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Cultivation Path of Practical Innovation Capability for Chinese Professional Degree Postgraduates: An Industry-Education Integration Perspective

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Abstract: *Practical innovation capability is an essential quality for professional degree postgraduates and a foundational aspect of their professional development. Focusing on the mechanism of industry-education integration and the goal of cultivating professional degree postgraduates, this paper analyzes the current status and deficiencies in nurturing practical innovation capabilities based on the concept of collaborative education. It proposes pathways for developing these capabilities through various dimensions, including cultivation mechanisms, curriculum systems, educational resources, mentorship teams, evaluation systems, and external environments.*

Keywords: *Collaborative education; Professional degree postgraduates; Practical innovation capability; Cultivation path*

1. Introduction

Professional degree postgraduate education plays a vital role in higher education, nurturing individuals with advanced practical skills and management abilities. Unlike academic postgraduates, professional degree postgraduates focus on practical skills, innovation, and professional competencies. As outlined in the Ministry of Education's document "Several Opinions on the Cultivation of Full-time Master's Degree Postgraduates," there is an emphasis on enhancing the practical and applied training, aiming to produce high-level, application-oriented specialists [1]. By fusing application-oriented talent development with collaborative education systems and linking the training of professional degree postgraduates with practice and innovation, universities can fulfill societal demand for high-quality professionals.

Establishing relationships with local governments, businesses, and other stakeholders to combine resources and construct a multi-dimensional collaborative industry-education integration framework can offer students comprehensive training resources and broader developmental opportunities. This approach promotes continuous growth through practice and research, preparing students for their future careers. This industry-education integration and collaborative education system are vital for enhancing the practical innovation capabilities of professional degree postgraduates, thereby improving their professional competitiveness and adaptability [2].

2. Overview of Collaborative Training for Professional Degree Postgraduates

Collaborative education integrates resources from businesses, industries, universities, and other societal entities, capitalizing on their complementary strengths. Driven by the needs of businesses and industries and supported by the educational and research capabilities of universities and research institutions, the ultimate goal is to develop high-level, application-oriented professionals through collaborative industry-education integration [3].

Industry-education integration is a primary implementation tool for the collaborative education mechanism and a crucial pathway for cultivating professional degree postgraduates. It combines resources to foster technological innovation, merging industry development, technology research and development, and academic education. This methodology emphasizes core technologies, pooling faculty, high-level talent, and industry experts. It promotes technological innovation in training and incorporates various activities into technological development and innovation processes, forming a training model

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centered on practical innovation [4].

The cultivation of practical innovation capabilities for professional degree postgraduates through the collaborative education system has training mechanisms. These mechanisms allow for interaction with professionals from various fields, gaining practical experience and knowledge, enhancing their practical innovation capabilities. By aligning postgraduate development directions and integrating school and external resources into the curriculum, a novel curriculum system is formed, stimulating postgraduate interest and creativity, ultimately improving their practical innovation capabilities.

3. Current State of Collaborative Cultivating Practical Innovation Capabilities in Professional Degree Postgraduates

3.1. Achievements in Collaborative Cultivating Practical Innovation Capabilities

3.1.1. Initial Formation of a Collaborative Education System

Universities have recently begun to expand beyond traditional university-enterprise cooperation, incorporating industrial resources, research institutions, and other societal forces to strengthen collaborative education. This approach has led to the development of a distinct professional degree postgraduate training mechanism that prioritizes the cultivation of practical innovation capabilities. The currently established collaborative education system encompasses two main aspects:

• Close Communication and Interaction among Stakeholders: Universities invite experts from enterprises, professional technicians, and academic experts from research institutions to deliver lectures, participate in practical training activities, and serve as project advisors for postgraduates. Universities assign postgraduate advisors and research group teachers to enterprises, industries, and regional departments to understand their development needs and organize collaborative projects. This interaction encourages regional industrial development and the transformation of core technologies, creating long-term, stable partnerships, and using regional enterprise and industry growth as a platform for developing practical innovation capabilities in postgraduates.

• Establishment of Joint Training Platforms: Universities have created joint training platforms for professional degree postgraduates through close collaboration and communication among universities, enterprises, and regional industry personnel. These platforms form “dual-mentor” research groups to undertake project development and technical exchanges. This approach not only enhances the practical skills and innovation awareness of postgraduates but also promotes enterprise and regional industrial development. The entire collaborative education system significantly strengthens the ties and interactions between universities and society, laying a solid foundation for cultivating more outstanding and practical talents.

