Article

Research on the Construction of a "Dual-Qualified" Teaching Faculty through School-Enterprise Co-Cultivation

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Abstract: Based on synergistic theory and symbiosis theory, this study focuses on the construction of a "dual-qualified" teaching faculty in computer science programs at application-oriented undergraduate institutions. Through three major initiatives—an industry-college led multidimensional cooperation model, a dual-tutor studio system, and a two-way school-enterprise co-cultivation approach—a systematic training model characterized by "deep school-enterprise integration and resource sharing" has been developed. Practice has shown that this model significantly increases the proportion of dual-qualified teachers, enhances students' practical innovation capabilities, and markedly improves the social service function of the faculty. This research provides a replicable and scalable practice paradigm for industry-education integration, offering valuable insights for promoting the development of teaching faculties and talent training reforms in application-oriented universities.

Keywords: dual-qualified teachers; school-enterprise co-cultivation; application-oriented undergraduate universities; industry-education integration

1. Research Background

In 2018, the Notice of the Ministry of Education on Issuing the "Key Work Points of the Ministry of Education in 2018" and the Opinions on Comprehensively Deepening the Reform of the Construction of Teaching Staff in the New Era issued by national authorities explicitly stated: "Vigorously enhance the competence and quality of teachers, with a focus on improving the competence of 'dual-qualified' teachers, and build a high-quality teaching force of dual-qualified teachers.". In 2021, the General Office of national authorities issued the Opinions on Promoting the High-Quality Development of Modern Vocational Education, emphasizing: "Strengthen the construction of dual-qualified teaching teams, improve the integrated industry-education mechanism, adhere to the integration of industry and education and cooperation between schools and enterprises. Implement regulations on teachers' regular practice in enterprises, support technical backbones from enterprises to teach in schools, and promote the reform of teaching staff construction that combines fixed and mobile posts, as well as mutual part-time appointments between schools and enterprises." To further advance the construction of dual-qualified teachers in vocational education in our province, in accordance with the Notice of the General Office of the Ministry of Education on the Certification of Dual-Qualified Teachers in Vocational Education (Teacher's Office [2022] No. 2), the Department of Education of Jiangxi Province issued the Jiangxi Vocational Education Dual-Qualified Teacher Certification Standards (Trial) (Gan Jiao Zhi Cheng Zi [2023] No. 21) for application-oriented undergraduate universities and higher vocational colleges (including vocational undergraduate

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schools). School-enterprise cooperation and the enhancement of dual-qualified teacher quality have become one of the key development directions for application-oriented undergraduate universities.

As an application-oriented undergraduate institution, our college has been exploring industry-academia collaborative education in computer science since 2007, based on the actual development needs of the discipline. After over a decade of deep industry-academia collaboration, we have achieved certain results in student training models, while also identifying several issues. For instance, there is a significant de-engineering tendency among engineering faculty, characterized by outdated disciplinary knowledge, deficient technical application capabilities, lack of knowledge integration and interdisciplinary approaches, and insufficient innovation in education. These shortcomings have resulted in inadequate practical and problem-solving skills among students. The current situation, where the "dual-qualified" competence of the teaching team is weak and its structural composition is irrational, is highly inconsistent with the requirements for building a "dual-qualified" teaching force amid the transformation and development of higher education.

