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Research on paths, problems, and countermeasures of joint cultivation of postgraduates by universities—An empirical analysis based on University X

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Abstract. Joint cultivation of postgraduates by universities is an important mechanism to promote inter-university resource sharing and improve the quality of postgraduate education, involving the optimal allocation of internal and external educational resources and the innovation of talent cultivation models. It can help relevant universities connect with high-level platforms in terms of team co-construction and resource sharing, facilitate disciplinary intersection and complementary advantages to promote academic output, enhance universities' disciplinary competitiveness through scientific research cooperation or disciplinary intersection, and cultivate postgraduates' practical abilities to improve their employment competitiveness. Therefore, through an empirical analysis of the paths, problems, and effectiveness of joint cultivation, this study further clarifies that constructing diverse mechanisms, co-building disciplinary platforms, deepening resource sharing, realizing disciplinary intersection, and improving evaluation systems are important measures for universities to promote the reform of joint cultivation models and enhance the quality of talent cultivation.

Keywords: postgraduate education, joint cultivation, quality improvement

1. Introduction

1.1. Theoretical basis and analytical framework

The Outline of the Education Power Construction Plan (2024-2035) proposes to optimize the layout of higher education, establish talent cultivation models driven by technological development and national strategic needs, and improve the mechanism for cultivating top-notch talents. At the critical stage of transformation and development in postgraduate education, in addition to improving the independent cultivation system, establishing effective joint cultivation mechanisms with high-level universities is a favorable way to enhance the quality of talent cultivation and ensure the effectiveness of high-level talent training. It can not only meet national development strategies and promote the modernization of postgraduate education governance systems and capabilities but also target cutting-edge key fields, support regional development strategies, and accelerate the construction of a high-quality, open postgraduate education system suitable for university development. Firstly, the joint cultivation of postgraduates involves the selection of trainees, monitoring of the cultivation process, and evaluation of cultivation effectiveness. Previous studies have mostly focused on policy interpretation or institutional analysis of a single disciplinary direction, lacking comprehensive research on cultivation data across multiple links. Considering the above, exploring typical cases of joint postgraduate cultivation in a university, scientifically analyzing basic data at various stages of joint postgraduate cultivation, and comprehensively evaluating the effectiveness and results of joint postgraduate cultivation can deepen the generating mechanism and practical dilemmas of joint postgraduate cultivation in universities. Secondly, as the main beneficiaries of educational services, students are often neglected in the evaluation process, despite their unique ability to provide valuable feedback on educational quality and effectiveness [1]. Confronting the practical needs and current difficulties of joint postgraduate cultivation from the perspective of postgraduates themselves (rather than universities or educational administrative departments) can, based on survey questionnaires and in-depth interview data, bridge policy gaps and management loopholes at the micro level, form certain mitigation strategies and collaborative mechanisms, and provide reference for universities with certain regional influence to seize opportunities for joint cultivation and improve the quality of talent cultivation.

1.2. Preparations and basic work

1.2.1. Establishing and improving internal and external communication and coordination mechanisms

The joint cultivation of postgraduates in universities is coordinated and promoted by the Graduate School and the Development Planning Office. Firstly, the Development Planning Office connects the annual quota indicators for joint postgraduate cultivation with the Graduate School. Secondly, the Graduate School issues a notice to each college on submitting candidates for joint cultivation, attached with a quota allocation form. The final list after statistics is sent to the Development Planning Office.

Meanwhile, the Graduate School maintains close communication with joint cultivation universities in the mainland regarding various links of joint cultivation, such as the selection list of students, payment of tuition and accommodation fees, credit conversion mechanisms, management of student registration and learning processes, and recording of student grades, to ensure that students successfully complete the corresponding learning tasks.