3.1.2. Initial Achievements in Industry-Education Integration

The foundation of multi-dimensional collaborative education has led to numerous cooperative projects, benefiting both the technical proficiency and practical skills of professional degree postgraduates and fostering enterprise product development and industrial upgrading.

Many teacher training institutions, in collaboration with local education bureaus and various primary and secondary schools, have jointly researched and promoted diverse teaching models, especially focusing on educational reform and development in rural areas, yielding significant results [5]. These collaborative projects enhance the educational and teaching capabilities of education master’s degree postgraduates while advancing the overall progress and development of the educational profession and teaching faculty.

Moreover, numerous engineering universities have partnered with enterprises and industry departments to establish engineering monitoring centers, maintaining long-term cooperation to meet the technical research and practical innovation needs of professional degree postgraduates. This collaboration has consistently produced high-quality, versatile talents. Examples of such collaborations can be seen in the field of electronic information, where electronics companies have partnered with domestic engineering universities to establish professional degree postgraduate programs and joint research centers or laboratories. These partnerships focus on researching and developing electronic components and circuit designs, with notable collaborations between companies such as Huawei, ZTE, Ericsson, and FiberHome, and universities like Beijing Institute of Technology, Xi’an Jiaotong University, and Nanjing University of Posts and Telecommunications [6]. In the automotive manufacturing field,

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universities such as Tongji University, South China University of Technology, and Southeast University have engaged in industry-university-research collaborations with domestic automotive enterprises like SAIC, FAW, and BYD. These collaborations focus on the research and development of new energy vehicles, safety driving technologies, and vehicle networking technologies, driving significant advancements in these areas [7].

3.2. Deficiencies in Collaborative Cultivating Practical Innovation Capabilities

Despite the initial achievements in cultivating practical innovation capabilities through collaborative education, several deficiencies persist.

3.2.1. Lack of Flexibility in Curriculum Design

The introduction of the collaborative education mechanism has significantly improved the curriculum design and content for professional degree postgraduates. There is an increase in courses emphasizing practical skills and applications, and the inclusion of high-level industry experts has broadened students' horizons, exposing them to cutting-edge professional technologies. However, some schools encounter limitations when collaborating with enterprises, leading to a restricted range of curriculum offerings. Moreover, although enterprises can offer extensive practical experience and training opportunities, they may lack the necessary teaching resources to deliver the required courses, further constraining the flexibility of curriculum design [8].

Collaborative education represents a more advanced form of cooperation than traditional university-enterprise collaboration, aiming to cultivate high-level, multidisciplinary, and application-oriented talents. While considering enterprise needs and market conditions, it is crucial to ensure the quality of education and the holistic development of students. On this basis, it is essential to develop more flexible and diverse curriculum designs. Emphasizing the integration of industry and education, curriculum development should involve extensive cooperation with research institutions, enterprises, and regional departments to fully utilize available resources, making the curriculum content richer and more practice-oriented.

3.2.2. Non-Standardized Mentor Teams

In the mentor setup for professional postgraduates, the mentor responsibility system is adopted, where mentors are expected to focus on enhancing postgraduates' practical, hands-on, and innovative abilities. Typically, professional degree postgraduates are assigned two mentors: one from within the university and one from outside. However, many universities emphasize building the internal mentor team while neglecting the importance of external mentors. There is no explicit requirement for research institution personnel or enterprise staff to serve as part-time external mentors, leading to some external mentors lacking the qualifications to effectively nurture practical innovation capabilities in postgraduates [9].

Moreover, in many universities' collaborative education mechanisms, internal and external mentors operate independently, fulfilling their educational duties without adequate communication and collaboration regarding individual students' situations. This lack of coordination hampers the cultivation of practical innovation capabilities in professional degree postgraduates.

3.2.3. Superficial Implementation of Collaborative Education Practices

The practice component is vital for developing the practical innovation capabilities of professional degree postgraduates. During this process, educators should integrate resources from various collaborative education partners, designing activities that include robust professional backgrounds, necessary technical training, and the incorporation of the latest research results. Postgraduates should apply theoretical knowledge, methods, and technologies to solve real-world problems and innovate in technology application methods.

However, there is often a disconnect between educational resources and industry needs, resulting in a gap between practical work demands and theoretical teaching content. This disconnect makes it challenging for some internal faculty to organize practice activities that align with actual work processes. Additionally, many external mentors face busy work schedules and time constraints, and they may lack trust in students, fearing mistakes during practical work that could lead to risks. Consequently, they may be unable or unwilling to provide sufficient practical opportunities for students. These factors result in practice activities during professional degree postgraduate training becoming superficial, often reduced to demonstrative teaching that fails to genuinely inspire students' research interest and innovation spirit, lacking an environment conducive to independent practice and innovation [10].

