Research on the Effective Path of "Promoting Research through Courses" in Cultivating Interdisciplinary and Applied Talents for Professional Degree Postgraduates

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Abstract. Abstact. Currently, talent cultivation faces numerous challenges, such as a shortage of school-enterprise tutors and a disconnection between curriculum construction and industry demands. The "promoting research through courses" model has emerged in response to these challenges. Its goals include training students' research capabilities, cultivating their interdisciplinary learning and application abilities, and establishing an ecological closed-loop between education and research. The reform measures involve innovating curriculum design to create new, advanced, and practical courses, adopting a hierarchical and progressive classroom teaching method combined with post-class diversion guidance, and conducting online-offline integrated case-based and scenario-based teaching. The reform has achieved remarkable results. Students have enhanced their research, knowledge application, and professional qualities. Schools have strengthened their discipline construction, teaching staff, and social influence. Enterprises have realized the talent reserve and technological innovation. The teaching model integrates theory and practice, promoting the high-quality development of education and teaching, and providing a new path to address problems in education and industry development.

Keywords: Promoting research through courses; Interdisciplinary and applied talents; Curriculum reform

1 Introduction

The "Development Plan for Professional Degree Postgraduate Education (2020-2025)" issued by the Academic Degrees Committee of the State Council and the Ministry of Education outlines clear requirements for enhancing the capabilities and standards of professional degree postgraduates. Interdisciplinary integration plays a crucial role in aligning disciplinary advancement with significant national strategic goals, facilitating the exchange of knowledge and innovation across fields. In response to the industry's urgent needs, there is a necessity to foster a new talent cultivation model for engineering

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disciplines that is future-oriented and sustainably competitive. This initiative aims not only to deepen educational reforms and promote industrial transformation but also to support the local industrial economy, marking the latest trend in industry development [1].

To address the demands of the social economy and business growth for innovative applied talents [2], it is vital to pursue reforms in talent development. This involves establishing a collaborative education system, exploring cooperative education channels between schools and enterprises, and nurturing a collaborative classroom culture [3] to enhance educational quality. However, identifying a feasible strategy and breakthrough that can elevate postgraduate cultivation quality, enable efficient interdisciplinary talent development, and be applicable in most universities remains a significant challenge. Currently, there are still notable gaps in the reform and exploration of applied talent cultivation [4].

The innovation in the cultivation objectives, quality standards, structural systems, model methods, and development concepts of professional degree postgraduate education cannot be achieved without the promotion of high-level supervisors. However, there is currently a phenomenon where "institutional supervisors focus on theory, while off-campus supervisors focus on business, and there is a lack of communication and interaction between them." Whether it is institutional supervisors, off-campus supervisors, or the level of cooperation between the two, there is still a large gap compared with the practical requirements of professional degree postgraduate cultivation. There is a shortage in both the quantity and quality of high-level school-enterprise supervisors. Under such a "double shortage" situation, starting from the "small" aspects, leveraging the collective advantages of multiple supervisors and multiple sources to build high-level signature courses, and attaching importance to the role of signature courses in postgraduate cultivation, and then popularizing the successful experience to more courses, can be regarded as an efficient and easily replicable talent cultivation path.

Currently, postgraduate education in China cannot fully meet the diverse needs of economic and social development, and the study during the postgraduate stage fails to provide substantial assistance for students' subsequent career development [5]. "Strengthening curriculum construction, attaching importance to the role of curriculum teaching in postgraduate cultivation, and enhancing the training of scientific methods and the cultivation of academic literacy for postgraduates through high-quality curriculum learning" [6], to make graduates more capable and improve their ability to add value to the organizations and/or society they are (or will be) serving [7], has become an important measure to improve the quality of postgraduate cultivation. However, how to carry out effective curriculum construction based on the actual situation in China remains a difficult problem that urgently needs to be solved in teaching practice [8]. In the context of integrating industry and education, the previous university curriculum structure, which emphasizes theory over practice, is contrary to the goal of building a practical education system. Theoretical knowledge, continuous professional development, and work practice should complement and support one another [9]. Therefore, it is urgent to promote curriculum reform in line with industrial needs. On the one hand, the curriculum structure should be adjusted by increasing professional practice courses, campus practice courses, enterprise practice courses, and social practice courses so as

to improve students' ability to apply knowledge. On the other hand, the curriculum content should be innovative. Based on the teaching of professional theory courses, universities should jointly design curriculum content with enterprises, incorporate industry technical standards, job ability requirements, etc., and achieve the organic integration of "knowledge imparting" and "ability cultivation" [10].