1.2.2. Establishing a selection mechanism for cultivation units to ensure the selection of excellent students

Colleges select students for joint cultivation by balancing professional directions, setting evaluation standards, and aiming to recommend excellent students in relevant disciplines, ensuring open procedures, fair evaluation, and evidence-based decisions. The selection process mainly includes the following steps: issuing a notice with recommendation criteria; eligible students submitting application materials; colleges organizing diversified evaluations, including on-site defenses and scoring by panels based on students' submitted materials, research potential, etc., and selecting joint cultivation students in descending order of scores; colleges publicizing the list of recommended students on their official websites and reporting it to the Graduate School. Other possible situations include, for example, if the number of voluntary applicants is insufficient, the college evaluation panel collectively decides whether existing students can participate in the joint cultivation program before submitting the list. Additional considerations in the evaluation by each college include coordinating annual rotation applications among professional directions and students' mental health status.

In summary, during the selection stage of students for joint cultivation, the university has clear bases and standardized procedures, providing excellent students with opportunities to pursue advanced studies on high-level university platforms and effectively ensuring the quality of joint postgraduate cultivation.

2. Brief introduction to research methods

This study, from the perspective of postgraduates participating in joint cultivation programs, obtained basic information and data on joint cultivation postgraduates through questionnaires and interviews.

2.1. Reliability analysis

This study analyzed the reliability of the questionnaire, with a sample size of 62 and 27 items in the questionnaire. The calculation results showed that the Cronbach's α coefficient was 0.873, indicating that the questionnaire had good internal consistency. Generally, a Cronbach's α coefficient above 0.7 is considered to have acceptable reliability, while a value above 0.8 indicates good reliability. Therefore, the reliability results of this questionnaire show that participants' responses to each item have high consistency and can effectively reflect the measured construct. The questionnaire performed well in terms of reliability, providing a reliable basis for subsequent data analysis and research.

2.2. Validity analysis

This study conducted validity analysis on the questionnaire data of joint cultivation through factor analysis, aiming to explore the impact of joint cultivation on postgraduates' academic and career development. The analysis results showed that the number of extracted factors was 8, and the eigenvalue and variance explanation rate of each factor indicated the validity of the model.

Firstly, the KMO value was 0.790, indicating that the sample was suitable for factor analysis. The results of Bartlett's test of sphericity showed that the p-value was less than 0.001, further verifying that there were significant correlations between variables, making them suitable for factor extraction. In the factor extraction process, the eigenvalue before rotation showed that the first factor had an eigenvalue of 10.64, with a variance explanation rate of 39.41%, indicating that the first factor had a strong ability to explain the overall variance. After rotation, the eigenvalue of the first factor decreased to 6.93, with a variance explanation rate of 25.67%, but it still maintained a high explanatory ability. The cumulative variance explanation rate after rotation reached 76.49%, indicating that the extracted factors could well explain the variability of the questionnaire data.

From the factor loading matrix, Factor 1 mainly focused on the impact of joint cultivation on the improvement of academic work, the output of scientific research achievements, and the enhancement of personal abilities, showing the importance of joint cultivation in academic development. Factor 2 was related to the statistics of academic output, indicating that joint cultivation played a significant role in improving postgraduates' academic achievements. Other factors also reflected impacts in different dimensions, such as the frequency of communication with supervisors and the relevance of courses.

In summary, the validity analysis results of the questionnaire in this study indicate that joint cultivation has a positive impact on postgraduates' academic and career development, and multiple factors extracted through factor analysis can effectively reflect the multi-dimensional characteristics of this impact. This provides important theoretical basis and empirical support for our university to continuously track and investigate issues related to joint postgraduate cultivation.

3. Data and problem analysis

3.1. Curriculum interconnection and credit recognition: breaking through the joint cultivation mechanism

Curriculum interconnection and credit recognition are important models and mechanisms to promote inter-university cooperation and student mobility. A university's implementation of curriculum interconnection and credit recognition with other high-level universities is based on the basic elements of its postgraduate joint cultivation, enabling the optimal allocation of educational resources and the innovation of talent cultivation models.