Research on "industry-academia collaboration" has achieved certain results both domestically and internationally. For instance, Yang Song and Yang Dawei, pointed out that cross-disciplinary training is an effective approach to address the shortage of dual-qualified teachers in local institutions. They emphasized achieving deep industry-academia integration by constructing a curriculum system with cross-professional characteristics and establishing a field-based teaching environment that integrates work and learning [1]. Ren Molin, from the perspective of industry-academia collaboration, argued that the cultivation of dual-qualified teachers should draw on the experiences of developed countries, focusing on the integration of theory and practice to enhance teachers' teaching and practical capabilities [2]. Li Yan, further proposed that although the number of dual-qualified teachers has met national requirements, their practical capabilities still need improvement. She recommended precisely enhancing teachers' competencies through tiered and categorized training standards and the incorporation of enterprise evaluation systems [3]. Xu Lijuan and Zhang Yiwen, based on symbiosis theory, analyzed issues such as insufficient endogenous motivation of symbiotic elements in industry-academia joint training programs. They proposed stimulating the symbiotic drive between educational institutions and enterprises through institutional optimization and environmental cultivation [4]. Su Jian et al., from the perspective of industrial colleges, emphasized enhancing the integration and practical capabilities of dual-qualified teachers through the practical path of "one center, dual management, three educational reforms, and five platforms" [5]. Zhang Shurong et al., taking maritime-related universities as an example, proposed that industry-academia collaboration should focus on social resources and construct a symbiotic support system serving the development of dual-qualified teaching teams, thereby addressing the higher demands of industrial upgrading on talent cultivation [6]. Through international comparative studies, Wu Fanghong, emphasized the irreplaceable role of enterprises in cultivating dual-qualified teachers. She proposed transforming traditional perceptions of the teaching profession and establishing a robust policy guarantee system [7]. Wang Hui, from the perspective of high-quality development, proposed that synergy theory provides scientific guidance for the cultivation of dual-qualified teachers. She emphasized constructing a collaborative industry-academia training model through three dimensions: training philosophy, competency structure, and operational system [8]. Ning Jinye et al., based on synergy theory, suggested promoting the cultivation of high-level dual-qualified teachers by improving the policy system, establishing a collaborative training mechanism, and building a support system [9]. Zheng Zhengbing et al., using electronic information majors as an example, emphasized that industry-education integration serves as a crucial approach for building dual-qualified teaching teams. They proposed optimizing the teaching team structure through resource sharing, establishing joint training platforms, and collaboratively developing evaluation and incentive mechanisms [10]. Zhang Zhirong, analyzed the current state of professional development of dual-qualified

teachers in vocational institutions and proposed that, under the context of industry-education integration, it is essential to build a dual-qualified teaching team that possesses both theoretical teaching competence and practical teaching capabilities [11].Kong Lingyu et al., through empirical research, verified the effectiveness of the "Four Modernizations" mechanism in the construction of dual-qualified faculty teams at local undergraduate institutions, demonstrating its significant role in enhancing teachers' instructional level and comprehensive competence [12]. Li Gongfa et al., pointed out that local undergraduate universities face challenges such as unclear understanding of the conceptual essence and structural imbalance in their dual-qualified faculty development. They proposed improvements in three key areas: evaluation standards, structural configuration, and professional training [13]. Liu Xiaoli, taking local vocational colleges in Hunan Province as a case study, suggested addressing the difficulties in constructing dual-qualified teaching teams through resource integration, mutually beneficial school-enterprise cooperation, and policy support mechanisms [14]. Deng Ping et al., under the background of New Agricultural Sciences, explored innovative development approaches for constructing dual-qualified teaching teams in agriculture-related majors at local institutions. They emphasized the importance of increased investment, establishing cooperation mechanisms, and exploring innovative teaching models [15]. Zhang Haimei, investigated pathways for cultivating dual-qualified teachers at local application-oriented undergraduate universities from both governmental and institutional perspectives. She proposed improving training models by drawing on experiences from Germany and Australia [16]. Chi Shuo and Huang Yue, based on the context of New Liberal Arts, proposed that the construction of dual-qualified college English teacher teams in local universities should emphasize practicality, specialization, and vocational orientation to facilitate the cultivation of application-oriented English talents [17]. Zhang Jianjun et al., analyzed the challenges faced in the high-quality development of dual-qualified teacher teams in local vocational colleges and suggested overcoming these developmental bottlenecks through government policy guidance, institution-led collaborative development, and support from industries and enterprises [18]. Li Yiyi, from the perspective of industry-education integration, proposed that the training system for dual-qualified teachers in local application-oriented universities should integrate theory and practice to promote educational development [19]. Chen Fengzhen et al., taking the food science program at Heze University as an example, suggested that the construction of dual-qualified teacher teams in local application-oriented undergraduate institutions should focus on faculty transformation to enhance educational quality [20]. Liang Ji, using the electronic information-related majors at Guangxi Normal University for Nationalities as a case study, explored pathways for constructing dual-qualified teaching teams in local application-oriented undergraduate universities in border regions, providing reference for other higher education institutions [21].

