

Construction and Practice of Internship and Training Bases under the 'Three-Horizontal, Four-Position, Five-Dimensional, Five-Vertical' Science-Policy-Industry-Education System

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Abstract: To address the challenges in industry-education integration—such as superficial collaborations between universities and enterprises, outdated training equipment, and the mismatch between talent cultivation and industrial demands. The research proposes a 'Three-Horizontal, Four-Position, Five-Dimensional, Five-Vertical' collaborative education system integrating science, policy, industry, and education. The model establishes a shared, hybrid virtual-physical internship and training base. Practices demonstrate that this approach has facilitated partnerships with 43 enterprises, developed 50 (horizontal projects), and earned accolades such as the Zhejiang Provincial Science and Technology Progress Award. According to recent reports, the employment rates in smart manufacturing have experienced a significant increase, with a rise of 25%. The research provides a replaceable model for applied undergraduate institutions to overcome the firewall phenomenon in industry-education integration and support regional industrial upgrading.

Keywords: Industry-Education Integration; Three-Horizontal; Four-Position; Five-Dimensional; Five-Vertical; Internship and Training Hubs; SPIE Collaboration

1. Introduction

The integration of industry and education is to build industrial projects that are in line with the university's major as the prototype to enable enterprises and universities to develop together. It represents an educational and practical approach tailored to contemporary societal norms[1]. However, during the

construction process, issues arise such as a monolithic model of education integration, limited university-enterprise cooperation models, and superficial collaborations. The system and mechanism for addressing application-oriented demands remain inadequate[2-3]. The integration of industry-education for undergraduate students is not seamless, lacking responsibility and active participation. Relevant systems are mismatched, and industry and enterprises are insufficiently engaged. Furthermore, supportive systems for fostering this integration are absent. The overall effect of university-enterprise cooperation remains unevaluated, and the path towards organic integration necessitates urgent innovation and breakthroughs[4]. Secondly, inadequate funding is a significant barrier, slow equipment upgrades and new internship equipment, the internship work tasks are simple and cannot be seamlessly connected with the equipment in the employment position, affecting graduates. Furthermore, students exhibit laziness in class at the internship engineering center, struggling to fully apply theoretical knowledge to practical situations. This results in students becoming overly reliant on theoretical knowledge without practical application, thereby hindering the cultivation of their practical innovation abilities[5]. Finally, the company has a substantial number of engineers and mentors guide students in their internship practice, yet there is a notable lack of in-depth theoretical knowledge. Based on the above issues, based on the national standards for undergraduate major teaching quality in general higher education institutions, engineering education major certification standards and new engineering construction requirements, it is necessary to integrate

industry and education with a shared training base, and the internship sharing base model is quickly replicate has operated stably for an extended period of time[6-8].

2. The Importance of Construction of Industry-education Integration Internship Training Base

The industry-education integration internship training base is the core carrier for deepening the reform of the modern vocational education system and cultivating high-quality applied talents. Constructing it holds great significance in fostering an organic connection among the education chain, talent chain, industrial chain, and innovation chain.

2.1 Serving National Strategies and Supporting Industrial Transformation and Upgrading

Focusing on the construction goals of 'Made in China 2025' and Zhejiang Province's 'Global Advanced Manufacturing Base', the base cultivates technical and skilled talents adapted to emerging fields such as smart factories and industrial Internet through digital design and intelligent manufacturing training, and helps '246' trillion-level industrial cluster development[9-11].

2.2 Innovate Talent Training Models and Solve the Pain Points of Traditional Education

Through the integration of three scenarios of 'campus+park+pastoralism', the real enterprise projects are transformed into teaching cases to solve the problem of students 'only talking about it on paper'. Building a 'four-dimensional collaborative' education system, from basic training to comprehensive practical training, can complete five-dimensional linkages in course teaching, virtual simulation, production internship, and social services[12-13].

2.3 Deepen University-Enterprise Cooperation and Promote High-Quality Development of Regional Economy

The co-construction base offers technical training to regional enterprises, covering intelligent production line operation, maintenance, and reverse engineering, among others. Collaboration among the government, universities, locals, and enterprises has led to the formation of an ecological chain encompassing

technical research and development, talent training, and social services. and relevant experiences can be replicated and promoted[14-16].

