

Development Path of Industry-Academia-Research Integration Driven by Collaborative Innovation of Off-Campus Research Institutions in Universities

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Abstract: This article discusses the practical training of professional master's degree students in off-campus research institutions of universities, aiming at exploring the effective development path of the Industry-academia-research integration. From the perspective of dual structure theory, this article first combs the development process of off-campus research institutions of universities in China universities, and takes Yibin as an example to explain its development background. Then, it deeply analyzes the existing three kinds of training modes: project practice, unit practice and autonomous learning, and points out the problems of unbalanced dual goals, inefficient resource coordination and fragmented assessment mechanism. Then, the theoretical basis of dual structure is explained, which shows that it originates from the dual theory of management organization and extends to "dual system" in the field of pedagogy. Finally, based on this theory, the optimization model of Industry-academia-research integration is constructed from four aspects: dual governance structure, dynamic training system, collaborative diversification of resources and integration of assessment mechanism, which provides theoretical and practical guidance for the integration and development of production and education in scientific research institutions.

1. Introduction

Under the background of the deep integration of higher education and industrial development, as a new force of innovation-driven development, off-campus research institutions in universities are playing an increasingly prominent role in the practical training of professional degree postgraduates [1]. For the off-campus research institutions of universities in China, it has experienced four stages from initial germination to vigorous development [2]. At first, some universities tried to set up scientific research institutions in different places based on specific needs, which paved the way for exploration. With the growth of economic development's demand for scientific and technological innovation, the number of off-campus research institutions of universities is gradually increasing, and the development model is constantly being explored [3]. After that, the promotion of regional coordinated development strategy has prompted off-campus research institutions to enter the stage

of rapid expansion [4]. Nowadays, it has entered a new stage of high-quality development, paying more attention to connotation construction and collaborative innovation.

Taking Yibin as an example, relying on the strategic opportunity of Chengdu-Chongqing economic circle construction and the support of the national pilot city policy of Industry-academia-research integration, Yibin actively introduced 10 universities and 17 research institutes [5]. This has not only injected a strong impetus into the local industrial upgrading, but also created favorable conditions for the practical training of professional master's degree graduates in scientific research institutions [6]. In this environment, it is of great significance to study the practical training of professional degree postgraduates in off-campus research institutions of universities for promoting the Industry-academia-research integration, improving the quality of postgraduate training and promoting regional economic development [7].

From the perspective of postgraduate training, the practical ability training of professional degree postgraduates is the key link. Off-campus research institutions in universities can provide rich practical resources and platforms, but there are still many problems in their training process [8]. It is an important task to analyze these problems in depth and explore scientific and effective solutions. By studying this topic, it hopes to improve the theoretical system of Industry-academia-research integration and provide theoretical support for the development of scientific research institutions. Moreover, it aims to provide practical guidance for optimizing the practical training mode of professional degree postgraduates, help cultivate more high-quality innovative talents to meet the needs of the industry, and promote the coordinated progress of regional economy and higher education.

2. Analysis of the present situation of practical training

Under the current general trend of the integration of education and industry, off-campus research institutions in universities have formed a diversified model for the practical training of professional degree postgraduates, but they are also facing a series of problems to be solved urgently. At present, there are mainly three kinds of training modes: project practice, organization practice and autonomous learning [9]. Under the "project practice" mode, Graduate students participate in various scientific research projects conducted by their supervisors at off-campus research institutions of universities, and improve their professional skills and ability to solve practical problems in the process of project implementation. The "organization practice" mode is to arrange graduate students to enter counterpart enterprises or organizations, go deep into the front line of the industry, understand the actual production operation process and accumulate practical experience. The mode of "autonomous learning" gives graduate students greater autonomy. They can choose their own practice contents and ways according to their own interests and research directions, and exercise their self-exploration and learning ability.

For example, Table 1 shows the practical training modes for professional degree postgraduates across off-campus research institutions in universities. The table compares the three training modes in detail from five dimensions: training objectives, practice contents, guiding subjects, time arrangement and expected results.

Although these training modes have their own characteristics, there are still many problems exposed in actual operation. The imbalance of dual goals is obvious, and universities pay attention to the cultivation of academic theories and expect graduate students to produce academic achievements. Scientific research institutions and enterprises pay more attention to practical skills and economic benefits, and pursue the commercial value or practical application effect of the project [10]. The inconsistent goals of the two sides make the direction of graduate students in the training process vague, and it is difficult to take into account both academic and practical

requirements.

