

Research on the Long-term Talent Training Path of Electrical Automation Technology Under the Integration of education, technology and talent

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Abstract

The integration of education, science, technology, and talent is critical for cultivating innovative professionals in modern vocational education. However, the conventional "3+3" segmented training model often suffers from fragmented stages and a disconnect between instruction and innovation. To address these systemic flaws, this study proposes a five-year integrated vocational education system tailored to the developmental trajectory of electrical automation majors. Utilizing Wenzhou Polytechnic as a case study, this paper constructs an optimized training framework driven by the collaborative synergy of educational, technological, and talent empowerment. This framework introduces comprehensive reforms across objective restructuring, curriculum integration, faculty development, and industry-academia-research collaboration. Practical outcomes indicate that this integrated approach successfully dismantles educational barriers, deeply merges professional instruction with technological innovation, and significantly elevates students' technical and innovative proficiencies. The reform not only fulfills the talent requirements of regional intelligent manufacturing upgrades but also provides a replicable paradigm for long-term training in related engineering disciplines.

Keywords

Integration of education, technology and talent; electrical automation technology; long-term schooling system.

1. Introduction

The new-era reform of vocational education emphasizes the coordinated integration of education, technology and talent. It closely links vocational education, industrial technological innovation and high-quality talent cultivation[1]. This linkage has become a key driving force for professional upgrading and talent empowerment in vocational education. The intelligent manufacturing industry is rapidly transforming toward digitization, intelligence and integration. The talent requirements for electrical automation have changed greatly. Talents are no longer only required to master basic equipment operation and maintenance. They need comprehensive abilities including system debugging, process optimization, technological iteration and innovative application.

The five-year integrated vocational education system offers a continuous and comprehensive pedagogical framework that perfectly aligns with the developmental trajectory of electrical

automation students, seamlessly guiding them from foundational knowledge acquisition to technological innovation. Conversely, the conventional "3+3" segmented training model presents notable limitations. Hindered by fragmented educational stages, disjointed instruction and research, and superficial industry-academia integration, this segmented approach overemphasizes basic operational proficiency for immediate job adaptation. By neglecting the cultivation of long-term innovative literacy, it ultimately fails to meet contemporary demands for industrial upgrading and integrated educational development[2].

Wenzhou Polytechnic is a national Double High-level vocational college. It deeply engages in the local intelligent manufacturing industrial cluster. The college has long explored long-term integrated talent training for electrical automation majors. It actively responds to regional industrial technological innovation and talent upgrading demands. This study reconstructs the long-term talent training system. It breaks the internal barriers between teaching, scientific innovation and talent output. It solves the structural defects of traditional training modes. The research provides theoretical and practical support for vocational professional upgrading, regional industrial innovation and compound talent cultivation.

2. Deficiencies of Traditional Segmented Talent Training Modes

2.1. Disconnected Training Objectives and Vague Stage Positioning

Secondary and higher vocational colleges formulate talent training plans independently. They lack unified top-level design and stage connection planning. This leads to homogeneous training objectives and ambiguous hierarchical positioning. Secondary vocational teaching overemphasizes shallow skill training such as basic equipment operation and simple circuit installation. It ignores the cultivation of professional theoretical foundation and engineering thinking[3]. The higher vocational stage only lasts two years. After deducting enterprise practice, the effective teaching time is merely 1.5 years. Teachers usually assume that students have complete basic knowledge from secondary vocational study. They directly teach advanced courses such as complex system debugging and automatic programming. This makes it difficult for students with weak foundations to adapt. In addition, the two-stage teaching fails to form a clear progressive ability gradient. It cannot realize the hierarchical cultivation from basic operators to innovative technical talents, which is inconsistent with industrial post demands.