In summary, existing research provides important theoretical foundation and practical references for the construction of "dual-qualified" teaching teams from multiple dimensions, including policy interpretation, model construction, and mechanism innovation, particularly emphasizing the core role of industry-academia collaboration in enhancing teachers' practical capabilities and optimizing team structure. However, most studies still focus on macro-level mechanism discussions. There remains a noticeable gap in research addressing the challenges of building "dual-qualified" teaching teams in specific disciplines (such as computer science) within application-oriented undergraduate institutions during deep industry-academia integration—particularly regarding systematic solutions to practical problems like weak engineering competencies and structural imbalances among teachers, based on long-term collaborative practices.

Based on this, this paper builds upon our institution's more than decade-long foundation and practical challenges in industry-academia collaborative education in computer science. Focusing on the core pathway of "joint industry-academia cultivation," it aims to explore a sustainable and efficient model for developing dual-qualified teaching teams that aligns with the characteristics of application-oriented undergraduate universities.

This research seeks to address the gaps in existing studies regarding micro-level practical implementation and disciplinary specificity, while providing empirical cases and solutions for reference by similar institutions.

2. Theoretical Basis

The development of a "dual-qualified" teaching team requires not only innovative mechanisms at the practical level but also solid theoretical foundations. Synergy theory and symbiosis theory provide crucial academic rationale and analytical frameworks for industry-academia collaborative education, profoundly guiding the pathway design and institutional construction for cultivating dual-qualified teachers.

The guiding role of synergy theory in cultivating dual-qualified teachers has become increasingly prominent. Proposed by German physicist Hermann Haken, this theory emphasizes that subsystems within a system can achieve evolution from disorder to order through mutual collaboration and the formation of order parameters, thereby generating a synergistic effect where "1+1>2". In the cultivation of dual-qualified teachers, higher education institutions and enterprises, as two heterogeneous subsystems, achieve resource interoperability and capability coupling through collaborative initiatives such as establishing industry-academia colleges, forming joint teaching teams, and engaging in cooperative technology research and development. This process ultimately enhances the overall systemic effectiveness. Guided by synergy theory, educational institutions and enterprises collaboratively formulate training objectives, co-design curriculum systems, jointly implement project-based teaching, and cooperatively evaluate educational outcomes. This approach promotes the formation of a deeply integrated training ecosystem involving "universities-enterprises-teachers." Its core lies in breaking down organizational barriers and stimulating synergistic effects, enabling teachers to receive systematic support in the integrated development of teaching capabilities and engineering practical skills, thereby achieving comprehensive enhancement of dual-qualified competencies.

Symbiosis theory similarly provides an important theoretical foundation for industry-academia collaborative education. Originating from biology and proposed by German mycologist Anton de Bary, this theory has been widely applied in social sciences to describe stable relationships between different organizations based on mutually beneficial cooperation. In the process of jointly cultivating dual-qualified teachers, universities and enterprises form typical symbiotic units: higher education institutions rely on enterprises for technological resources, practical scenarios, and innovation projects, while enterprises leverage universities' talent reserves, knowledge achievements, and teaching-research support. Through the exchange of materials, information, and energy, both parties establish a mutually beneficial and synergistic development relationship.

Symbiosis theory emphasizes that a healthy symbiotic system must possess three essential elements: a well-defined symbiotic interface, a rational benefit distribution mechanism, and a sustainable symbiotic environment. This principle guides us in the process of developing dual-qualified teachers, necessitating the establishment of institutionalized collaboration platforms, improvement of dual-mentor management mechanisms, and creation of achievement sharing and feedback systems. These measures ensure the stability and continuity of industry-academia collaboration, thereby promoting the evolution of dual-qualified teacher development from a "mechanical combination" to an "organic integration."

Although synergy theory and symbiosis theory differ in their emphases—the former focusing on integration and collaboration mechanisms, while the latter emphasizes mutual benefit and interdependence—both point to the necessity and feasibility of deep industry-academia integration. Together, they provide a systematic and scientific theoretical framework for cultivating dual-qualified teachers. Within this framework, the development of dual-qualified teachers is no longer merely a matter of teacher training, but

rather a systematic project involving system construction, mechanism design, and institutional innovation. Fundamental breakthroughs must be achieved through collaborative interactions and symbiotic evolution among multiple stakeholders.

