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Research on School-Enterprise Collaborative Talent Training Paths for Electrical Platform Practical Courses Under Digital-Intelligent Transformation

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Abstract: As a key carrier linking theoretical knowledge and engineering practice, electrical platform practical courses should rely on the school-enterprise collaborative talent training model under digital-intelligent transformation to realize the organic connection among the education chain, talent chain, and industrial chain. On this basis, this paper briefly analyzes the requirements for core literacy of electrical talents brought by digital-intelligent transformation, and discusses the existing problems and optimization paths in school-enterprise collaborative teaching of electrical platform practical courses under digital-intelligent transformation, so as to provide theoretical references for cultivating high-quality electrical talents adapted to the digital-intelligent era.

Keywords: Digital-intelligent transformation; Electrical platform practical courses; School-enterprise collaborative talent training

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1. Introduction

Electrical platform practical courses, covering multiple modules such as electrical control platforms, intelligent operation and maintenance platforms and virtual simulation platforms, serve as the core carrier of practical teaching and a critical path to transform theoretical knowledge into engineering practice. School-enterprise collaborative talent training can integrate universities' advantages in theoretical teaching and enterprises' practical resources. Against the backdrop of digital-intelligent transformation, optimizing the system of electrical platform practical teaching and improving talent training quality is an effective reform path for electrical majors.

2. Requirements for core literacy of electrical talents under digital-intelligent transformation

2.1. Solid professional knowledge literacy

With the wide application of digital-intelligent technologies in the electrical engineering industry and higher education, talent training of electrical majors in universities should not only deliver professional theoretical knowledge to students, but also cultivate their basic digital-intelligent knowledge and skills, such as in-depth integrated application of big data analysis, artificial intelligence, Internet of Things and other digital technologies in electrical fields, as well as the capability to solve practical electrical control problems via digital technologies. Electrical platform practical courses act as an important carrier for students to internalize professional knowledge. The teaching activities shall cater to the demands of digital-intelligent electrical talents in the new era, guiding students to master core basic knowledge including circuit principles and PLC electrical control system analysis, while learning application principles and practical methods of emerging technologies such as intelligent sensors and edge computing in electrical engineering scenarios [1].

2.2. Strong engineering practical ability

At present, posts in the electrical industry require professionals to skillfully operate intelligent electrical and automatic control equipment, and master practical skills including electrical equipment installation, debugging, fault diagnosis, and operation & maintenance. In traditional practical courses for electrical majors, students only imitate teachers' demonstrations to finish basic exercises in textbooks, resulting in slow growth of engineering practical ability. In addition, teachers need to provide students with opportunities to practice complex engineering problems under digital-intelligent scenarios. Building a practical teaching network integrating virtuality and reality, linking on-campus and off-campus resources, can effectively improve students' engineering practical capabilities in digital-intelligent environments. Virtual simulation reproduces all links of industrial electrical control systems, and combined with real enterprise practice bases, it bridges the last gap between theory and practice.

2.3. Outstanding innovative thinking and ability

Digital-intelligent transformation drives continuous iteration of electrical technologies, bringing growing demands for innovation in intelligent electrical equipment and control systems. Electrical talents are required to possess prominent innovative thinking and capabilities, capable of conducting innovative design and optimization of electrical products and control systems by integrating digital-intelligent technologies [2]. Therefore, teachers should introduce real engineering projects into teaching, allowing students to learn and practice optimizing control algorithms with AI technologies during project practice, and think about more efficient solutions for practical tasks through hands-on operation [3]. In this process, teachers shall encourage students to break traditional thinking stereotypes and attempt cross-border integration of emerging digital-intelligent technologies and electrical expertise, exploring new ideas for technical application in engineering practice.

3. Existing problems in school-enterprise collaborative teaching of electrical platform practical courses under digital-intelligent transformation

3.1. Imperfect school-enterprise collaborative mechanisms

Cooperation between many universities and enterprises remains superficial without sound collaborative mechanisms. There is no regular communication and docking system between the two sides, and their roles

are not clearly defined: universities focus on theoretical teaching while enterprises undertake practical work, failing to form a sound co-construction, sharing and joint training model. Some enterprises lack internal motivation to participate in collaborative training, joining higher education merely out of social responsibility or policy compliance, leading to superficial cooperation and shallow industry-education integration [4]. Meanwhile, discrepancies exist between universities and enterprises in talent training objectives, curriculum standards and practical evaluation systems, weakening the joint force of collaborative education and failing to give full play to the educational value of electrical platform practical courses.