2.2. Irrational Curriculum System with Repetition and Discontinuity

Curriculum connection is the core and difficult point of integrated vocational education. Traditional segmented modes lack overall coordination of curriculum standards and teaching contents. They cause two prominent problems: repeated basic courses and discontinuous core courses. Basic courses such as public foundation, electrical fundamentals and mechanical knowledge are repeatedly taught in two stages. This wastes educational resources and students' learning time. In contrast, advanced core courses lack systematic enlightenment in the secondary vocational stage. These courses include advanced PLC programming, industrial robot integration, frequency conversion speed regulation and industrial network control. The fast teaching pace in higher vocational colleges leads to fractured knowledge and skill systems. Furthermore, the curriculum design is poorly connected with actual post working processes. The lack of modular teaching further aggravates the disconnection between theory and practice[4].

2.3. Fragmented Practical Teaching and Disordered Skill Progression

Electrical automation is a highly practical major. It requires systematic and progressive practical training. Traditional secondary vocational practical training focuses on scattered projects such as equipment disassembly and basic circuit debugging. It only aims to improve students' basic operational proficiency. Higher vocational comprehensive training focuses on

system debugging and integration, but it is not connected with secondary vocational training foundations. The whole practical training lacks hierarchical and progressive design. Besides, secondary and higher vocational training venues and equipment are constructed independently without sharing. This causes repeated construction and idle high-end resources. No five-year continuous practical teaching system is available. Students' skill training becomes fragmented, and they cannot form a complete competency chain for automatic system operation, debugging and optimization[5].

2.4. Imperfect Teacher Team and Evaluation System

Secondary and higher vocational teachers work independently in teaching and research. Secondary vocational teachers are good at basic practical teaching but lack the ability of advanced technical teaching. Higher vocational teachers are proficient in theoretical and project teaching, but they are unfamiliar with secondary vocational students' learning situations and basic training standards. The cross-stage teaching adaptation is poor. The absence of two-way teaching research mechanisms makes integrated teaching impossible. In terms of evaluation, traditional modes rely on final written exams and single skill assessments. They focus on knowledge memorization and one-time learning results. They ignore the dynamic growth of students' skills and innovative literacy during the five-year training cycle. The lack of whole-process and diversified evaluation mechanisms cannot fully reflect talent training quality.

2.5. Insufficient Depth of School-Enterprise Collaborative Education

Current school-enterprise cooperation mostly stays at the shallow level of internship arrangement and employment delivery. Enterprises do not deeply participate in the top-level design of integrated talent training. They are rarely involved in training plan formulation, curriculum development, practical project design and teaching implementation. Teaching contents lag behind the latest industrial technologies, processes and equipment standards. There is a clear gap between school teaching and industrial practical demands. Graduates require secondary training after taking posts. This reduces the pertinence and effectiveness of talent training and fails to meet industrial demands for innovative technical talents[6].

3. Core Reform Ideas and Educational Logic Under Integrated Development

The integration of education, technology and talent aims to realize deep coupling and collaborative empowerment of teaching, scientific innovation and talent supply. It breaks the traditional vocational education defect of valuing teaching over scientific research and innovation. It also adapts to the digital, intelligent and innovative transformation of the intelligent manufacturing industry. Based on the long-term teaching experience of Wenzhou Polytechnic and local industrial innovation demands, this reform abandons fragmented segmented teaching ideas. It adopts an overall reform principle centered on stage integration, science-education integration, innovative empowerment and talent quality improvement. It constructs a three-in-one modern educational logic of foundation consolidation, technological empowerment and talent upgrading to form a closed-loop collaborative system of teaching, innovation and talent cultivation as shown in Figure 1.

From an educational perspective, this reform leverages the inherent advantages of the five-year integrated vocational schooling system. By consolidating cross-stage teaching resources, it reconstructs progressive training objectives and curriculum frameworks, thereby eliminating persistent issues such as curriculum redundancy, skill discontinuity, and stage fragmentation. Furthermore, it establishes a tiered professional education system designed to solidify

students' theoretical foundations and occupational competencies, facilitating a seamless transition from basic skill acquisition to comprehensive technical application.

