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Practice of School-enterprise Cooperation Program Training Camp for Electronic Information Majors

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Abstract: To address issues such as the disconnect between practical teaching and industry demands in electronic information talent cultivation, as well as the limitations of competition-driven models, this paper proposes a "School-Enterprise Collaborative Project Training Camp" model. Through hierarchical project repository design, innovative management mechanisms, and the development of an online learning platform, cutting-edge engineering cases from enterprises are integrated into pilot courses. Teaching evaluation data from this reform initiative shows significant improvements in curriculum goal achievement and students' engineering practice capabilities. Over half of students receiving good or higher evaluations have secured internship opportunities under the school-enterprise collaborative training model. A tripartite win-win order-based training cycle among students, schools, and enterprises has been initially established, providing new support for applied universities to deepen industry-education integration reforms.

Keywords: Project Training Camp; School-Enterprise Cooperation; Stratified Project Library

1. Introduction

With the deep integration of artificial intelligence and electronic information technology, industries now demand higher practical skills and comprehensive design capabilities from electronic information engineering professionals. However, traditional teaching models struggle to meet the talent requirements in complex engineering scenarios. To address the disconnect between practical education and industrial needs, this paper explores the "School-Enterprise Collaborative Training Camp" model. This innovative approach aims to help applied universities deepen industry-education integration reforms, thereby enhancing both the quality of talent cultivation and their alignment with corporate demands.

2. The Problem of Cultivating Innovative Practice Ability of Electronic Information Talents

2.1 The Training Program and Teaching Mode are Relatively Old

In recent years, China has accelerated the upgrading of mid-to-high-end industries and structural transformation. Modern electronic information technology is rapidly integrating with various artificial intelligence models, driving comprehensive and complex engineering design in the electronics sector to evolve at an unprecedented pace. The growing demand for next-generation engineers with expertise in high-complexity, long-design-chain integrated design capabilities presents significant challenges to the national talent cultivation model for electronic information-related disciplines.

The talent development programs for electronic information majors in most Chinese universities share two prominent commonalities. First, the content of theoretical textbooks often fails to align with industrial technological advancements. Second, supporting experimental and practical courses tend to focus narrowly on isolated principles, technologies, or processors, with technical depth limited to verification and basic applications. This has resulted in a chronic absence of comprehensive innovation courses that address real-world product development and engineering scenarios involving high complexity and extended design chains[1].

2.2 Practical Limitations of Competition, Project and Innovation and Entrepreneurship Driving Model

Since the Ministry of Education launched its New Engineering Initiative in 2017, many undergraduate universities have implemented various forms of competition-driven and project-driven teaching reforms in electronic information disciplines. These institutions have introduced credit policies for events such as Electronic Design Competitions, Intelligent Robot Combat and Competition, Embedded Systems Contests, and RoboMaster (RoboMaster) Robotics Challenges. They have also established innovative studios, open laboratories, and entrepreneurship platforms. By encouraging students to enhance their comprehensive professional skills through competitions, research, and innovation-entrepreneurship activities, these measures have significantly improved the quality of talent cultivation in electronic information-related fieldsp[2].

However, breakthroughs in artificial intelligence and large-scale AI models over the past three years have driven generational technological shifts across industries—from equipment manufacturing and home appliances to telecommunications, automotive, drones, and robotics. For instance, China's Level 2 autonomous driving technology undergoes a "Moore's Law" -style upgrade every nine months. This industrial transformation is widening the gap between companies 'evolving demands for graduates' expertise and the technical capabilities of current training programs. Exploring innovative talent development models has become an urgent priority to bridge this divide.

3. Pilot Design of School-Enterprise Cooperation Training Camp for Electronic Information Engineering Major

3.1 Research and Analysis on the Training Camp Model of School-Enterprise Cooperation Projects

Under the high pressure of current technological competition, enterprises begin to actively participate in the talent training mode of universities. The measures to solve the aforementioned limitations are as follows:

(1) Universities and cutting-edge enterprises jointly set up school-enterprise cooperation experimental classes and order classes, and enterprises deeply participate in the design of talent training programs, curriculum systems, curriculum contents, experiments and practical training projects.