According to the survey results, 51% of students in the university engaged in credit recognition during joint cultivation, while the other 49% participated in joint cultivation after completing course studies, without involving credit recognition. 58% of courses and credits between the two universities were basically consistent. Curriculum interconnection enabled the university and another high-level university to establish corresponding course relationships through negotiation, realizing the sharing and complementarity of teaching resources. This interconnection not only includes the connection of course content but also involves the coordination of teaching methods and the unification of evaluation standards. The credit recognition system, which mutually recognizes credits obtained by students in different institutions, provides convenience for students to study across universities. The implementation of curriculum interconnection and credit recognition, firstly, promotes the optimal allocation of educational resources, avoids duplicate construction, and improves resource utilization efficiency. Secondly, it provides students with richer learning choices and more flexible learning paths, contributing to personalized cultivation. Thirdly, by breaking institutional barriers, it promotes the development of openness and inclusiveness in the higher education system. Finally, it builds a platform for in-depth cooperation between universities, laying a foundation for the innovation of joint cultivation models. In conclusion, joint cultivation of postgraduates during the course learning stage is conducive to consolidating disciplinary professional knowledge and enhancing students' theoretical literacy.

3.2. Disciplinary intersection and complementary advantages: promoting academic output

With the rapid development of science and technology, research in a single discipline can hardly address increasingly complex scientific issues and social needs. Disciplinary intersection and complementary advantages have become important ways to promote academic innovation and improve the quality of scientific research achievements. Through knowledge integration, method reference, and team collaboration across different disciplines, it is possible to break the limitations of traditional research paradigms and spawn new theories, technologies, and applications. Due to certain differences between postgraduates' own disciplinary backgrounds and the disciplinary backgrounds of supervisors in joint cultivation universities, students inevitably come into contact with academic resources in interdisciplinary fields during joint cultivation.

According to the survey results, disciplinary intersection under different disciplinary backgrounds can promote complementary advantages between the two universities. 40% of students believed that joint cultivation universities had greatly helped their university's professional direction or disciplinary development, and 34% of students believed that joint cultivation universities had provided significant help in this regard. The comprehensive effect of joint cultivation on improving the quality of postgraduate cultivation under the background of disciplinary intersection is mainly reflected in the following aspects: Firstly, breaking disciplinary barriers and expanding research horizons. Research in a single discipline is often limited by its own theoretical framework and methodology, while disciplinary intersection can integrate knowledge from different fields to provide a more comprehensive analytical perspective. For example, bioinformatics, which combines biology and computer science, has promoted the rapid development of genomics and big data analysis. Secondly, promoting technological innovation and solving complex problems. Many major scientific issues require interdisciplinary collaboration. For example, interdisciplinary research in environmental science, economics, and sociology can provide better policy recommendations for sustainable development. Thirdly, improving research efficiency and optimizing resource allocation. Research teams from different disciplines can share equipment, data, and methods, reduce duplicate research, and improve resource utilization efficiency. In particular, they can

accumulate diversified experience in cultivating professional degree postgraduates to achieve corresponding cultivation goals [2].

3.3. Team complementarity and resource sharing: efficiently linking high-level platforms

With the development of science and technology and the deepening of disciplinary integration, resources from a single university can hardly meet the needs of high-level postgraduate cultivation. The university joint cultivation model has achieved the improvement of scientific research capabilities, disciplinary intersection innovation, and efficient connection with high-level platforms through team complementarity and resource sharing.

Firstly, in terms of team personnel complementarity, 44% of students faced the "dual-supervisor system", allowing students to complete course learning and scientific research practice in two universities. This can integrate high-quality faculty and scientific research resources, and cooperation between the two universities can also make up for the shortcomings in basic research and applied research. Of course, close communication and cooperation between students and their two supervisors can create a harmonious scientific research atmosphere. 72% of joint cultivation postgraduates regularly reported and communicated with their supervisors from the home university, with 83% of the communication content involving personal research progress and 64% involving thesis proposal selection and thesis revision. It can be seen that during the joint cultivation period, supervisors from the home university did not withdraw but continued to supervise and guide students' academic progress.