3. Main Measures for the Construction of a "Dual-Qualified" Teaching Faculty

3.1. Industry College-Led Multidimensional Cooperation Model

The three-dimensional cooperation model led by the industrial college takes the joint construction of the Artificial Intelligence and Big Data Industrial College as the core carrier. It has systematically established a "curriculum development center + project training base + technology R&D platform" trinity collaborative education framework in conjunction with leading enterprises such as Huawei Cloud and Baidu Intelligent Cloud. The curriculum development center, jointly established by enterprise engineers and university teachers as the teaching team, is oriented to real industrial needs and technological evolution. It collaboratively develops modular project courses, loose-leaf teaching materials and training guides, and integrates enterprise certification systems and industry standards into talent training programs to achieve close alignment between curriculum content and post capabilities. Relying on real data, cases and development environments provided by enterprises, the project training base builds highly simulated engineering scenarios. Under the joint guidance of enterprise mentors and on-campus teachers, students carry out project training in teams, participating in the full-process practice from demand analysis, scheme design to system implementation and deployment, which significantly improves their engineering practice and innovation capabilities.

The technology R&D Platform focuses on applied research and collaborative innovation in the fields of artificial intelligence and big data. The platform encourages teachers to lead students in participating in enterprise technical research and horizontal projects. It promotes the transformation of research achievements into teaching resources, forming a closed-loop mechanism of "teachers' enterprise practice - real project R&D - teaching case transformation". This effectively feeds back into teaching, promotes the improvement of teachers' capabilities and discipline development, and thus facilitates the cultivation of dual-qualified teachers.

3.2. Dual-Tutor Studio System

The dual-tutor studio system is an important mechanism to deepen industry-education integration, promote school-enterprise collaborative education, and facilitate the training of dual-qualified teachers. It specifically achieves two-way integration, resource sharing, and capability complementarity through the establishment of "Enterprise Tutor In-Campus Studios" and "Teacher In-Enterprise Workstations".

The "Enterprise Tutor In-Campus Studios" hire senior enterprise engineers or technical backbones to be stationed on campus regularly, introducing real industrial projects, case materials, and technological processes into classroom teaching and practical links. Enterprise tutors not only participate in curriculum design and joint teaching, but also guide students in project-based learning, graduation design, and innovative practice, helping students adapt to the enterprise environment in advance, master practical skills, and strengthen their engineering practice and innovation capabilities.

Correspondingly, the "Teacher In-Enterprise Workstations" encourage university teachers, especially young teachers, to go deep into cooperative enterprises. Relying on the actual technical needs and technical difficulties of enterprises, they form teacher-student teams to jointly participate in technical research, product development, and process optimization. Teachers accumulate first-hand experience, update their knowledge structure in enterprise practice, and transform real enterprise problems into teaching cases and research topics, realizing mutual improvement in teaching and research feeding back into teaching.

Through the closed-loop design of "enterprises entering classrooms, teachers entering enterprises, projects entering courses, and students entering teams", the system constructs an integrated collaborative training model of "teaching-research-production", which effectively improves the training quality of applied talents, teachers' engineering practice and teaching capabilities, while enhancing enterprises' sense of gain and sustainability in participating in education.

3.3. Two-Way School-Enterprise Co-Cultivation Construction

On one hand, university teachers adopt the "teacher first, then position" approach. University teachers already hold teacher qualification certificates; to enhance their "dual-qualified" competence, measures such as "skill training, job rotation, entrepreneurship, and certificate examination" are implemented to improve their engineering practice capabilities. Specifically, a talent exchange mechanism between the university and enterprises is established. Relying on the school-enterprise cooperation platform, teachers receive further training. A system is put in place for university teachers to regularly participate in skill training and on-the-job training at enterprises. Professional teachers are organized to take turns working at enterprises on a temporary basis. Teachers are encouraged to start businesses using the school-enterprise cooperation platform and obtain senior certificates in relevant majors. By participating in production, R&D, and technological innovation at enterprises, teachers can truly improve their engineering practice abilities.