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Furthermore, the evaluation mechanism for practice components has its shortcomings. It tends to be formalistic, lacking comprehensive assessment and guidance of the practice process. Current evaluation mechanisms focus more on assessing students' theoretical application, teamwork, and originality, rather than thoroughly evaluating the development of their practical and innovative abilities. This further exacerbates the superficial nature of practice training.

4. Pathways for Collaborative Cultivating Practical Innovation Capabilities in Professional Degree Postgraduates

4.1. Systematization of Training Mechanisms to Standardize the Cultivation of Practical Innovative Capabilities

To better achieve the educational objectives for professional degree postgraduates and enhance their practical innovation capabilities, a comprehensive and robust training mechanism must be established and perfected.

First, it is essential to clearly define the training objectives, with practical innovation capabilities as the core goal. The integration of industry and education should be leveraged as a crucial method for collaborative education in cultivating professional degree postgraduates. This involves formulating relevant teaching policies that align with the training orientation and educational direction of higher education institutions, considering national strategies, social production, and industrial development needs. The objectives should permeate the curriculum design, adjustments in the course system, the implementation of teaching activities, the integration of teaching resources, and the construction of infrastructure. When establishing these goals and teaching policies, the suggestions and requirements of the government and enterprises should be considered to meet the demands of high-quality industrial development. This approach also provides more practical opportunities for postgraduates, enhancing their practical skills and application levels.

Second, it is necessary to design stringent selection and diversion mechanisms, set assessment targets and indicator systems, and adjust the assessment focus according to different disciplines, gradually diverting those unsuitable for professional degrees. The selection and diversion mechanisms should incorporate the opinions of enterprises or laboratories, taking into account their requirements for postgraduate capabilities and setting corresponding assessment targets and indicators. This alignment with industry development needs, along with the support and opportunities for practical training from enterprises or laboratories, can significantly enhance postgraduates' practical innovation capabilities. Increasing the academic pressure on postgraduates can stimulate their motivation for self-development in innovative practices, thereby strengthening the synergistic effect of the entire education system.

Third, establishing practical teaching platforms and innovation bases is crucial for providing practical training opportunities and resource support. Creating an environment conducive to teaching and learning can stimulate postgraduates' awareness and capability for innovation and entrepreneurship, enhancing their practical application skills and problem-solving abilities, and laying a solid foundation for their future career development. Collaboration with enterprises or laboratories can facilitate the sharing of teaching resources and infrastructure, creating practical teaching bases on platforms of university-enterprise cooperation. This collaboration offers excellent practical environments and spaces for students, providing more genuine internship opportunities and project collaborations, promoting the integration of resource advantages. Additionally, establishing standardized management mechanisms that align with collaborative education, including forming management teams and detailed management regulations for practical teaching platforms and innovation bases, is essential for ensuring their effective operation and sustainable development.

In summary, clear objectives, stringent selection and diversion mechanisms, and the establishment of practical teaching platforms and innovation bases can build an efficient collaborative education mechanism. This not only enhances professional degree postgraduates' practical innovation capabilities but also lays the groundwork for cultivating elite talents with innovative and entrepreneurial spirits.

4.2. Flexibility in Curriculum System to Enrich the Collaborative Education Process for Postgraduates

Addressing the current inflexibility in the curriculum system for professional degree postgraduates necessitates the introduction of a dynamic adjustment mechanism, allowing for flexible adjustments to

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course content and hours based on actual needs.

On one hand, the curriculum systems for professional degree postgraduates should be distinct from those of academic degree postgraduates, emphasizing the "practical capabilities" requirement for the former. Courses should be application-oriented, with a significant proportion dedicated to practical training. High-level industry executives and management personnel should be invited to deliver lectures, enhancing students' practical application skills. Furthermore, elective and supplementary courses conducted by industry experts can expose students to cutting-edge professional technologies, broadening their horizons and meeting their developmental needs.

On the other hand, a dynamic adjustment mechanism for course design should be established, involving regular evaluations of course settings and content based on student feedback and course effectiveness. This mechanism ensures the practical relevance and targeted nature of the curriculum. A robust course evaluation system is necessary to regularly assess existing courses, understand their teaching effectiveness and market demand, and optimize and improve courses based on these evaluations. When designing courses, close collaboration with enterprises and industry-related institutions is essential to understand market demand trends, jointly discuss course design, and timely adjust course settings to ensure alignment with market needs.