(2) Universities integrate their distinctive academic programs with regional industrial characteristics to collaboratively establish industry-academia training camps. Notable examples include: the Tencent Technology-Beihang University partnership camp, the Visual Applications Bootcamp under South China Normal University's "AI Empowers Universities Initiative", and the Smart Manufacturing Training Camp by Zhengzhou University of Light Industry and Sibes Electromechanical Systems. These exemplary cases provide valuable references for research and practical development in this field[3].

Our university's Electronic Information Engineering program, recognized as a first-class undergraduate program in Henan Province and an application candidate for international engineering education accreditation, has developed a two-phase educational reform strategy. Building on feedback from peer experts in higher education institutions and corporate representatives over the past three years, we will implement phased improvements. The initiative includes establishing flexible industry-academia collaboration training camps through partnerships with enterprises, while also developing customized industry-specific classes with regional industry leaders such as XJ Electronics, Xuchang Intelligent, and Kaipu Testing[4].

3.2 Model Design of Training Camp for School-Enterprise Cooperation Project of Electronic Information Engineering

The university has launched pilot programs for industry-academia collaboration in electronic information experimental training courses. Through joint project-based training camps with corporate engineers, we align cutting-edge technical challenges and R&D skills from real-world product development with undergraduate education. This initiative significantly enhances the depth and technological relevance of engineering innovation practices, enabling students to achieve comprehensive skill integration, intensive learning, and hands-on experience in highly realistic industrial innovation scenarios that mirror real-world challenges[5].

(1) Formulate the mode of school-enterprise cooperation and determine the integration ratio of school-enterprise resources

The selection process commenced with comprehensive evaluations of training camps for university-enterprise collaboration programs at peer institutions. Through interviews with faculty members and beneficiary students, we gathered firsthand insights to identify target enterprises based on their industry specialization, technical focus, and operational scale. Following intensive negotiations and rigorous assessments, Henan Province's specialized SME Guirui Intelligence was finalized as the partner organization. The company specializes in intelligent perception systems, decision-making control solutions, and equipment integration technologies designed for complex industrial scenarios.

The university's faculty team and industry partners convened a talent cultivation seminar to analyze corporate training programs, technical reserves, and R&D capabilities. Based on specialized disciplines and enterprise engineering case characteristics, they formulated the "University-Enterprise Resource Allocation Plan". This plan primarily covers pilot courses, curriculum revisions, engineering case collections, textbook development, blended learning resources, faculty distribution ratios, online-offline teaching ratios, practical training environment upgrades, teaching environment improvements, project-based management systems, two-way incentive mechanisms for teaching staff, and rational assessment methods for examinations.

(2) Select the pilot courses and enterprise project library

The project repository and curriculum resources are seamlessly integrated with our university's current program framework, ensuring precise alignment between preparatory instruction and the training camp's scientifically designed schedule. Both parties have designated the 14th to 17th weeks of the sixth semester for "Comprehensive Design in Electronic Information Engineering" as the pilot course for the training camp, while incorporating "Deep Learning-Based Embedded Microcontroller Application Development" from the company's existing teaching resources as a compatible module. A joint faculty team has curated, categorized, and assessed the difficulty of enterprise-provided classic engineering cases, breaking them down into sub-projects that cover embedded systems, IoT, artificial intelligence, sensor detection, and communication technologies. The project repository spans beginner, intermediate, and advanced levels, with student teams of three members completing projects within 20 instructional hours each, ensuring cost-effective project management.

(3) Design the management mechanism of training camp

Given the varying educational resources and disciplinary characteristics of institutions, the management framework for training camps should not simply replicate corporate-academic collaboration models. Through alignment with corporate governance structures and industry-specific needs, universities and enterprises jointly develop practical "Camp Implementation Management Guidelines". Companies initiate faculty training programs and corporate internships to cultivate project management mindset and team collaboration skills. Engineers integrate frontline work experience and professional expertise into student development processes, while university instructors oversee on-site operations, provide guidance, collect process data, analyze performance metrics, and deliver feedback.

