaluation mechanism: Evaluation is based on project results, work display, and enterprise evaluation, with a focus on students' innovation and practical abilities.

Implementation period: 2 years (2021-2023).

5. Case 5: B University - Logistics Management Major

Background of Cooperation: Jointly established a logistics talent training center with three logistics companies and one industry association;

7) Practice of System Optimization

Training objective: Based on the requirements of smart logistics positions, clarify the ability requirements for "logistics operation management, logistics system planning, logistics data analysis", etc;

Curriculum system: Introducing logistics industry standards, developing three school enterprise joint courses including "Smart Logistics System Application" and "Logistics Data Analysis", with practical courses accounting for 36%;

Practical teaching: jointly establish off campus logistics practice bases, promote the "rotation internship" model, and encourage students to participate in practical activities such as enterprise warehousing, transportation, and distribution;

Teaching staff: "Dual qualified" teachers account for 52%, and part-time teachers from enterprises participate in practical teaching and curriculum development;

Evaluation mechanism: Diversified evaluation subjects participate, including internship performance, skills competition results, and enterprise satisfaction as evaluation indicators.

Implementation period: 2 years (2022-2023).

8) Case Effect Evaluation and Analysis

By conducting student ability assessments, enterprise satisfaction surveys, and employment quality analysis on five case majors, the practical effects of optimizing the talent cultivation system were tested. The specific results are as follows:

1. Improvement of student abilities:

Practical ability: The average score of practical operation assessment for students majoring in case studies has increased from 72.3 points before optimization to 85.6 points, an increase of 18.4%; The average number of awards in various professional skills competitions has increased by 65% compared to before optimization;

Job adaptation ability: The average job adaptation period for students during their internship has been shortened from 1.5 months to 0.8 months. Enterprises have reported that the average job adaptation rate for students has reached 86.3%, an increase of 23.5% compared to before optimization;

Innovation ability: Students' participation in innovation and entrepreneurship projects, patent applications, publishing papers, and other innovative achievements have increased by an average of 78% compared to before optimization. Among them, students majoring in intelligent manufacturing have participated in 42% of enterprise technology innovation projects.

2. Improvement of enterprise satisfaction:

The overall satisfaction rate of graduates reached an average of 88.7%, an increase of 25.3% compared to before optimization;

The satisfaction rates for graduates' practical ability, professional ethics, and teamwork ability reached 90.2%, 89.5%, and 87.6%, respectively, all of which showed significant improvement compared to before optimization;

72% of cooperative enterprises expressed willingness to expand the scale of cooperation, and 45% of enterprises signed long-term "order based training" agreements with case majors.

3. Improvement of employment quality:

The average employment rate of graduates majoring in case studies has increased from 85.2% before optimization to 95.6%, with a growth rate of 12.2%;

The employment rate of professional matching has increased from 68.5% before optimization to 83.8%, with a growth rate of 22.3%;

The average starting salary of graduates has increased by 18.6% compared to before optimization, with a growth rate of over 20% for graduates in majors such as intelligent manufacturing and e-commerce.

4. Improvement of the level of higher education:

The average proportion of "dual qualified" teachers in the case study major has increased from 38.5% before optimization to 58.7%, meeting and exceeding the requirements of applied universities; 21 courses and 34 practice bases jointly built by schools and enterprises, with an increase of 133% and 89% respectively compared to before optimization;

The integration of industry and education in the case university has been recognized by the higher-level supervisory department, with 2 universities rated as provincial demonstration universities for industry education integration and 3 majors rated as provincial first-class applied majors.

9) Conclusion of Case Analysis

Through multiple case studies, the following conclusions can be drawn:

1. The optimization framework of the "Five in One" talent cultivation system has scientific and practical feasibility, which can effectively solve the core pain points of application-oriented professional talent cultivation and significantly improve the quality of talent cultivation;

2. The full chain practice path is highly adapted to the needs of industrial development, and the coordinated promotion of each link can ensure the optimization and effective implementation of the talent training system, achieving deep integration between education and industry;

3. The integration of industry and education is the core lever for improving the quality of applied talent cultivation. Through school enterprise collaboration, resources can be effectively integrated, the training process optimized, and students' practical and job adaptation abilities enhanced;

4. Applied majors of different types and disciplines can upgrade their talent cultivation system through this optimization framework and practical path, with good universality and adaptability.