Table 1 Comparison of Practical Training Models

Training Model	Training Objectives	Practical Content	Guidance Providers	Time Arrangement	Expected Outcomes
Project Practice	Enhance the ability to combine scientific research with practice and solve practical project issues	Participate in scientific research projects conducted by their supervisors at research institutions	Joint guidance by university supervisors and collaborating expert	Flexibly arranged according to the project cycle, generally no less than 6 months	Complete the established tasks of the project and produce relevant scientific research achievements
Workplace Internship	Familiarize with industry operational processes and enhance practical operational skills	Engage deeply in production, operations, and other aspects within enterprises	Primarily guided by enterprise mentors, with assistance from university supervisors	Usually 3-6 months	Produce an internship report and master specific job-related skills
Independent Learning	Cultivate independent exploration and innovation capabilities	Self-determine practical content, such as research surveys, experiments, etc.	Guided by university supervisors, with the option to seek advice from external experts	Self-planned, with a total duration of no less than 3 months	Complete an innovative practical report or work

There is a lack of efficient resource sharing and integration mechanism among universities, scientific research institutions and enterprises. The equipment, data, venues and other resources needed for practical teaching are scattered and fail to form a joint force. Taking an off-campus research institutions in universities as an example, the advanced theoretical research equipment in universities cannot be effectively connected with the actual production equipment of enterprises, which leads to difficulties for graduate students in transforming from theoretical research to practical application and limits the full improvement of practical ability. The separation of assessment mechanism cannot be ignored. Universities, scientific research institutions and enterprises evaluate graduate students' practical achievements according to their own standards. Universities pay attention to academic standardization and theoretical depth, scientific research institutions pay attention to the quality of project completion and technological innovation, while enterprises pay more attention to actual work performance and contribution to enterprises. This difference in assessment standards and methods makes the assessment of graduate students' practical achievements lack of comprehensiveness and scientificity, and cannot accurately reflect the real practical ability and comprehensive quality of graduate students, thus affecting the improvement of practical training quality.

3. Interpretation of the theoretical basis of dual structure

The root of dual structure theory can be traced back to the theory of organizational duality in the field of management. In the field of management, the theory of organizational duality emphasizes that organizations need to have both the ability to explore new opportunities and the ability to use existing capabilities to adapt to the complex and ever-changing external environment. Exploration

means that organizations should constantly seek new knowledge, technology and markets and carry out innovative activities; the utilization focuses on the optimization and full use of existing resources, processes and technologies to improve the operational efficiency of the organization. These two seemingly contradictory abilities are actually interdependent and mutually promoting, and jointly promote the sustainable development of the organization.

With the development of theory and interdisciplinary integration, the dual structure theory has been extended in the field of pedagogy and gradually evolved into a "dual system". In the context of pedagogy, "dual system" emphasizes the coordinated development of theory and practice. It breaks through the limitation of the separation of theoretical teaching and practical teaching in traditional education, and advocates the close combination of theoretical knowledge teaching in schools and practical skills training in enterprises or practice places. This combination is of great guiding significance for the cultivation of professional master's degree students in scientific research institutions. It allows graduate students to acquire systematic professional theoretical knowledge in the school environment and build a solid academic foundation, which is a process of exploring new knowledge and new theories. Besides, with the help of the practice platform provided by scientific research institutions, it enables graduate students to go deep into actual projects or industry scenes, apply theoretical knowledge to practice, and realize the transformation and innovation of knowledge, which is equivalent to the process of using theoretical knowledge. The exploration and utilization advocated by the dual structure theory and the coordination of theory and practice provide a solid theoretical basis for optimizing the practice training mode of professional master's degree students in off-campus research institutions in universities. This will help to solve the problems existing in the current training process, such as the imbalance of dual objectives and the inefficiency of resource coordination, promote the deep Industry-academia-research integration, and improve the quality of postgraduate training.

4. Based on the dual structure theory, the optimization path construction of the Industry-academia-research integration

The dual structure theory provides a clear direction for the Industry-academia-research integration in scientific research institutions. Starting from four key aspects: governance structure, talent cultivation system, resource coordination and assessment mechanism, a more perfect integration model of production and education can be constructed.

In terms of dual governance structure, universities, off-campus research institutions and practical cooperation organizations need to clarify their respective rights and responsibilities and build a collaborative decision-making mechanism. Universities should give full play to the leading role of academics and provide systematic theoretical knowledge system for graduate students; Off-campus research institutions should leverage their advantages as platforms to effectively integrate local practical resources; Practical cooperation organizations, additionally, should utilize their industrial resources to excel in the practical cultivation of graduate students. For example, the three sides can set up a joint training working group to jointly formulate major issues such as postgraduate training plan, curriculum and practical teaching plan. Dynamic training system requires real-time adjustment according to industry development and market demand. It needs to update the course content in time and integrate into the latest technology and research results in the industry. Furthermore, it also needs to set up practical projects flexibly to ensure that graduate students are exposed to the most cutting-edge practical topics. For example, in view of the emerging field of artificial intelligence, relevant frontier courses are set up in time, and corresponding practical projects are set up, so that graduate students can participate in actual artificial intelligence application development projects.