Faced with urgent problems in postgraduate curriculum construction, it is imperative to explore an innovative and effective solution path. Previous attempts have not fully solved the problems. As a crucial part of improving the cultivation quality of postgraduates, curriculum construction still faces many difficulties in adapting to industrial needs. In this context, the new concept of "promoting research through courses" has emerged. It closely combines curriculum construction with scientific research practice and is expected to break the deadlock in school-enterprise cooperation, bridge the gap between education and industry, and bring new hope for improving the cultivation quality of professional degree postgraduates and promoting the deep integration of industry and education. Next, this article will conduct an in-depth discussion on the connotation, implementation path, and potential effectiveness of "promoting research through courses", with the hope of providing useful references for solving the current problems in education and industrial development.

2 The Goal Orientation of the "Promoting Research through Courses" Reform

2.1 Training Research Abilities

"Promoting research through courses" focuses on the comprehensive cultivation of students' research abilities and plays a crucial role in teaching practice. The curriculum is designed around the actual needs of enterprises and cutting-edge industry technologies. By introducing real-world enterprise project cases, students are exposed to industry challenges. For example, in the Energy Internet and Smart Grid Technology course, a postgraduate course that teaches about the current development status, challenges, technological trends, and countermeasures of the power energy system, which is the hub for achieving the "dual-carbon" goal, is based on the integration of multiple disciplines such as electrical engineering, control engineering, energy and power, electronic information, meteorology, and management, as well as the integration of universities and enterprises, and theory and practice, as shown in Figure 1.

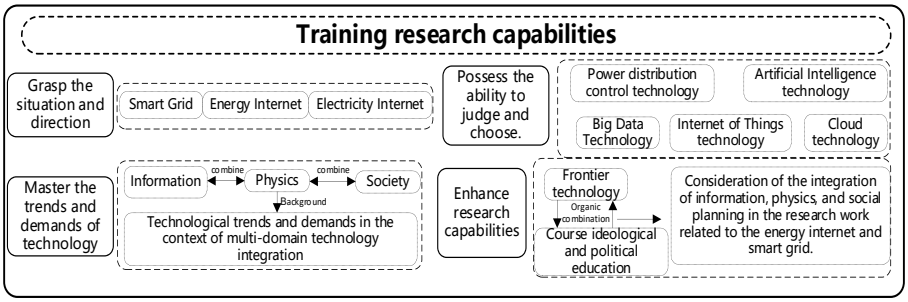

Fig. 1. (Taking the energy internet and smart grid technology course as an example) Training research ability

In the process of curriculum learning, students are no longer limited to mastering theoretical knowledge. Instead, they are project-oriented and go through a complete scientific research process from problem-raising, solution-design, and technology-selection to practice-verification. Under the joint guidance of teachers and enterprise mentors, students learn to use professional knowledge to analyze project requirements, select and apply appropriate cutting-edge technologies to solve practical problems, and exercise scientific research skills such as literature research, experimental design, and data analysis.

2.2 Cultivating Interdisciplinary Learning and Application Abilities

In the "promoting research through courses" model, universities and enterprises collaborate to develop teaching content aligned with curriculum goals, integrating real enterprise projects and technical requirements into the curriculum. This allows students to engage in enterprise-related research projects throughout their learning process. Additionally, this model dismantles the information barrier between schools and enterprises. Enterprise mentors actively participate in curriculum instruction, working alongside university educators to guide students. The two sides regularly exchange information during teaching and research, sharing the latest industry trends, technical challenges, and academic research findings. By participating in project-chain-based teaching, students progressively acquire the applied skills necessary for interdisciplinary knowledge, spanning project conception, design, and implementation. In cooperative inquiry-based learning, students from diverse disciplinary backgrounds interact with one another, generating new ideas and expanding their problem-solving perspectives. Converting multi-disciplinary knowledge into practical outcomes not only enhances students' abilities to learn and apply interdisciplinary skills but also fosters their innovative and practical competencies.