In summary, the training plans, curriculum systems, and course content for professional degree postgraduates should not remain static. Leveraging the advantages of collaborative education, it is vital to stay attuned to industry development trends and market demands, designing course content scientifically and reasonably, adjusting course settings promptly, and optimizing training plans to form a curriculum system centered on cultivating practical innovation capabilities.

4.3. Enrichment of Educational Resources to Build Platforms for Developing Postgraduates' Innovation and Practical Capabilities

To effectively cultivate the practical innovation capabilities of professional degree postgraduates, it is necessary to integrate resources from schools, governments, industries, and enterprises, establishing a collaborative education model that is "school-led, industry-guided, enterprise-assisted."

First, the leading role of schools in collaborative education should be fully emphasized to ensure the orderly operation of platforms for developing postgraduates' innovation and practical capabilities. As the primary site for education and teaching, schools should meticulously fulfill their educational responsibilities, developing feasible training plans based on students' actual conditions and needs, and offering core professional courses to help postgraduates systematically master professional knowledge and build a solid professional foundation. A well-structured curriculum can provide professional faculty and quality educational resources, enhancing postgraduates' learning abilities and competitiveness. Schools should also guide and coordinate the collaborative education system's participants, integrating resources from enterprises, social organizations, and other educational institutions to offer more practical opportunities and project participation, helping postgraduates better understand professional knowledge and improve practical skills.

Second, the guiding role of the industry in collaborative education should be actively utilized to align the cultivation of postgraduates' Practical Innovative Capabilities with industry and enterprise needs. The training of professional degree postgraduates should rely on industry advantages, leveraging the industry's guidance and leadership in curriculum development, evaluation standards, internships, and faculty teams to enhance postgraduates' innovation and practical capabilities and comprehensive quality. For instance, industry experts can be invited to give lectures on industry trends and challenges, providing comprehensive industry knowledge to postgraduates; successful or failed industry cases can be used as teaching cases for analysis, helping postgraduates learn from experiences and improve their Practical Innovative Capabilities; and collaborating with top industry institutions on cutting-edge research projects can allow postgraduates to grasp the latest research results and technological applications in the industry, enhancing their research and practical skills.

Third, the collaborative education model should maximize the assistance benefits from enterprises, ensuring the cultivation of postgraduates' innovative capabilities is grounded in practical experience. Enterprises can provide practical opportunities such as internships, visits, and observations, allowing students to experience industrial environments, understand real work content and processes, and gain practical experience; they can also offer technical support for student projects, facilitating experimentation and research in real or simulated environments; and enterprise technical staff can serve as mentors, offering professional guidance and assistance, jointly exploring and solving production

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practice issues, thus enhancing practical capabilities. By participating in this mechanism, enterprises not only help cultivate high-level talents but also benefit from an increased talent pool, and their employees can improve their professional skills, thereby enhancing the enterprise's core competitiveness.

4.4. Continuously Optimize the Structure of the Mentor Team to Enhance the Quality of Innovation Talent Cultivation

To better cultivate innovative talent, it's crucial to explore diversified mentor team-building models, scientifically adjust the structure of the teacher team, improve teacher training mechanisms, and enhance teaching and guidance levels. These steps will help foster the Practical Innovative Capabilities of professional degree postgraduates.

First, improving the mentor training and evaluation mechanism is essential to elevate their educational and guidance standards, promote their career development, and ensure the quality of professional degree postgraduate training. Mentors should understand their educational and guidance responsibilities, particularly the specific requirements and characteristics of professional degree postgraduates, to provide responsible and effective guidance. Additionally, mentors must continuously improve their teaching and guidance skills by learning new knowledge, techniques, and methods and applying them in their work to offer better guidance and services to postgraduates.

Second, focus on building a high-quality "dual-qualified" team, which forms a solid foundation for cultivating high-quality professional talents needed for an innovative nation. The "dual-qualified" team in universities consists of educators who have both industry background and teaching experience. They can combine their industrial experience with teaching expertise to provide more practical and in-depth education to professional degree postgraduates and guide them in innovation through practical experience. Schools should encourage mentors to engage in frontline production, solving specific technical problems for enterprises while continually honing and enhancing their practical skills. This "dual-qualified" team development strongly supports the cultivation of practical innovation capabilities in professional degree postgraduates under the collaborative education mechanism.

Third, attracting experienced experts, scholars, and enterprise personnel as part-time external mentors enriches the mentor team and optimizes its structure. These external mentors, with extensive practical experience and professional skills, often come from diverse industry sectors with different backgrounds. They can offer more practical and innovative projects, promote interdisciplinary exchange and cooperation, and broaden the academic vision and professional skills of postgraduates. Furthermore, external mentors usually have wide professional networks, helping students establish connections and access more internship and job opportunities, enhancing their employability. Universities should also strengthen the assessment and management of part-time external mentors to ensure they possess excellent teaching and guidance abilities, industry experience, and research directions aligned with the university’s teaching and research goals.