Collaborative diversity of resources is an effective way to integrate resources from all sides. The

First, integration of human resources: establishing a dual-supervisor system, comprising both a university supervisor and an industry mentor, will be implemented to jointly guide graduate students throughout their practical training phases. The Second, integration of platform resources: co-establishing and sharing joint facilities, "Joint Laboratories" or "Practical Training Bases" will be co-developed and shared. These facilities will be oriented towards industrial technological needs, aiming to tackle technical challenges, or focused on industry talent demands, allowing graduate students to gain hands-on experience at production sites within partner organizations. An internal "Resource Information Platform" will be established to aggregate the equipment databases, expert directories, projects and achievement/patent libraries of all three parties. The Last, integration of data resources: focusing on the practical application of data and intellectual property, centered on the practical utilization of data and intellectual property, and under strict adherence to confidentiality agreements, partner organizations will provide anonymized industry data and real-world cases, the off-campus scientific research institutions are responsible for demand docking and resource integration, while the university will be responsible for theoretical foundational research and technical solution design. Together, these resources will be transformed into practical training topics for graduate students. Change the fragmented assessment situation of universities, scientific research institutions and practical cooperation unit, and comprehensively consider the multi-dimensional performance of graduate students' theoretical knowledge level, practical operation ability and innovative thinking. Based on the dual structure theory, the optimization path measures of the Industry-academia-research integration are shown in Table 2.

Table 2 Optimization Path Measures for Industry-Education Integration Based on the Dual Structure Theory

Optimization Direction	Specific Measures	Implementation Entities	Expected Effects
Dualization of Governance Structure	Establish a joint training working group to jointly formulate training plans, course curricula, and practical plans	Universities, off-campus research institutions and practical cooperation unit	Form unified decision-making to address the imbalance of dual objectives
Dynamization of Training System	Update course content according to industry development and flexibly set up practical projects	Universities, off-campus research institutions and practical cooperation unit	Keep training content aligned with industry frontiers and enhance graduate adaptability
Diversification of Resource Collaboration	Establish mechanisms for integrating human, platform, and data resources, enabling the systematic reorganization and flow of these core components	Universities, off-campus research institutions and practical cooperation unit	Break down resource barriers and improve resource collaboration efficiency
Integration of Assessment Mechanism	Establish a unified assessment system covering theoretical, practical, and innovative capabilities	Universities, off-campus research institutions and practical cooperation unit	Comprehensively and accurately evaluate graduates and promote the improvement of training quality

Based on the dual structure theory, the construction of the optimization path of the Industry-academia-research integration can effectively solve the problems existing in the practice training process of professional degree postgraduates in off-campus research institutions in universities, and realize the deep integration of theory and practice. This can improve the quality of postgraduate training, promote the Industry-academia-research integration to a higher level, and transport more high-quality talents with innovative and practical abilities for industrial development.

5. Conclusions

Based on the dual structure theory, this article makes a systematic study on the practical training of professional master's degree students in off-campus research institutions in universities. It is found that although many modes have been formed in the current practice training, the problems such as unbalanced dual goals, inefficient resource coordination and split assessment mechanism have restricted the in-depth development of the Industry-academia-research integration. Through the tracing and explanation of the dual structure theory, its theoretical guiding value for solving existing problems is clarified. Based on this, the optimization path of Industry-academia-research integration is constructed from four key dimensions: governance structure, training system, resource coordination and assessment mechanism. Dual governance structure, build a joint training working group among universities, off-campus research institutions and practical cooperation unit, unify decision-making, and make the goals of the three sides coordinated. The training system is dynamic, keeping up with the pace of the industry, and ensuring that what graduate students have learned meets the latest needs of the industry. Through diversified means, achieving resource coordination can both break down resource barriers and enhance resource utilization efficiency. The assessment mechanism should be integrated, and a comprehensive and unified assessment system should be established to accurately measure the comprehensive quality of graduate students. The implementation of these optimization paths is expected to solve the existing problems, promote the Industry-academia-research integration of scientific research institutions to a new height, improve the training quality of professional degree postgraduates, and transport innovative talents with both theoretical and practical abilities for industrial development. Future research can consider further verifying the actual effect of these optimization paths through empirical research, and adjusting and perfecting them according to practical feedback, so as to better serve the practical needs of the integration development of production and education of scientific research institutions.

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