2.3 Establishing an Ecological Closed Loop of "Education Feeding Back into Research and Research Upgrading Education"

Under the "promoting research through courses" model, students apply the theoretical knowledge learned in class to actual enterprise research and development projects. By solving technical problems in the R&D process, students not only deepen their understanding of professional knowledge but also enhance their scientific research and practical skills, creating valuable feedback from education to research.

New challenges and demands arising from enterprise R&D processes offer rich and cutting-edge cases and research topics for curriculum instruction. Universities can then update teaching content and optimize the curriculum system based on these, allowing education to keep pace with industry technological development trends and achieve the advancement of teaching through research.

3 The Reform Measures of "Promoting Research through Courses"

3.1 Curriculum Design

In the curriculum design of "promoting research through courses", a unique and forward-looking concept is adhered to. On the one hand, efforts are made to present a complete set of methodologies and knowledge "technology trees" clearly to students. In terms of curriculum content selection, it closely follows the trend of the times, integrating emerging advanced technologies such as artificial intelligence, big data analysis, and blockchain applications, and introducing advanced industry routes and cutting - edge concepts, enabling students to access the most advanced knowledge systems and keep abreast of industry trends. In the teaching implementation process, great importance is attached to the all-around cultivation of students' professional abilities, professional qualities, and professional thinking.

The curriculum design also focuses on creating remarkable features of "newness", "advancement", and "practicality". "Newness" is reflected in the up-to-date curriculum content and teaching methods, constantly updating the knowledge system and using new teaching means such as online-offline hybrid teaching and virtual simulation teaching. "Advancement" emphasizes that the teaching process is always guided by advanced technology trends, ensuring that university teaching is closely aligned with enterprise demands so that what students learn meets enterprise requirements. "Practicality" is realized through the emphasis on practical teaching. Students can accumulate rich practical experience through enterprise internships and participation in actual projects, truly applying what they have learned and laying a solid foundation for future career development. The curriculum design concept is shown in Figure 2.

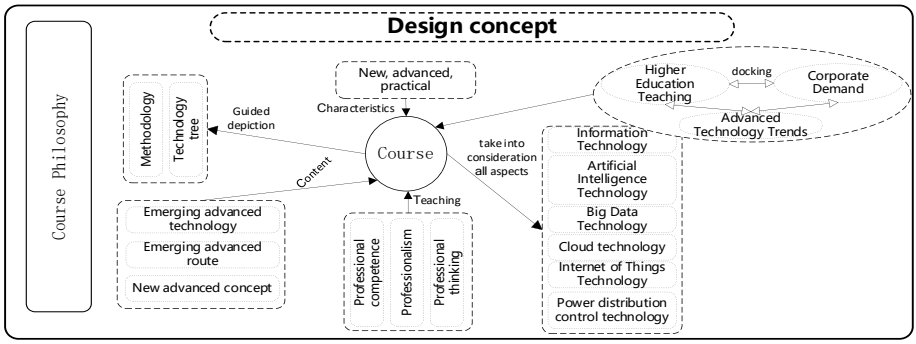

Fig. 2. Course Content and Teaching Method Design.

3.2 Hierarchical - Setup and Progressive Classroom Teaching + Post-class Specialized Diversion Guidance

During the classroom teaching stage, leveraging the advantages of multiple teachers and various sources, such as university professors, enterprise technical leaders, and industry experts, several skilled enterprise technical professionals with rich practical experience and engineering capabilities are hired as off-campus supervisors for postgraduates. Taking the course " Energy Internet and Smart Grid Technology " as an example, the supervisor teams from both inside and outside the university encompass multiple disciplines, including Electrical Engineering, Control Engineering, Energy and Power Engineering, Electronic Information, Meteorology, and Management. A teaching framework with hierarchical settings and progressive levels is established. University professors impart professional theories, enterprise technical leaders share practical cases, and industry experts introduce the latest cutting-edge developments. According to the course objectives and students' cognitive development, knowledge points and questions are organized from easy to difficult.