Secondly, in terms of platform resource sharing, 95% of joint cultivation universities shared their library and database literature; 75.8% of joint cultivation universities invited joint cultivation students to participate in important academic conferences and other disciplinary activities; however, only 25.5% of joint cultivation universities provided laboratories for students' experiments, and 17% of joint cultivation students received support from joint cultivation supervisors' scientific research projects. Generally speaking, 87% of joint cultivation postgraduates believed that resources from joint cultivation universities and their supervisors promoted the output of their scientific research achievements during the postgraduate period. In fact, university joint cultivation can, in a sense, promote the formation of scientific research communities [3].

3.4. Disciplinary intersection and scientific research cooperation: enhancing disciplinary competitiveness

The postgraduate joint cultivation model mainly integrates multi-disciplinary resources, promotes inter-university collaboration, and deepens industry-university-research integration. It can not only cultivate more innovative high-level talents but also promote the overall improvement of universities' scientific research levels. The specific deepening of joint cultivation in this university is insufficient, but under the condition of limited resource integration, the situation of improving disciplinary competitiveness through cross-research cooperation among joint cultivation postgraduates in this university is increasing year by year.

According to the survey, 53% of postgraduate supervisors from the two universities have basically consistent disciplinary backgrounds, and 58% of supervisors from the two universities communicate more than twice a month. This indicates that there is a close academic connection between the two universities' faculty, providing a reliable basis for supervisors from the two universities to collaborate in cultivating postgraduates. In terms of scientific research cooperation and achievement output between joint cultivation postgraduates and supervisors from the two universities, 56% of students collaborated with supervisors from the home university and achieved results; 21% of students collaborated with joint cultivation supervisors and achieved results; 46.7% of students believed that joint cultivation greatly promoted the output of scientific research achievements; 45.1% of students believed that there was a partial improvement. At the same time, 87% of joint cultivation postgraduates believed that joint cultivation universities paid more attention to cultivating postgraduates' practical abilities than their own university, thus indirectly affecting the scientific research competitiveness of their own university on the basis of complementary advantages.

3.5. Emphasizing practical ability cultivation: enhancing competitiveness in further study and employment

Postgraduate education needs to focus not only on cultivating academic research capabilities but also on strengthening practical abilities and employment competitiveness. In recent years, the joint cultivation model of this university has gradually become an important way of postgraduate education. 87% of students participating in joint cultivation in this university believed that joint cultivation universities paid more attention to cultivating postgraduates' practical abilities than their own university. Therefore, students' participation in joint cultivation is an important model to effectively improve the quality of postgraduate cultivation.

Postgraduates' scientific research practical abilities or work practical abilities are extremely important for their personal development. According to the survey results, students participating in joint cultivation believed that joint cultivation had improved their further study, employment, disciplinary cognition, practical skills, employment competitiveness, disciplinary vision, and innovative thinking to varying degrees, among which the most significant improvements were in disciplinary cognition and competitiveness in further study.

In summary, to ensure that the talent cultivation of a certain university reaches a higher level, continuing joint cultivation with high-level universities remains an effective way to improve the quality of postgraduate cultivation in the university in the future. However, at the same time, the university surveyed students participating in joint cultivation and found that 54% of students believed that joint cultivation mostly achieved their career goals, and 25% of students believed that joint cultivation helped them fully achieve their employment goals. 67% of students believed that joint cultivation universities, cooperative units, or supervisors fully supported their personal development. 50% of students believed that the joint cultivation system was imperfect, with deficiencies in supervisor collaboration mechanisms, depth of resource sharing, and connection of curriculum systems, leading to 32% of students believing that the efficiency of joint cultivation between the two universities was lower than their personal expectations. Of course, this also includes subjective considerations of students and supervisors, but it provides reliable data support for the university's future joint postgraduate cultivation and points out the direction for future reform of this work.