From a technological standpoint, the training model aligns precisely with rapid industrial iterations. It integrates cutting-edge enterprise technologies, novel processes, and applied research projects into routine pedagogical and practical training. By constructing school-enterprise collaborative innovation scenarios and incorporating frontier content—such as intelligent control, industrial digitalization, and system optimization—the reform cultivates students' adaptive thinking and engineering innovation capabilities, effectively bridging the gap between academic instruction and industrial advancement.

Regarding talent cultivation, this initiative transcends the traditional, single-skill training paradigm to focus on developing versatile, innovative, and compound technical professionals. It comprehensively enhances students' occupational adaptability, sustainable development potential, and technological innovation capabilities, precisely fulfilling the intelligent manufacturing industry's demand for high-caliber electrical talents.

Guided by five core principles—holistic design, phased implementation, progressive advancement, innovative empowerment, and industry-education synergy—the overarching reform pools high-quality resources across curricula, practical training, faculty, and enterprises. Consequently, it establishes five integrated systems encompassing curriculum instruction, innovative practice, teacher development, collaborative education, and diversified evaluation. This comprehensive framework effectively resolves the prominent deficiencies of traditional long-term talent training, notably weak innovation capacity, low job adaptability, and singular educational structures.

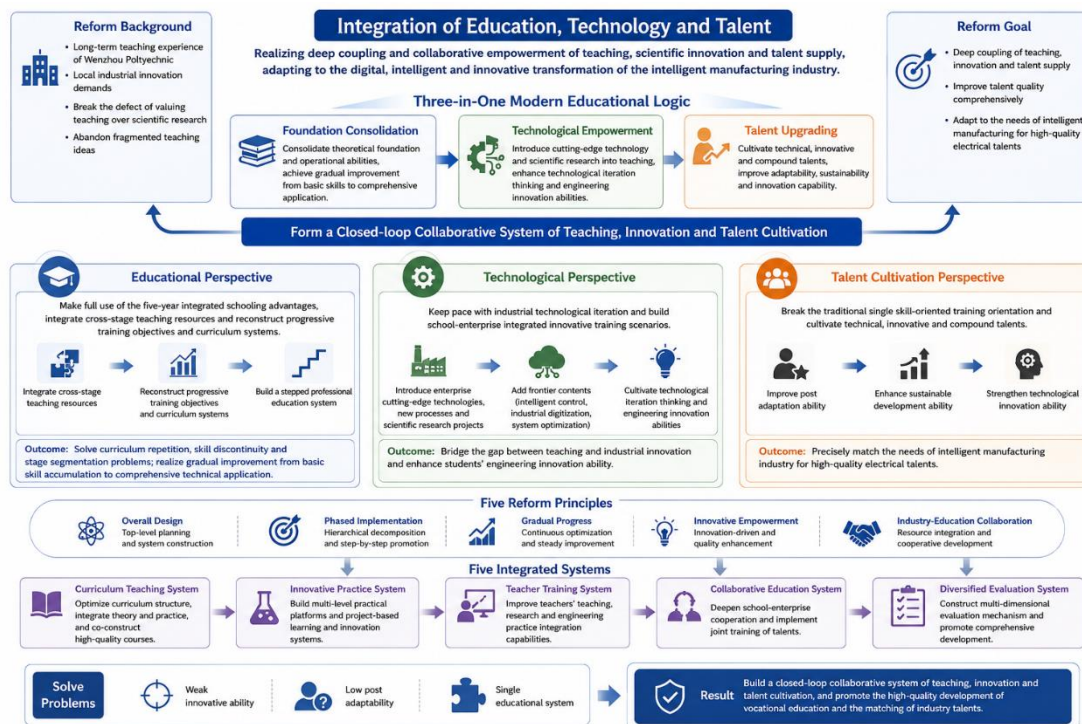


Fig. 1 Teaching Reform Framework Diagram

4. Specific Implementation Strategies of Integrated Teaching Reform

4.1. Optimize Top-level Design and Reconstruct Progressive Training Objectives

The college establishes a professional construction steering committee with cooperative secondary vocational schools and local leading manufacturing enterprises. The committee