After class, students are divided into special topic groups according to their interests, academic foundations and career plans, and receive targeted guidance from university teachers and enterprise supervisors. For students interested in academic research, teachers guide them to explore theories, conduct research and write papers. Students inclined towards practical applications participate in actual projects under the guidance of enterprise supervisors, engaging in technical development and operations. During the projects, students can integrate theoretical knowledge with practice, accumulate experience, and enhance their ability to solve practical problems.

The School-Enterprise Joint Intelligent Laboratory, shown in Figure 3, provides students with advanced experimental equipment and real practical scenarios. In the intelligent laboratory, students inclined towards practical applications can get exposed to cutting-edge industry technologies. Under the guidance of enterprise supervisors, they can utilize the resources of the laboratory to carry out technical development and operations, transforming theoretical knowledge into practical achievements and truly achieving the application of what they have learned.

Fig. 3. School-enterprise Joint Intelligent Laboratory.

3.3 Case-based and Scenario-based Teaching Combining Online and Offline Approaches

Select real cases carefully and construct scenario-based teaching situations: Collect and screen representative real engineering/scientific research cases covering different scales, technical difficulties, and application fields. According to the content of the cases, construct scenario-based teaching situations. Multimedia presentations, on-site visits, simulated projects, etc., enable students to experience the actual operation of engineering/scientific research projects as if they were on the scene.

The online virtual software experiment and the offline practical application software complement each other. Through diverse methods such as multimedia presentations, field visits, and simulated projects, students can experience the actual operation of engineering/scientific research projects as if they were on the scene, truly achieving the goal of case-based and scenario-based teaching with the integration of online and offline approaches, and effectively improving students' ability to solve practical problems.In the teaching process, combined with on-site or remote access to the project cloud platform of enterprises and the software and hardware resources of school-enterprise joint laboratories, online and offline interactions are carried out.

4 Reform Achievements of "Promoting Research through Courses"

4.1 From the Student Perspective

The reform of "promoting research through courses" makes students the biggest beneficiaries. In terms of research ability, students learn to independently discover, analyze, and solve complex problems by participating in actual projects and scientific research process training in the courses. By engaging in project processes, students cultivate the ability to independently cope with industry technical challenges. Their knowledge application ability is also significantly enhanced. The theories they have learned are no longer just empty talk on paper but can be flexibly applied in practical scenarios. At the

same time, it adds project participation experiences to students, enriches the content of their resumes, and is of great help to their future employment and development.

To vividly demonstrate the effectiveness of the "promoting research through courses" reform in student cultivation, the following analysis is carried out with a set of data, as shown in Table 1. The table covers multiple key time points from 2020 to 2024, comparing the changes in various indicators before, during, and after the reform. These indicators specifically include dimensions such as students' research abilities, knowledge application abilities, employment situation, and student satisfaction.

Table 1. Comparison of Key Indicators of Student Development Before and After the Reform

Year/Relevant Indicators	Changes in Research Ability		Changes in Knowledge Application Ability		Changes in Employment and Student Satisfaction		
	Average number of published papers (per person)	Average number of participated scientific research projects (per person)	Average score of enterprise internship performance (Full score: 10)	Average number of competition awards (per person)	Proportion of students employed in renowned enterprises and research institutions	Student satisfaction rate regarding course gains	Students' sense of self-ability improvement
2020 (Before the Reform)	0.22	0.34	7.0	0.16	30%	70%	60%
2021(During the Reform)	0.20	0.40	7.5	0.12	25%	72%	60%
2022(After the Reform)	0.28	0.44	8.0	0.20	38%	85%	75%
2023	0.28	0.52	8.0	0.28	—	90%	85%
2024	0.36	0.64	8.5	0.40	—	92%	88%

4.2 From the School's Perspective

Schools have reaped a great deal from the reform of "promoting research through courses." In terms of discipline construction, through in-depth cooperation with enterprises, schools can promptly understand the latest industry technologies and demands and integrate them into the curriculum system and scientific research projects, thus promoting the update and innovation of disciplinary knowledge. For example, the professional courses of Energy Internet and Smart Grid combine the industry's "dual carbon" target requirements and offer relevant cutting-edge research directions, enabling the development of disciplines to keep up with the pace of the times.