3.2. Disconnection between platform courses and post requirements

Current teaching of electrical platform practical courses is still dominated by traditional electrical technology, failing to fully integrate big data, information and Internet technologies, which causes mismatches with digital-intelligent posts in the new era. In addition, without targeted teaching design, training projects are not set according to various enterprise posts. The electrical industry develops rapidly with the constant emergence of new technologies and processes, while traditional teaching resources lag behind industrial progress, making graduates fail to meet enterprise employment demands [5]. Besides, most case projects on practical platforms are simplified theoretical verification projects, lacking real production-related items such as robot control.

3.3. Insufficient allocation of practical platform resources

Practical platforms form the foundation of electrical practical teaching, yet universities and enterprises still have deficiencies in platform resource construction. Restricted by funds and venues, universities update training equipment slowly and lack intelligent electrical control devices and virtual simulation labs, making it difficult to build environments that simulate complex digital engineering. For enterprises, production tasks and safety management limit the full opening of practical resources to students, leaving learners with narrow hands-on experience and insufficient understanding of core enterprise technologies and workflows. Moreover, universities and enterprises fail to integrate resources effectively, resulting in repeated construction and resource waste, which hinders resource sharing [6].

4. Optimization paths for school-enterprise collaborative teaching of electrical platform practical courses under digital-intelligent transformation

4.1. Optimize school-enterprise collaborative mechanisms to consolidate collaborative safeguards

To effectively implement school-enterprise collaborative education for electrical engineering platform-based practical courses, universities should set up a leading group for school-enterprise collaborative education. The group shall be headed by the college's vice dean for teaching and the enterprise's human resources director, with members including heads of electrical engineering departments, enterprise technical department directors, professional teachers and enterprise mentors. It shall be responsible for overall coordination of all collaborative education work, formulating collaborative education plans, clarifying the duties and division of labour for both sides, and resolving problems arising in the collaborative education process. The leading group shall hold regular meetings and establish a regular communication and docking mechanism to ensure the orderly advancement of collaborative education [7]. Under the leadership of the leading group, enterprises shall give full play to their enabling role. In the development of electrical engineering platform-based practical

courses, the whole-process closed loop of engineering projects shall be guaranteed from demand analysis, scheme design, implementation to project acceptance; meanwhile, another whole-process closed loop of engineering projects shall be guaranteed covering plan formulation, resource allocation, project execution, progress monitoring and hand-over evaluation. These are the so-called "dual closed-loops": the "project process closed-loop" and the "project structure closed-loop". Meanwhile, to further stimulate enterprises' internal motivation to participate in collaborative education, universities and enterprises shall jointly build a benefit-sharing mechanism to achieve mutually beneficial win-win results through approaches such as joint technology research and development cooperation, targeted talent delivery and joint construction of internship bases. Universities introduce enterprise project resources to optimise practical teaching and improve talent training quality. By participating in collaborative education, enterprises can pre-secure high-quality graduates with digital-intelligent electrical engineering skills, leverage universities' scientific research strength to tackle technical difficulties in production, and enhance their core competitiveness [8].

4.2. Update platform curriculum system to strengthen post alignment

First of all, teachers should be guided by the core competency requirements of digital-intelligent positions, clarify the training objectives of platform-based practical courses, focus on cultivating students' professional foundational literacy, engineering practical capabilities, innovation capabilities and collaborative teamwork capabilities, take the application capability of digital-intelligent technologies as the key focus of course training, and ensure that course objectives are highly aligned with enterprise job requirements. For example, for positions of intelligent production line control, the training of students' capabilities to conduct data monitoring and fault diagnosis by applying big data and Internet of Things technologies shall be added to the course objectives [9].

Secondly, teachers majoring in electrical engineering should strengthen cooperation and exchanges with electrical enterprises, build a school-enterprise collaborative curriculum development team, optimize the content of platform-based practical courses in combination with enterprise job demands, integrate digital technologies such as big data, artificial intelligence and the Internet of Things, and construct a three-tier curriculum module of "basic practice + core practice + innovative practice". The basic practice module focuses on cultivating the basic professional skills of electrical engineering majors, including traditional contents such as circuit debugging and PLC programming; the core practice module focuses on cultivating digital-intelligent skills, including robot motion control and frequency converter control; the innovative practice module focuses on cultivating students' innovation capabilities, including the optimization of intelligent control systems [10]. Meanwhile, in the curriculum teaching reform, teachers introduce "programmable logic controller experiment box", "IFAE discrete-industry intelligent manufacturing comprehensive training system", "EETPro elevator simulation training system" and "Rockwell Industrial Automation Collaborative Innovation Center" as pilot platforms. Students act as the project's second-party contractor to participate in the actual engineering project workflow, simulate real enterprise working scenarios throughout the whole process, and experience the full life cycle of projects. Course grades are determined by students' project completion status and in-process performance. Final examinations are discarded, and assessment focuses on process and deliverables to realize "assessment through practical practice" [11].