investigates regional post competency standards and industrial innovative demands. It formulates integrated five-year talent training plans and defines progressive positioning for each stage. The first three years of secondary vocational education focus on foundation cultivation. The core goals are to consolidate basic knowledge, enlighten professional skills and shape professional literacy. It cultivates students' basic abilities in electrical foundation, electrical drawing recognition and basic equipment commissioning. It helps students form standardized professional operation awareness. The last two years of higher vocational education focus on quality improvement and innovation empowerment. It cultivates students' advanced abilities in PLC programming, industrial network control, intelligent equipment integration and system optimization. It enables students to solve complex post technical problems independently and realize the upgrading from basic skilled talents to comprehensive innovative technical talents.

4.2. Integrate Curriculum Resources and Build Progressive Curriculum System

Driven by an "occupational role-competency-curriculum" paradigm, this reform systematically resolves curriculum redundancy and discontinuity by eliminating overlapping modules and addressing advanced skill deficits. It constructs a modular, tiered five-year framework comprising public foundational, professional foundational, core professional, professional expansion, and comprehensive training modules.

Instruction is progressively structured: public foundational courses utilize unified standards—focusing on core knowledge accumulation in the secondary vocational stage and occupational adaptation in the higher vocational stage. Professional foundational modules are strategically positioned early to establish a robust disciplinary base. The core professional curriculum employs a meticulous gradient layout. Foundational skills, such as low-voltage electrical applications and basic PLC, are established in the secondary phase. These seamlessly bridge into advanced higher vocational topics—including advanced PLC programming, servo control, industrial robotics, and automated line commissioning—to precisely meet high-end industry demands.

Crucially, comprehensive training escalates annually from discrete skill exercises to authentic enterprise project practicums. By continuously embedding frontier technologies in intelligent manufacturing and digital control, the curriculum remains strictly synchronized with rapid industrial iterations and integrated developmental requirements.

4.3. Optimize Practical Teaching and Build Stepped Training System

Grounded in collaborative school-enterprise bases and premium training resources, this study establishes a four-tier progressive practical pedagogical framework. This continuous five-year system smoothly transitions students from foundational protocols (Years 1-2: circuit installation, basic troubleshooting) to specialized core competencies (Years 3-4: PLC, frequency conversion, industrial networks), culminating in advanced engineering applications (Year 5: automated line debugging and system optimization via authentic enterprise projects).

Crucially, the reform champions the systemic integration of occupational roles, coursework, skill competitions, and certifications. By embedding industry standards—such as those for electrical and industrial robot maintenance—into the curriculum, the framework utilizes competitive and certification assessments to drive educational innovation. This paradigm fosters teaching enhancement through competition and standardizes training through certification. Ultimately, by co-constructing and sharing cross-stage training facilities, the institution eliminates infrastructural redundancy, thereby optimizing resource allocation and maximizing the efficiency of technical talent cultivation.

4.4. Optimize Teacher Team and Build Integrated Teaching Echelon

A long-term two-way exchange and joint teaching research mechanism is established for secondary and higher vocational teachers. An integrated double-qualified teaching team is formed. Regular collective lesson preparation, curriculum standard research, learning situation analysis and teaching reform activities are carried out. These activities unify cross-stage teaching standards, progress and requirements and break teaching barriers. A two-way teacher training plan is implemented. Secondary vocational teachers are sent to enterprises for temporary training and advanced technical learning to improve innovative teaching ability. Higher vocational teachers participate in secondary vocational classroom teaching and research. They are familiar with basic teaching modes and learning situations to optimize advanced curriculum design. In addition, enterprise technical backbones and industrial craftsmen are employed as part-time teachers. They participate in practical guidance, project innovation and curriculum development. The mixed teaching team of full-time college teachers and enterprise part-time teachers strongly supports integrated and innovative teaching reform.