The teaching staff has also been strengthened. The participation of enterprise experts and technical backbones in teaching brings rich practical experience and the latest industry information, promoting the improvement of practical teaching abilities of university teachers and achieving the deep integration of theory and practice. The social influence of schools has been significantly enhanced. The students cultivated have

strong practical abilities and high comprehensive qualities, and are widely recognized by enterprises, which improves the reputation and popularity of the schools. The close cooperation between schools and enterprises has also attracted more social resources, creating favorable conditions for the development of schools and further consolidating the position of schools in the industry.

4.3 From the Enterprise Perspective

Enterprises have obtained tangible benefits from the reform of "promoting research through courses." In terms of talent reserve, by participating in curriculum teaching and project guidance, enterprises can have early access to and screen outstanding students, realizing the precise cultivation and reserve of talent. During the process of guiding students, enterprise supervisors can deeply understand the professional abilities and comprehensive qualities of students, providing convenience for enterprises to select suitable talents.

The technological innovation ability of enterprises has also been improved. When students participate in enterprise projects, they bring new knowledge and ideas, providing new ideas for enterprises to solve technical problems. For example, in the projects of energy enterprises, students use the learned cutting-edge technologies to propose solutions for optimizing the energy management system, effectively improving the energy utilization efficiency of enterprises. The two-way knowledge transformation mechanism between enterprises and universities enables enterprises to promptly obtain the scientific research achievements of universities and apply them to production practice, accelerating technological innovation and product upgrading, and enhancing the competitiveness of enterprises in the market.

4.4 From the Teaching Model Perspective

"Promoting research through courses" has promoted the innovation and development of teaching modes. The traditional teaching mode focuses on the imparting of theoretical knowledge, while "promoting research through courses" achieves the deep integration of theory and practice. Classroom teaching with hierarchical settings and progressive levels, combined with after-class diversion guidance, teaches students in accordance with their aptitudes according to their characteristics, meeting the development needs of different students. Flipped classroom teaching, with the help of social software, breaks the limitations of time and space, stimulates students' learning initiative, and cultivates their autonomous learning and research abilities.

The case-based and scenario-based teaching with the integration of professional education and ideological and political education, and the combination of online and offline instruction, enriches the teaching content and forms. Real cases and scenario-based teaching enable students to better understand the application of knowledge, and the integration of ideological and political elements achieves the educational goal of fostering virtues and educating people. Multiple teaching modes complement each

other and develop synergistically, forming a diversified teaching mode system, providing useful references for educational and teaching reforms, and promoting educational and teaching towards high-quality development.

5 Conclusion

As an innovative measure to address the challenges in postgraduate curriculum construction, "promoting research through courses" has achieved remarkable results. At the student level, it not only improves students' research and knowledge application abilities but also shapes good professional qualities, laying a solid foundation for their future development. Through in-depth cooperation with enterprises, schools have optimized discipline construction, strengthened the teaching staff, and expanded their social influence. Enterprises have achieved a dual harvest of talent reserve and technological innovation, enhancing their market competitiveness. In terms of teaching modes, it has realized the integration of theory and practice and the coordinated development of various innovative teaching methods, promoting educational and teaching to enter a stage of high-quality development. In the future, it is necessary to further promote the "promoting research through courses" model, continuously improve reform measures, and deepen the integration of industry and education. This will strongly support the cultivation of high-quality professional degree postgraduates who can adapt to economic and social development and promote the coordinated development of education and industry.

In the future, the mode of "promoting research through courses" should be further promoted, school-enterprise cooperation should be continuously deepened, and reform measures should be constantly improved, so that it can play a greater role in the integration of industry and education, provide strong support for cultivating high-quality professional degree postgraduates who meet the needs of economic and social development, and promote the deep integration and coordinated development of the education chain and the industrial chain.

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