Finally, enhancing the collaboration between internal and external mentors ensures that postgraduates receive comprehensive, systematic, and structured training in practical innovation capabilities. Establishing a "dual-mentor communication" system allows internal and external mentors to discuss individual postgraduates' situations, identify their strengths and weaknesses, and jointly formulate collaborative education goals. This collaboration should focus on aligning teaching resources and designing educational activities around the course objectives to provide precise training services for postgraduates.

Such a collaborative education mechanism will optimize postgraduate professional learning, innovation practice, and capability development, fostering deep cooperation and exchange between internal and external mentors and enhancing the scientific and complete structure of the mentor team.

4.5. Continuously Improve the Evaluation System to Motivate Postgraduates to Enhance Their Practical Innovative Capabilities

A comprehensive course evaluation system is crucial for improving educational outcomes. It helps assess the quality of education, refine teaching methods, and promote bidirectional communication between teaching and learning, effectively motivating professional degree postgraduates to enhance their Practical Innovative Capabilities.

An evaluation system aligned with the collaborative education curriculum and teaching model should be established, with guiding evaluation indicators that reflect the growth of practical innovation

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capabilities and direct postgraduates to strengthen their practical, innovative, and application skills. In designing the evaluation system, consider setting teaching evaluation indicators for enterprise part-time mentors, evaluation indicators for students' participation in technical development projects, and personal innovation and development evaluation indicators. For example, students might be required to develop and document their innovative ideas and reflections upon completing each research phase or to write practice logs describing and analyzing encountered problems. This quantifiable and visual evaluation system helps avoid superficial teacher evaluations and provides a basis for assessing students' growth in practical innovation capabilities.

Additionally, strengthening the evaluation and feedback of practical components ensures that practical teaching effectively enhances professional degree postgraduates' Practical Innovative Capabilities. For various practical components, especially those involving enterprise collaboration, establish scientific and reasonable evaluation indicators, including practical skills, practice quality, outcome production, team collaboration, and communication skills. Provide timely feedback on evaluation results to students, mentors, enterprises, and training institutions to facilitate the improvement and enhancement of practical activities. These evaluation and feedback measures not only motivate postgraduates to improve their Practical Innovative Capabilities but also help mentors better guide students and continuously innovate and refine practical teaching.

4.6. Create a Favorable External Training Environment to Form a Collaborative Education Synergy

To better achieve the collaborative education goal of enhancing professional degree postgraduates' practical innovation capabilities, a favorable external training environment must be created by fully mobilizing the collaborative education resources and forming a concerted effort.

On one hand, the guiding role of local governments should be leveraged to actively implement industry-education integration policies. From the school’s perspective, it is important to strengthen connections with regional departments, research institutions, educational departments, and other administrative bodies, continuously promoting communication. This allows the government to understand the training needs of universities better and formulate more flexible training policies, internalizing the external environment for professional degree postgraduates and providing a better growth environment. From the government’s perspective, policies supporting university needs should be developed, encouraging enterprises to strengthen their support for universities, establishing platforms for industry-education integration, and providing venues and opportunities for enterprise-university cooperation, thereby creating a better external training environment for universities.

On the other hand, attracting various social forces to actively participate in university practice innovation activities provides students with diverse resources and career opportunities while driving technological innovation and socioeconomic development. This involvement brings new ideas and innovation directions for the cultivation of professional degree postgraduates.

5. Conclusions

The crux of nurturing professional degree postgraduates under the collaborative education mechanism lies in effectively mobilizing the strengths of educational institutions, society, and enterprises to establish a cohesive framework. This framework aims to provide postgraduates with ample resources, expansive opportunities, and a robust platform for growth. This study has elucidated the current deficiencies in the collaborative education of professional degree postgraduates. By addressing these issues, we have progressively developed a comprehensive collaborative education mechanism, thereby ensuring the enhancement of postgraduates' innovative and practical capabilities.

Looking ahead, we hope that higher education institutions will continue to fortify the construction of collaborative education mechanisms. It is imperative to thoroughly consider the cultivation needs of postgraduates' practical and innovative abilities, creating a multi-layered and integrated educational environment. In such a collaborative and nurturing setting, postgraduates will be encouraged to innovate boldly and engage actively in practice, continually elevating their practical and innovative skills.

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