4.5. Deepen Industry-Education Integration and Improve Collaborative Mechanism

The college deepens school-enterprise cooperation to realize full-process and all-round collaborative education[6]. It cooperates with local leading enterprises including Chint Group and Yalong Intelligent Equipment Group. Both sides jointly build industrial colleges, shared training bases and master studios. Relying on enterprise real production projects and technical resources, they co-revise integrated talent training plans, develop modular innovative courses, compile characteristic textbooks and design innovative training projects. The college fully implements modern apprenticeship and order-based training modes. It formulates customized training schemes according to enterprise post and innovation demands. Students participate in cognitive internship, follow-up internship, innovative training and post internship in stages. It realizes seamless connection between campus teaching, innovative training and enterprise production and research. A school-enterprise two-way evaluation mechanism is established to ensure that talent training adapts to industrial innovative development demands.

4.6. Innovate Evaluation Mode and Establish Whole-Process Diversified Evaluation System

This reform abandons the traditional single result-oriented evaluation mode. It constructs a whole-process, diversified and hierarchical evaluation system suitable for five-year long-term training. The evaluation covers five dimensions: theoretical knowledge, practical skills, professional literacy, innovative ability and growth increment. Multiple evaluation subjects include teachers, practical instructors, enterprise engineers and students. The evaluation method combines process assessment and summative assessment. Process assessment runs through the whole five-year teaching cycle[7]. It records students' daily classroom performance, practical operation, project completion, innovative practice and skill progression. Summative assessment is comprehensively determined by stage examinations, skill certificates, competition achievements and internship performance. Differentiated evaluation standards are set for different stages. Secondary vocational evaluation focuses on basic competency assessment, while higher vocational evaluation emphasizes comprehensive ability and innovation assessment. The system can objectively and dynamically reflect students' five-year growth and training effects.

5. Conclusion

The integrated development of education, technology, and talent provides a crucial guiding framework for long-term vocational education. Consequently, the integrated teaching reform

for electrical automation majors serves as a pivotal strategy for cultivating high-caliber, innovative professionals to support the upgrading of the intelligent manufacturing industry. Leveraging its "Double High-level" infrastructural advantages and aligning with regional industrial characteristics, Wenzhou Polytechnic effectively addresses the systemic limitations of traditional segmented training—namely, stage fragmentation, the disconnect between instruction and scientific innovation, inadequate cultivation of innovative capacities, and low occupational adaptability. Through comprehensive optimizations, the institution has constructed a novel, long-term integrated talent training model. This paradigm shift encompasses progressive objective reconstruction, an integrated curriculum system, a tiered innovative training platform, a collaborative "dual-qualified" faculty framework, deep industry-academia-research synergy, and a diversified, whole-process evaluation mechanism.

This optimized training model successfully dismantles cross-stage educational barriers, facilitating the profound integration of professional education, practical instruction, technological innovation, and talent output. Multiple iterations of teaching practice confirm the reform's efficacy, demonstrating substantial improvements in students' professional proficiencies and engineering innovation literacy. Key performance indicators—including certification acquisition rates, competition award rates, and high-quality employment rates—have experienced steady growth. Furthermore, the quality of cultivated talent has garnered comprehensive recognition from local intelligent manufacturing enterprises, culminating in a replicable and scalable pedagogical reform paradigm. Moving forward, the college remains committed to the requirements of integrated development. Future initiatives will focus on deepening industry-academia-research integration, enriching digital innovative teaching resources, refining hierarchical training schemes, and continuously optimizing the long-term training system. Ultimately, this sustained effort will ensure the steady supply of high-quality, versatile, and innovative electrical automation professionals to drive the high-quality development of the intelligent manufacturing sector in southern Zhejiang.

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