3. Contents of the Construction of Industry-Education Integration Internship Training Base

Fully carry out the construction of Digital Zhejiang and the Ningbo Intelligent Manufacturing Demonstration City, precisely target the key industries within '246' trillion-level industrial clusters, expedite industrial upgrading and structural transformation, prioritize the promotion of digital transformation and intelligence in the manufacturing sector, and establish a top-notch internship and training sharing platform that seamlessly integrates industry and education, while incorporating virtual and real-life off-campus collaborative training and internship base.

The construction of this base rooted in the talent training concept of 'three integrations' (integrating science and education, industry and education, as well as politics and education, to enhance innovation ability). establishing a 'four-mentor' system (including campus mentors, enterprise mentors, government mentors, and secretary mentors) for all staff members; 'five-dimensional teaching' (curriculum teaching+research teaching+park teaching+base teaching+social teaching) for all-round education; 'five-vertical abilities' (hands-on ability, expression ability, cooperation A comprehensive joint training platform that encompasses the entire educational process, integrating talent cultivation with technological advancements, facilitates deep integration of science and governance through the 'innovation consortium+sharing consortium' model. This is achieved via collaborative efforts among universities, governments, leading enterprises, and rural areas, ensuring that educational initiatives are closely aligned with industrial demands and technological progress., industry and education, and create a high-quality 'compound' and 'innovation' talent joint training model of 'government, university, local and enterprise' collaboration, and 'learning, research, innovation and application' mutual promotion, and cultivate application and technical talents with the Red Eagle spirit,

family and country feelings, innovation awareness and practical ability.

First, implement the 'dual subject' education of university-enterprise cooperation, and realize the 'three-docking' of the docking of curriculum settings and work processes, the docking of learning content and job skills, and the docking of practical teaching and enterprise projects. The second is to jointly build a long-term mechanism for the deep integration of industry and education. By jointly building a teaching staff, co-building a curriculum system, co-building a quality monitoring and evaluation system, we can address the talent shortages and technical obstacles faced by small and medium-sized enterprises within the ecological chain during their digital transformation endeavors. The third is to accelerate the base's intelligent training equipment and high level of informatization, and to integrate digital design, intelligent manufacturing, and teacher training to provide a practical platform for the digitalization of employees of regional small and medium-sized enterprises. The specific talent cultivation model of the internship and training base in the integration of industry and education is shown in Figure 1.

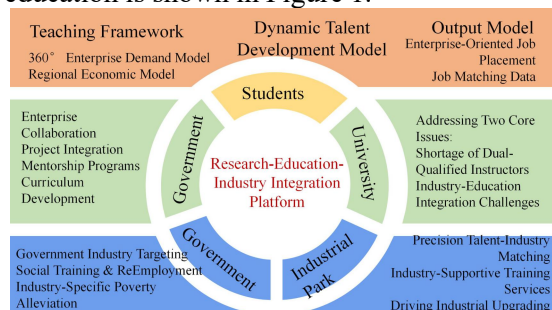


Figure 1. Talent Cultivation Model of Internship Training Base under the Science, Government, Industry and Education System

4. Practice of Construction of Industry-Education Integration Internship Training Base

4.1 Highlight 'digitalization +' and Promote the Transformation and Upgrading of Engineering Professional Groups

Government, universities, industries, enterprises and research teamed up to build a digital design and manufacturing talent training base for interdisciplinary, cross-professional, and cross-university-enterprise-

oriented digital design and manufacturing talent training base around the intelligent nature of the field of intelligent manufacturing/smart agriculture; around the strategic idea of 'strengthening chains, making up for shortcomings, and extending chains by implementing a 'chain-based group structure', with a focus on the diversified 'smart +' integrated professional group structure. university-enterprise sports professionals serve as both key personnel and the foundation for a task-based training model tailored to the real production environment of engineering enterprises; universes and enterprises jointly develop talent training plans, curriculum standards and textbooks for engineering professional groups, further optimize professional enhance linkage, sharing, and offer comprehensive training courses, while introducing special practice projects aimed at strengthening digital design and virtual simulation, thereby fostering students' comprehensive capabilities in personalized learning and digital applications.