4. Countermeasures and conclusions

4.1. Establishing multi-level mechanisms to ensure the quality of joint cultivation

Multi-level mechanisms should first establish smooth connections in curriculum resource sharing and credit exchange. To promote curriculum interconnection and credit recognition, it is first necessary to strengthen policy coordination. The Graduate School should issue guiding documents, clarify basic principles and implementation paths, and constructing a unified standard system is crucial, including formulating general rules for credit calculation, course correspondence guidelines, and quality evaluation frameworks. Establishing multi-level quality assurance mechanisms is key to ensuring the effectiveness of recognition. This includes internal quality control of institutions, third-party evaluation, and regular review systems. At the same time, the technical support system should be improved by developing a unified curriculum information platform and credit conversion system to improve work efficiency and transparency. In addition, it is necessary to improve the interest coordination mechanism and mobilize the enthusiasm of all parties through reasonable cost-sharing and benefit distribution.

Curriculum interconnection and credit recognition are important directions for the reform and development of higher education, with significant significance for improving educational quality, promoting resource sharing, and enhancing international competitiveness. Although there are many challenges at present, a more open and flexible joint cultivation mechanism can be built through institutional innovation, standard unification, and quality assurance measures. In the future, further theoretical research and practical exploration should be strengthened to continuously improve relevant policies and technical support, promoting higher education cooperation to develop in a deeper level. This will not only help cultivate talents with more international perspectives and innovative abilities.

4.2. Co-building disciplinary platforms to strengthen collaborative innovation

In recent years, higher education has undergone major changes, which have had a chain reaction on scientific research guidance [4], and the cooperation between postgraduates and supervisors is particularly important. In terms of promoting scientific research output through disciplinary intersection, it is suggested that qualified colleges and relevant disciplines establish interdisciplinary research platforms and scientific research institutions with high-level universities in the mainland. Firstly, interdisciplinary research centers or joint laboratories can be established to promote exchanges and cooperation between scholars and postgraduates. Encouraging interdisciplinary talent cultivation can be achieved through dual-degree programs, interdisciplinary courses, and joint supervisor systems to cultivate compound talents with multi-disciplinary backgrounds. Secondly, optimizing the scientific research evaluation system. Traditional academic evaluation often focuses on contributions to a single discipline, so a more flexible evaluation mechanism should be established to recognize the innovative value of interdisciplinary research. Thirdly, strengthening industry-university-research collaborative innovation, with cooperation between enterprises, universities, and research institutions to promote the integration of basic research and applied research and accelerate the transformation of scientific and technological achievements. Disciplinary intersection and complementary advantages are an inevitable trend in the development of contemporary scientific research. To promote the output of high-level academic achievements, it is suggested to strengthen policy support, set up special funds to encourage interdisciplinary research; promote academic exchanges and hold interdisciplinary academic forums; build open and shared data and experimental platforms. Through multi-disciplinary collaborative innovation, the academic community will be able to solve scientific problems more efficiently, promote the improvement of university quality assurance systems [5], and drive social progress.

4.3. Establishing collaborative mechanisms to deepen resource sharing

Since joint cultivation of postgraduates is still in the exploration stage for the research object university, firstly, there are problems such as imperfect management mechanisms, inconsistent student status, credit recognition, and graduation standards, which affect cultivation efficiency. Secondly, insufficient supervisor collaboration and inadequate communication between dual supervisors lead to insufficient depth in students' research directions. Finally, students also face adaptability challenges, such as increased psychological and academic pressure due to cross-university or cross-regional studies.