4.3. Strengthen practical platform construction to improve teaching quality

In terms of hardware-facility development, hierarchical configuration can be adopted to enable students to

not only fully practise their basic skills but also experience cutting-edge technical application scenarios in the field of industrial control engineering. Equipment at the basic layer shall include programmable logic controllers, variable-frequency speed regulators and so on, to help students master the key logic of electrical control as well as the basic capabilities of equipment commissioning and maintenance. The intelligent layer needs to introduce industrial robot workstations, machine-vision inspection systems, intelligent sensor networks and the like, so as to support practical training for core intelligent-manufacturing skills such as industrial networking and communication-protocol commissioning. The system layer simulates real-world factory production workflows and control logic, and builds a teaching scenario integrating virtual and real elements for mutual verification by leveraging physical production lines and virtual-simulation platforms [12]. Meanwhile, universities may co-establish virtual-simulation laboratories with enterprises to develop virtual-simulation experimental platforms with independent intellectual property rights. Combined with on-campus semi-physical emerging-engineering training bases and off-campus enterprise practice bases, a practical-teaching network featuring "virtual-real integration and internal-external interaction" can be formed. In terms of software development, focus shall be placed on the industrial-software ecosystem that underpins core segments of intelligent manufacturing. Industrial configuration programmes, PLC programming and simulation software, offline programming and simulation platforms for industrial robots suitable for teaching scenarios shall be integrated or developed, with consideration given to both their popularity in industrial applications and practical teaching value, allowing students to proficiently employ them to tackle engineering challenges [13]. In addition, teachers shall integrate practical resources from universities and enterprises and construct a resource-sharing database to realise the sharing of training equipment, practical cases, teaching resources and other items, thus improving resource-utilisation efficiency.

4.4. Build dual-qualified teaching teams and perfect faculty development

The teaching faculty constitutes the core force for school-enterprise collaborative talent cultivation. Relying on school-enterprise collaboration, it is necessary to build a team of "dual-qualified" teachers and enhance their practical teaching capabilities as well as their ability to apply digital-intelligent technologies. First of all, universities should arrange teachers majoring in electrical disciplines to take temporary posts in enterprises on a regular basis, take part in corporate production practices, technology research and development and other work, understand corporate job requirements and technological trends, and improve their practical capabilities and the application competence of digital-intelligent technologies. Enterprises shall provide practical posts and technical guidance for university teachers to help them master emerging digital technologies and engineering practical skills [14]. Meanwhile, universities shall regularly organize training for teachers on digital-intelligent technologies and teaching methodologies to renew their teaching concepts and improve teaching competence.

Secondly, enterprises shall select key electrical technical personnel and engineers with rich engineering practical experience and proficiency in digital-intelligent technologies to serve as enterprise mentors, who will participate in the teaching and tutoring of practical courses on the platform, and provide students with practical guidance and on-the-job training services. Enterprise mentors are responsible for explaining corporate job demands and engineering practice cases, and guiding students in practical operations, innovative design and other activities, so as to make up for the deficiency of practical experience among university teachers. In the meantime, a training mechanism for the teaching competence of enterprise mentors shall be established. Universities shall offer training covering teaching methods and teaching rules for enterprise mentors to improve their teaching abilities [15]. Finally, universities may engage enterprise mentors as part-time teachers,

while enterprises may hire university teachers as technical consultants, so as to realize the two-way flow of teaching resources.

5. Conclusion

As highly practical engineering majors, electrical disciplines rely heavily on practical teaching to cultivate students' engineering and innovative capabilities, and platform practical courses serve as the key path to transform theoretical knowledge into engineering practice. Therefore, by optimizing collaborative mechanisms, renewing curriculum systems, co-building practical platforms and constructing dual-qualified teachers, schools can realize sustainable development of school-enterprise collaborative education and provide strong talent support for high-quality development of China's electrical industry.

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