The pilot curriculum's industry-academia collaboration program training camp version has established a rational assessment framework for key elements across the industrial chain, including process-related components, outcome-based metrics, non-technical factors, and evaluation methodologies. Essential resources such as components, consumables, instruments, and dual-mentor systems have been clearly defined in accordance with the newly implemented teaching quality assurance system and management tracking procedures.

(4) Textbook design and resource bank construction

Based on pre-training assessments, student groups independently select project levels, methods, and projects from the project repository. The curriculum features three formats: project-based, modular, and workbook-style. The project-based format focuses on technical analysis and implementation pathways, while the modular approach breaks down key technical knowledge modules from the project repository's knowledge graph. The workbook-style materials emphasize component parameters, equipment specifications, engineering standards, and team collaboration protocols. Prior to the training camp's launch, two online resource repositories had been jointly developed through collaborative efforts.

1) Online learning service platform for school-enterprise combined project training camp

The platform is used for students' self-learning of knowledge before training, including embedded, artificial intelligence, information processing, wireless communication, competition case studies and other resources, and can automatically collect pre-training learning data.

2) Training cloud platform

The enterprise-designed integrated learning and training cloud platform, built upon a pre-configured online programming environment, delivers cloud-based practical training modules covering embedded system design, Python programming, machine learning, image processing and computer vision, intelligent speech technology, natural language processing, and deep learning. These modules are presented through digital teaching technologies including flowchart-based interfaces, visual programming tools, and 3D virtual simulations.

(5) Implementation of site and hardware and software supporting facilities

This pilot initiative primarily utilizes on-campus experimental facilities to establish a hardcore platform for student-led workshop-style artisan studios. Through collaboration with faculty teams, we design and optimize both software and hardware resources, providing abundant and flexible engineering project support elements. The training camp venue not only offers high-speed wireless internet access, ample basic consumables, and various professional instruments, but also features a newly tailored software and hardware resource library specifically designed for instructors and students.

Table 1. Hardware and Software Support for Training Camps for Domestic Substitution and AI Model

order number	Category name	Major components
1	Split component module library	Simulators, digital devices, filters, signal conditioning circuits, sensor modules, wireless communication modules, micro motors, reducers, video acquisition, etc
2	Embedded processor development board	STM32F103, AT32F403A, APM32F103, HC32F103, AT32F407, GD32H7, AT32F407, etc
3	High performance computing processor development board	Lattice ECP5, Compa PGC1KD/PGC2KD, Altera Cyclone IV, PGL22G/PGL50G, TMS320F28335, TMS320C5517, ADP32F035
4	Lightweight intelligent computing development board	Raspberry PI 4B, Raspberry PI 5, Jetson Nano 2GB, Jetson Nano B01
5	High performance computing power platform	NVIDIA RTX4090*4 (running 96G video memory)
6	AI training hardware and software platform	Intelligent equipment edge computing experimental platform, intelligent sensing and control digital experimental platform, power sensing and interconnection application virtual-real simulation system, power sensing and interconnection application verification platform, etc