4.2 Reshape Digital Craftsmen and Build a Curriculum System of 'basic Sharing-special Modularization-comprehensive Project Practical'

Relying on the three-level talent training model with cooperative enterprises, we will formulate a talent training plan for university-enterprise education, and based on the digital development of industrial technology, improve the specification positioning of manufacturing digital talents, connect with the pilot of the 1+X certificate system, and reconstruct the 'wide-diameter and thick-basis' digital design course system. Focus on the research and exploration of new teaching methods for curriculum reform such as 3D design, reverse engineering, virtual simulation teaching, intelligent manufacturing production simulation, etc. Do a good job in overall curriculum design and teaching organization and implementation, 'pass, help, and lead', prepare lessons collectively, standardize lesson plans, build online courses, and actively participate in engineering education and teaching ability competitions.

4.3 Relying on the Ecological Alliance, We Will Jointly Build a High-Quality 'Dual-Teacher Structure' Teaching Team

Leverage the 'dual teacher' training bases of the Ecological Alliance to enhance practical skills and teaching methodologies across mechanical and software disciplines. Focus on engineering general skills, curriculum development, and the application of information technologies such as virtual simulation. Integrate ideological and political education with professional teaching standards to foster comprehensive, modular teaching competencies among educators.

Drawing upon the strength of Huawei, iFlytek, Haitian Group, Ningbo Dalong Agriculture, and other pioneers in industry-education integration, we endeavor to establish a dynamic and cooperative community that facilitates the two-way exchange of personnel between universities and enterprises. Enhance the processes for recruiting part-time teachers with professional expertise independently, and foster the two-way movement and reciprocal hiring of educators from among high-level engineering and technical specialists, highly skilled individuals, and applied undergraduate students. We will endeavor to establish a distinguished and proficient dual-teacher workforce, characterized by noble professionalism, exceptional quality, superb teaching skills, a balanced structure, and a harmonious blend of full-time and part-time educators.

Integrate the 'campus+park' concept to collaboratively establish a shared platform that seamlessly fuses virtual and physical realms.

The construction of off-campus internship bases needs to change the traditional university-led construction model, such as sole proprietorship models or university-enterprise cooperation, and instead aim to establish a shared off-campus internship base that integrates virtual and real elements, leveraging the existing facilities of enterprises or engineering centers. The construction of the 'shared' internship training base is led by the enterprise, and the ownership and use management rights are affiliated to the enterprise. The internship base's housing, software, and hardware facilities are shared by other universities and mechanical engineering majors, with peak internship management in place. Virtual teaching factory platform and virtual internship project.

5. Practical Achievements in the

Construction of Industry-Education Integration Internship Training Base

The college considers university-local and university-enterprise cooperation as one of its two pivotal development strategies, offering comprehensive organizational and systemic guarantees. A working group is established to review the base's development strategy, operation model, and medium- to long-term development plans, coordinating efforts among various units, organizing base project evaluations, and formulating and refining various systems for digital design and manufacturing training bases, thereby enhance departmental work coordination, and strengthen supervision of construction progress and quality. There are several achievements in this practice.

5.1 In-Depth Cooperation of Enterprises and Multi-Party Sharing Strategies

Leading enterprises engage in alliance operations, formulating digital talent standards. Meanwhile, digital technology companies contribute to technology development, offering digital upgrade solutions, while platform-based companies facilitate digital talent sharing, collectively meeting market demands.

universities and enterprises jointly invest in constructing hardware facilities at the training base, normalizing the two-way exchange of human resources, and sharing educational resources through production-education integration, thereby creating a comprehensive, networked, and information-rich sharing system. Implement management and sharing with 'dual subject'. A management committee will be jointly established to strengthen the management personnel of both universities and enterprises, jointly determine the management responsibilities of both universities and enterprises, and jointly improve the work procedures and assessment and evaluation methods of university and enterprises.