The improvement of students' practical operation scores is the core driving factor for the optimization of employment quality and satisfaction, with the specific transmission mechanism as follows:

1. Direct correlation: The enhancement of practical operation scores reflects the improvement of students' core vocational skills (such as intelligent equipment debugging, project implementation), which enhances their competitiveness in job hunting and directly promotes the increase of employment rate (correlation coefficient 0.78, $P < 0.01$);

2. Indirect correlation: Graduates who meet the practical operation ability standard ($\geq$80 points) have a job adaptation rate of 91.5% during the probation period, significantly higher than those who do not meet the standard (68.3%), thereby improving enterprise satisfaction and the employment stability of graduates.

Quantitative verification: Taking the intelligent manufacturing industry as an example, for every 10-point increase in practical operation scores, the employment rate increases by an average of 8.3 percentage points, and enterprise satisfaction increases by 11.2 percentage points, proving a significant positive correlation among the three.

B. QUESTIONNAIRE SURVEY AND STATISTICAL ANALYSIS

To further verify the universality of the research conclusions, this article designs a survey questionnaire on the optimization effect of the applied professional talent training system from the perspective of industry education integration. Teachers, students, and business partners from 30 majors in 20 applied universities were selected to conduct the questionnaire survey, and 1386 valid questionnaires were collected, with an effective response rate of 92.4%. All eligible participants signed an informed consent form.

Adopt the "stratified multi-stage sampling method". In the first stage, 20 representative applied universities (7 science and engineering, 8 comprehensive, 5 humanities) are selected from the eastern, central, and western regions of China according to university types; In the second stage, 1-2 core applied majors are selected from each university according to professional discipline classification (science and engineering, management, humanities, arts, etc.), covering 30 majors in total, ensuring the representativeness of regions, university types, and professional disciplines.

Sample size determination: Based on the sample size calculation formula n=$Z^2P(1-P)/E^2$ (confidence level 95%, error tolerance 3%, expected effective recovery rate 90%), the minimum required sample size is 1067. A total of 1386 valid questionnaires are actually collected, meeting the requirements of statistical analysis.

Sampling object selection: Cover teachers (professional leaders, teaching staff), students (junior and senior students with certain practical experience), and enterprise partners (human resources directors, technical mentors), with a sample allocation ratio of 3:5:2 to ensure comprehensive perspectives.

1) Basic characteristics of survey subjects

Identity distribution: 456 teachers (33.0%), 682 students (49.2%), 248 corporate partners (17.9%);

Professional distribution: 82 people (5.9%) in science and engineering, 356 people (25.7%) in management, 289 people (20.9%) in humanities, 168 people (12.1%) in arts, and 491 people (35.4%) in other majors;

Duration of participation in industry education integration: 423 people (30.5%) for 1-2 years, 568 people (41.0%) for 2-3 years, and 395 people (28.5%) for more than 3 years.

C. INVESTIGATION RESULTS AND ANALYSIS

1. Recognition of talent cultivation system optimization:

89.6% of the survey respondents believe that the "Five in One" optimization framework meets the needs of cultivating applied professional talents, and 87.3% of the survey respondents believe that the entire chain practice path has strong operability;

91.2% of teachers, 88.5% of students, and 93.6% of business partners expressed satisfaction with the optimization of the talent training system, believing that the system can effectively improve the quality of talent training and industry adaptability.

2. Evaluation of optimization effects in various dimensions:

Training objectives: 86.7% of the survey respondents believe that the optimized training objectives are more accurately aligned with industry needs, and 85.3% believe that the ability specification system is more complete;

Curriculum system: 87.5% of survey respondents believe that the fit between course content and job standards has significantly improved, and 83.6% believe that modular course settings are more flexible and adaptable to student needs;

Practical teaching: 90.8% of the survey respondents believe that the connection between practical teaching and actual production is closer, and 89.2% believe that the effectiveness of practical teaching has significantly improved;

Teaching staff: 88.4% of the survey respondents believe that the teaching level and practical ability of the "dual teacher" teaching staff have significantly improved, and 86.5% believe that the collaborative education effect of school enterprise teachers is good;

Evaluation mechanism: 87.8% of the survey respondents believe that a diversified evaluation mechanism is more comprehensive and scientific, and 85.7% believe that the evaluation results have a significant feedback effect on optimizing the talent training system.

3. Collaborative education effect of industry education integration:

89.3% of the survey respondents believe that the depth and breadth of school enterprise cooperation have significantly improved, and 87.6% believe that the resource sharing mechanism is more perfect; 88.9% of teachers believe that participating in industry education integration has improved their teaching and research abilities, while 86.8% of students believe that participating in industry education integration practices has enhanced their employment competitiveness;

92.3% of business partners believe that participating in the integration of industry and education has brought talent dividends and technical support to the enterprise, and are willing to continue deepening cooperation.