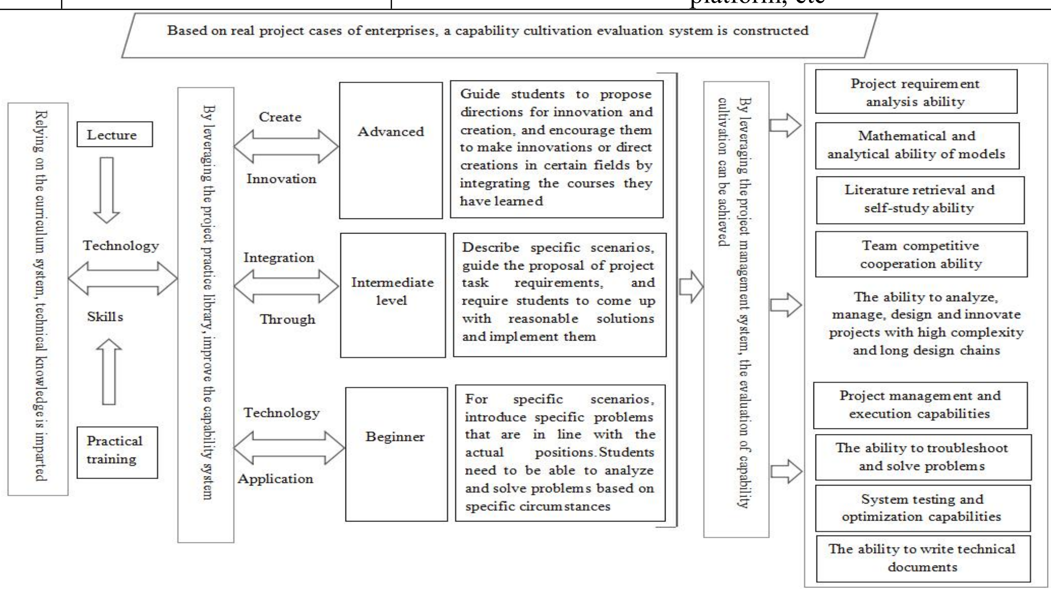

Figure 1. Ability Training System based on Project Practice Library

4. Pilot Reform Practice of Training Camp

Figure 1 illustrates the competency development framework for our university's Electronic Information Engineering program, developed through a school-enterprise collaborative training camp utilizing a project-based practical repository. Under the pilot initiative, the training camp will systematically progress through seven phases: topic selection, project planning, requirements analysis, system design, implementation, acceptance evaluation, and final summary.

Project Topic Selection, Planning, and Requirements Phase: Based on pre-training assessments, students form teams and select projects from a practical repository of beginner, intermediate, and advanced levels that align with their interests, strengths, and skill sets. Within 5 working days after topic selection, they must submit a project proposal and timeline schedule. This phase emphasizes engineering research and management principles, fostering awareness of project justification and approval processes while developing essential skills including literature search, open-source code analysis, component manual application, technical feasibility assessment, and task decomposition.

System Design and Project Implementation Phase: Following technical specifications and task breakdown diagrams, student teams enhance technical capabilities through online learning platforms and practical training cloud platforms. By integrating project-based textbooks, modular handbooks, and work manuals, they refine technical details, analyze knowledge frameworks, master core software/hardware modules, optimize component parameters, verify engineering standards, and streamline team workflows while diligently conducting R&D using instruments. The school-enterprise collaborative faculty team effectively coordinates instruction through scenario-based teaching and task-driven methodologies. Engineers guide students in understanding job requirements, professional evaluation criteria, technical leadership roles, and development team responsibilities, transforming project tasks into real-world assignments. During guidance sessions, ideological education elements and competitive collaboration concepts are seamlessly integrated.

Project Acceptance Phase: Student groups present their project outcomes and submit reports. The faculty team collaboratively evaluates their fault debugging, task decomposition, division of labor effectiveness, engineering R&D capabilities, project management proficiency, and task completion status (as shown in Figure 2). This phase further enhances students' competencies in literature search, system analysis, logical reasoning, teamwork coordination, and professional documentation writing.

Figure 2. Schematic Diagram of Project Acceptance

Project summary stage: Each student should share the multi-dimensional feelings of growth, and the school teachers and enterprise engineers will evaluate the process elements, final elements and non-technical elements from three perspectives: engineering certification achievement, enterprise talent evaluation and training camp evaluation mechanism.

5. Practice Results and Conclusions

Through the meticulous planning and implementation of the training camp, the course quality reports during this engineering accreditation application period revealed that both quantitative and qualitative indicators showed: the achievement rate of individual course objectives increased by no less than 7% year-on-year, with an average improvement of 14.7% across all course objectives. Analysis of end-of-term surveys conducted by corporate experts, peer experts, in-house faculty, and trainees indicates that students rated as "good" or higher under the training camp evaluation mechanism have demonstrated enhanced engineering design capabilities and workplace competencies compared to pre-camp levels. Notably, 60% of these students have received multiple corporate invitations and applied for school-enterprise integrated training programs. As planned, they will complete their senior year internships and graduation projects simultaneously within corporate settings, establishing a preliminary framework for order-based talent cultivation that fosters a win-win relationship among students, schools, and enterprises. The reform practices of this school-enterprise collaborative training camp will continue to support the engineering accreditation efforts for our Electronic Information Engineering program through ongoing improvements in subsequent cycles.

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