To address the above challenges, we need to continuously strengthen the following aspects: Firstly, establishing a collaborative management mechanism, formulating a unified joint cultivation agreement, and clarifying rules for credit recognition, dual supervisors' responsibilities, and achievement distribution. Setting up a joint management office to coordinate course arrangements, scientific research projects, and student assessments. Secondly, deepening resource sharing models, building a "university alliance cloud platform" to share courses, experimental data, academic lectures, and other resources. Promoting the open sharing of large-scale instruments and equipment to improve utilization efficiency. Thirdly, strengthening supervisor team building, holding regular supervisor exchange meetings to promote scientific research cooperation. Implementing the dual-supervisor system and clarifying job responsibilities. Fourthly, enhancing the student support system, providing training for adapting to cross-university studies, such as guidance on academic writing and scientific research software use. Establishing joint scholarships to encourage excellent students to participate in international exchanges. Fifthly, promoting in-depth integration of industry, university, and research, continuing to cooperate with enterprises to set up "industry supervisors" and promote the transformation of scientific research achievements. Joint cultivation of postgraduates by universities is an important way to improve the quality of talent cultivation and promote scientific and technological innovation. Through team complementarity and resource sharing, high-level platforms can be efficiently linked to achieve a "1+1>2" synergy effect. In the future, it is necessary to further improve management mechanisms, optimize resource allocation, and strengthen supervisor collaboration to give full play to the advantages of joint cultivation and cultivate more compound innovative talents for national strategic needs.

4.4. Strengthening research intersection to enhance disciplinary competitiveness

Joint cultivation is a supporting force for university development. The key strategies to enhance disciplinary competitiveness are as follows: Firstly, establishing flexible joint cultivation mechanisms, formulating interdisciplinary postgraduate cultivation plans, allowing credit recognition and course sharing. Setting up special funds to support interdisciplinary research projects. Secondly, strengthening international cooperation and exchanges, promoting joint cultivation programs with internationally renowned universities, such as the "China Scholarship Council (CSC) Joint Doctoral Program". Encouraging postgraduates to participate in international academic conferences and cooperative research. Thirdly, optimizing the evaluation system, establishing evaluation standards suitable for interdisciplinary research, avoiding the limitations of traditional single-discipline evaluation systems, and encouraging the output of high-level interdisciplinary papers and patents.

Disciplinary intersection and scientific research cooperation are important ways to enhance universities' disciplinary competitiveness. The postgraduate joint cultivation model, through integrating multi-disciplinary resources, promoting inter-university collaboration, and deepening industry-university-research integration, can not only cultivate more innovative high-level talents but also promote the overall improvement of universities' scientific research levels. In the future, universities should further improve the joint cultivation mechanism, break disciplinary barriers, and build a more open and collaborative scientific research ecosystem to adapt to the new trends in technological development.

4.5. Improving evaluation systems and strengthening employment guidance

The prominent problems reflected by students, universities, and social employers mainly include: insufficient connection between practice and theory, inconsistent cultivation goals with partners, leading to disconnection between practical content and academic research; uneven resource allocation, with more cooperation opportunities for prestigious universities and large enterprises, and limited university resources; imperfect evaluation systems, with current assessment of joint cultivation postgraduates still focusing on theses, and practical achievements not fully recognized. Based on students' suggestions on joint cultivation work, the university should introduce corresponding optimization strategies: Firstly, strengthening in-depth university-enterprise cooperation, establishing long-term and stable joint cultivation bases to ensure that practical projects match disciplinary development. Secondly, optimizing the dual-supervisor mechanism, clarifying the responsibilities of enterprise supervisors, increasing guidance frequency, and providing corresponding incentives. Thirdly, improving the evaluation system, especially focusing on the stratification of academic and professional postgraduate cultivation, incorporating practical achievements (such as project reports, patents, etc.) into postgraduate assessment standards, and emphasizing the quality evaluation of postgraduate projects [6]. Fourthly, expanding resource sharing, promoting the construction of university alliances

to benefit more ordinary students. Fifthly, strengthening employment guidance, integrating career planning courses into the joint cultivation process to enhance students' employment adaptability.

In conclusion, the university joint cultivation model for postgraduates has significant advantages in improving practical abilities and employment competitiveness, but it still needs further optimization in resource integration, supervisor collaboration, and evaluation mechanisms. In the future, more diversified joint cultivation methods should be promoted to meet the social demand for high-level applied talents and facilitate the high-quality development of postgraduate education.

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