On the other hand, enterprise teachers adopt the "position first, then teacher" approach. Enterprise teachers already hold engineer qualification certificates and have strong engineering practice capabilities, but compared with university teachers, their theoretical foundation and teaching ability need improvement. To enhance their "dual-qualified" competence, training methods such as "teacher training, further study, certificate examination, and substitute teaching" are adopted. That is, using the school-enterprise cooperation platform, enterprise teachers receive necessary teacher skill training and relevant further education, and are encouraged to obtain higher education teacher qualification certificates. Enterprise teachers are also invited to teach together with university teachers at the school to improve their teaching ability.

The "school-enterprise co-cultivation and two-way construction" method helps strengthen the "dual-qualified" competence of both university and enterprise teachers. The integration of university and enterprise teachers is conducive to realizing human resource sharing and achieving a win-win situation for both parties.

4. Implementation Effectiveness

The above-mentioned measures for building a dual-qualified teacher team have achieved remarkable results in teacher team construction, talent training, and social services. In terms of teacher structure, the proportion of dual-qualified teachers has increased significantly, from 12% in 2022 to 67% in 2025, reflecting the overall improvement in the ability of the teacher team to integrate engineering practice and teaching, and making the teacher team more in line with the needs of applied talent training. The enterprise satisfaction survey on school-enterprise cooperation shows a satisfaction rate of 92%, indicating that enterprises highly recognize the university's organizational management, student training quality, and cooperation depth in the process of school-enterprise collaborative education.

Students' practical and innovative abilities have also been substantially improved. In recent years, current students have won 13 national awards, 89 provincial first prizes, and 134 other awards in professional competitions, demonstrating significant progress in students' comprehensive quality and innovative abilities under the project-driven teaching model.

Teachers' social service functions have been significantly enhanced. In recent years, through deepening industry-university-research cooperation and actively responding to

the needs of regional economic and industrial development, they have undertaken a large number of horizontal projects related to technology development, technical services, and achievement transformation that meet the actual needs of enterprises. Up to now, the accumulated funds received for horizontal scientific research projects have reached 13.64 million yuan, covering multiple fields such as information technology, artificial intelligence, ecological protection, and educational innovation. This fully reflects the ability of the teacher team to respond to social needs and solve practical problems. This cooperation has not only promoted enterprise technological upgrading and product innovation but also effectively accelerated the transformation of university scientific research achievements into real productive forces, enhancing the university's influence and contribution in local areas and industries.

In summary, the measures for building a dual-qualified teacher team have not only optimized the teacher structure and improved the quality of talent training but also significantly enhanced the university's social service capabilities and regional influence, providing a successful practical example for the reform and development of application-oriented universities.

5. Conclusion

This paper systematically elaborates on the three core measures and practical effects of the construction of the "dual-qualified" teacher team in our university. By building a "three-dimensional cooperation model led by industrial colleges", the university has jointly established curriculum development centers, project training bases and technology R&D platforms with enterprises, realizing the in-depth integration of the education chain, industrial chain and innovation chain. The "dual-tutor studio system" has formed an integrated collaborative system of "teaching-research-production" by setting up enterprise tutor in-campus workstations and teacher in-enterprise practice mechanisms, significantly improving the engineering practice and innovation capabilities of teachers and students. The "school-enterprise co-cultivation and two-way construction" program has effectively promoted the complementary and integration of capabilities between university teachers and enterprise engineers through the dual-path training mechanism of "teacher first, then position" and "position first, then teacher".

In terms of implementation effects, the proportion of dual-qualified teachers has increased significantly, and key indicators such as school-enterprise cooperation satisfaction, students' awards in competitions and funds for horizontal projects have made breakthrough progress, fully verifying the significant effects of the above measures in optimizing the teacher structure, improving the quality of talent training and enhancing social service capabilities. This study provides a replicable and promotable practical paradigm for application-oriented universities to deepen industry-education integration and build a high-level dual-qualified teacher team, which has certain reference value and promotion significance.

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