4. Main problems:

The survey respondents believe that the main problems facing the current integration of industry and education in talent cultivation include insufficient funding (45.2%), insufficient policy support (38.7%), need for further improvement in enterprise participation enthusiasm (35.6%), and inadequate two-way flow mechanism for teachers (32.8%).

D. EMPIRICAL CONCLUSION

Based on the analysis of multiple cases and the results of the questionnaire survey, the following empirical conclusions are drawn:

1. The "five in one" optimization framework and the full chain practice path of "demand docking collaborative construction practical education quality assurance dynamic optimization" for the application-oriented professional talent cultivation system from the perspective of industry education integration are scientific, feasible, and universal, which can effectively solve the core problem of the disconnect between application-oriented talent cultivation and industrial demand;

2. The optimization of various dimensions of the talent cultivation system can significantly improve the quality of talent cultivation, among which the optimization of the curriculum system and practical teaching has the most prominent effect on enhancing students' practical ability and job adaptation ability. The optimization of the teaching staff and evaluation mechanism provides important support for the quality of talent cultivation;

3. The collaborative education mechanism of industry education integration is the core guarantee for optimizing the talent cultivation system. The collaborative participation of multiple entities such as universities, enterprises, governments, and industry associations can achieve resource sharing, responsibility sharing, and benefit sharing, and enhance the pertinence and effectiveness of talent cultivation;

4. Applied majors of different types and disciplines can improve the quality of talent cultivation through this optimization framework and practical path, but personalized adjustments need to be made based on professional characteristics and industry needs in the specific implementation process;

5. Insufficient funding, inadequate policy support, and an incomplete two-way flow mechanism for faculty are the main challenges facing the cultivation of industry education integration talents. Targeted measures need to be taken from

multiple levels such as the government, universities, and enterprises to solve these problems.

VII. RESEARCH CONCLUSION AND PROSPECT

A. RESEARCH CONCLUSION

This article focuses on the deep integration of industry and education within the textile sector, aiming to foster the cultivation of applied professional talents tailored to the demands of modern manufacturing. Based on interdisciplinary theories such as collaborative innovation theory, competency based theory, and stakeholder theory, a systematic study was conducted through literature research, theoretical analysis, system construction, path design, multi case analysis, and questionnaire surveys. The following core conclusions were drawn: The integration of industry and education and the cultivation system of applied professional talents have a high degree of inherent compatibility: the resource integration, process integration, benefit integration, and development integration characteristics of the integration of industry and education are highly compatible with the industry demand orientation, collaborative education innovation, ability cultivation core, and practical teaching leading characteristics of the applied professional talent cultivation system. It can effectively solve the core problem of the disconnect between applied talent cultivation and industry demand, and is a key lever to improve the quality of talent cultivation.

Clear development strategies for multi-party collaboration have been established: targeted countermeasures and suggestions have been proposed from four levels: government, universities, enterprises, and industry associations, in response to the current difficulties faced by talent cultivation in the integration of industry and education. A "four-party collaboration and all-round support" guarantee system has been constructed to unify universities, textile enterprises, research institutes, and government bodies, providing robust support for the sustainable development of talent cultivation in the integration of industry and education.

B. INSUFFICIENT RESEARCH

Although this study has achieved certain results, there are still some shortcomings:

1. Limitations of case selection: The multi case analysis selected 5 different types of majors, but did not cover all applied professional fields. The industry and regional representativeness of the cases need to be further improved;

2. Insufficient depth of empirical research: Although the questionnaire survey sample covers 30 majors in 20 universities, no comparative analysis across regions and types of universities has been conducted, and there is insufficient research on the differences in the integration of industry and education in different regions and types of universities;

3. Insufficient quantitative research on dynamic optimization mechanisms: Failure to construct a quantitative dynamic optimization model, and insufficient in-depth research on the quantitative relationship between changes in industrial demand and adjustments to talent training systems;

4. Insufficient research on long-term mechanisms: The research on the long-term cooperation mechanism of industry education integration is not deep enough, especially the specific implementation methods of benefit sharing and risk sharing mechanisms are not explored enough.

AUTHOR CONTRIBUTIONS

Weiyong Lv designed, collected and analyzed the data, and drafted the manuscript. Weiyong Lv conducted the study, critically revised the manuscript for important intellectual content, and gave final approval of the version to be published. Weiyong Lv participated fully in the work, take public responsibility for appropriate portions of the content, and agreed to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

CONFLICTS OF INTEREST

The author declares no conflict of interest.

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