To achieve mutually beneficial results, thereby fostering a win-win situation for both parties. Coordinate the planning and cooperation of faculty between universities and enterprises, encompassing student and employee training, as well as course textbook development. Share the outcomes of the 'five batches' initiative for integrating industry and education, and collaboratively establish an online and offline platform for showcasing achievements.

5.2 Innovate Mechanism Paths and Highlight the Application of Results

Mechanism innovation - Establish a multi-level 'campus+park' industry-education integration mechanism. Taking into account the differentiated needs of different majors in the university for technical learning and labor skills, we are aimed at the 'compound' and 'innovative' applied talents training. In designing and implementing talent training plans, curriculum systems, and cross-college and cross-professional talent training models, universities such as Carnegie Mellon University, Wuhan University, and Nanchang University have demonstrated effective approaches to fostering interdisciplinary skills and labor competencies. We integrate labor factors into the applied technical talent training education system, and establish a cross-penetrating, multi-level '3455' education mechanism, while promoting the deep integration of labor education with professional education in a stratified and classified manner.

Path breakthrough - achieving a diversified labor application teaching model with deep integration. Focus on rural revitalization, emphasizing digital agriculture, digital rural areas, and nurturing new farmers, and work with local governments to integrate resources across fields, colleges and majors, enabling teachers and students to gain deeper insights into the countryside, engage in park activities, focus on key industries, and effectively serve the local community; facilitating a seamless connection between pastoral work, park production, and campus practice emphasis on all-round cultivation, and integrate comprehensive practical experience training throughout the education process to bridge the gap in talent cultivation.

Ecological chain construction - forming a multi-dimensional technical education ecological chain of 'creation and application of academia, production and application'. Local governments and enterprises introduce 'pastoral+park' resources to invigorate teaching elements, realizing a 'curriculum, research, park, base, and social teaching' structure that fosters production, creation, and application of technology, so that the theoretical and technological technologies learned on campus can be applied to innovative practices in the

production practice of the park, and technology is rooted in the pastoral land, allowing the 'two parks' to bloom scientific and technological power and realize the empowerment of industry and agriculture in science and technology.

5.3 Some Phased Results Achieved

There are 43 university-enterprise cooperation enterprises, with Geely being honored as the provincial demonstration base and Shuanglu earning the title of university-level demonstration base. Furthermore, it collaborated with Tairuisi to launch a specialized chip customization class. It won the third prize of Zhejiang Science and Technology Progress in the New Year. Additionally, it boasts one project of industry-university cooperation with the Ministry of Education, one project of collaborative education, one provincial natural science fund, and fifty horizontal projects. projects, and holds 10 invention patents. It has successfully developed water metering equipment, promoted digitalization in rural areas, implemented comprehensive reforms of agricultural water prices, enhanced rural drinking water engineering, and provided other technical services in over 400 villages in Ningbo and more than 700 villages in Taizhou. The organization has authored a 300,000-word monograph titled 'Research on Rural Drinking Water Safety Equipment and Operation Management'. It is entrusted by 10 counties and districts of Ningbo City and is widely utilized in 6 agricultural professional cooperatives in Ningbo City.

6. Summarize

An ecological alliance that integrates three scenarios of 'campus+park+countryside', solves the problem of 'one-head' cooperation between traditional university and enterprise, and forms a long-term mechanism for the coordination of government, universities, local and enterprise resources. The curriculum system is reconstructed with digitalization as the main line, and through the third-level training of 'basic sharing-special modularization-comprehensive practical' policy, the student's Technical application ability compliance rate has risen from 68% to 92%. , It has established a shared platform integrating virtual and real elements, serving

over 400 rural digital transformation projects in Ningbo City, generating a total of more than 200 million yuan in technology transformation benefits, and facilitating mutual value enhancement between the education chain and the industrial chain.

Looking ahead, it is imperative to extend the integration of '5G+Industrial Internet' into virtual training to enhance the quality and efficiency of skill development., improve the dynamic evaluation system, and promote the replication and promotion of the education model to colleges and universities in the central and western regions.

Acknowledgments

This paper is supported by Ningbo University of Finance and Economics School Teaching and Teaching Reform Project (No. 23xwkyb26).

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