Research on optimization strategies for integration of industry and education of postgraduates in applied university------using the transportation major as example

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ABSTRACT. As a traditional engineering project, the transportation major established in applied university should keep up with the development strategy of new engineering and aim at cultivating professional talents in line with the new era, new model and new development. The education structure of our country is optimizing day by day, and the integration of industry and education to training postgraduates shows strong necessity and applicability. Colleges and universities should break the traditional education concept of "tradition, curriculum, and index", and update and expand into a multi-dimensional model structure of "focusing on goals, majors, courses, educating people, and understanding", which is conducive to the development of postgraduates in transportation majors. In view of the framework of multi-dimensional mode, this paper puts forward countermeasures such as improving the integrated training environment, optimizing the curriculum system according to the needs, setting up a dual-teacher education team, innovating the evaluation system, etc., which provides new ideas for improving the integration of industry and education in the new engineering transportation major.

Keywords: Integration of industry and education; Major in transportation; cultivation method

1 Introduction

The major of transportation is the product of the excellent engineering colleges that integrate the characteristics of running schools for many years with the experience of creating learning, and have the advantages of multiple resources such as teaching staff, curriculum system, practice base and social influence. Since February 2017, the Ministry of Education has formulated documents such as "Fudan Consensus", "TianDa Action", and "Several Opinions on Reform" in order to build a new engineering strategy. Among them, "Several Opinions of The General Office of the State Council on Deepening the integration of Industry and Education" (Document of the General Office of

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the State Council [2017] No. 95) [1] clearly points out that the reform of personnel training for integrating industry and education should be promoted. Improve the classified training system for academic talents and applied talents in higher education, increase the proportion of applied talents in training, and deepen the reform of training programs in engineering schools. At present, China's graduate education structure shows the characteristics of hierarchical differentiation, and professional degree and master students reach two-thirds of the scale. In 2020, the Academic Degrees Committee of The State Council and the Ministry of Education issued the "Professional Degree and Graduate Education Development Plan (2020-2025)", which further clarified the "innovation of professional degree and graduate education training mode, and improve the integration of production and education training mechanism". Therefore, colleges and universities need to break the traditional training concept that only takes "indicators and data" as the single goal, transform and upgrade the training framework and reasonably continue the integration of application, production and education, and cultivate professional and technical talents who can not only have the ability of "speaking and moving" but also adapt to the new era, new development and new model background.

2 Analysis on the training framework of transportation professionals under traditional background

Traditionally, engineering majors have predominantly focused on domains such as civil engineering, machinery manufacturing, and transportation, which cater to the rapid expansion of China's heavy industry. In their pursuit of scientific and technological advancements, colleges and universities tend to rely excessively on conventional methods, placing a significant emphasis on data indicators and theoretical findings. This practice has the potential to render academic graduate students incapable of effectively applying technology, and professional graduate students may struggle to fully comprehend the intricate theoretical principles associated with chaotic situations [2]. Consequently, the Shandong Jiaotong University waterway transportation degree graduate training system, compared with the framework system of national standards for graduate professional teaching quality, exhibits the following three primary issues. Firstly, the professional scope remains confined, thereby hindering its applicability to the contemporary characteristics of intelligent transportation vehicles and intricate transportation modes. Secondly, the abundance of basic subjects and prolonged theoretical courses within the graduate curriculum results in the potential loss of pivotal courses such as control principle, planning theory, and the essence of method. Lastly, the majority of enterprises today are involved in modern intelligent modeling industries, and the practical experience of graduate students during their studies significantly diverges from actual operations, thereby resulting in an inability to seamlessly transition from theory to practice. In light of this, the present study specifically analyzes the advantages and disadvantages of the training framework for the master's degree training program of Waterway transportation major at Shandong Jiaotong University, and proposes its enhancement and expansion into a multi-dimensional construction framework.

3 Multi-dimensional update framework for the integration of production and teaching training of new engineering majors

3.1 Attach importance to the training goal of combining realistic background with practice

To fully comprehend the aims and objectives of talent training, colleges and universities should align their efforts with the current transformational paradigm of industry demand. Specifically, they should adopt a multifaceted and meticulously crafted approach to market demand as their guiding principle. This entails refining their focus on enhancing the accuracy and seamless integration of professional talents with the specific requirements of industry. In light of China's progressive transformation of transportation into an increasingly advanced and intricate realm, it is imperative for professional graduate students from Shandong Jiaotong University engaged in waterway transportation to comprehend the evolutions within the field. Traditional bulk cargo ships have undergone substantial upgrading, and the emergence of advanced large-scale container ships has solidified their status as cutting-edge materials. Additionally, a variety of intelligent navigation concepts, such as intelligent electronic charts, high-precision satellite systems, and unmanned smart docks, have become the prevailing trends in today's transportation landscape. It is imperative for institutions to recognize the significance of embracing such innovations, rather than solely relying on traditional navigation techniques and principles. Consequently, the integration of production and education becomes a necessary measure. Furthermore, the formulation of training goals necessitates the alignment of professional knowledge of transportation with the fundamental practical operational capabilities of enterprises. Detailed talent training goals are outlined in Table 1.

Table 1. Training objectives of postgraduates majoring in transportation

Talent training objectives	Specific requirements
Professional knowledge	Be able to understand the advanced directions and concepts in the field of transportation, understand the knowledge of engineering science, and be familiar with the complex theoretical content of books.
Professional Competence	With the ability of engineering innovation, skilled use of modern tools engaged in transportation professional design, development, manufacturing, testing, and operation management.
Operation technique	Master the basic mechanical manufacturing ability, observe the ways and methods of experiments, and make computer simulation algorithms.
Working ability	Good oral communication skills, the ability to cooperate with others and be good at learning, the ability to follow the international awareness to expand their horizons.

3.2 Attach the professionalization level of curriculum system subjects

In the past, the training curriculum system for graduate students in traditional engineering majors followed a linear structure consisting of "general courses – subject basic courses – specialty basic courses – specialty orientation courses – elective courses for research objects." The majority of graduate students chose courses with professional orientation to fulfill the credit requirements. However, the lack of clear learning objectives and monotonous curriculum color posed challenges in meeting the needs of enterprises and were not aligned with the demand for talents in the transportation profession. It is crucial to explore advanced previous studies and then conduct professional excavation and in-depth analysis. The course system for transportation graduate students is depicted in Figure 1. It is noticeable that the school does not offer crucial public courses such as programming language, numerical analysis, modeling and simulation, which are essential for transportation majors. While professional courses are electives in accordance with students' needs, the curriculum content stipulated by the school exhibits high repetitiveness, the number of courses is limited, and the professional courses do not align with reality. Hence, it is essential to prioritize linking curriculum with practical requirements in the context of new engineering, divide the professional postgraduate curriculum system into key characteristics, and incorporate necessary courses in the direction of intelligent transportation. By redefining the proportion of compulsory courses and elective courses and disrupting the previous school regulation system for student choice, a more comprehensive curriculum system can be implemented.

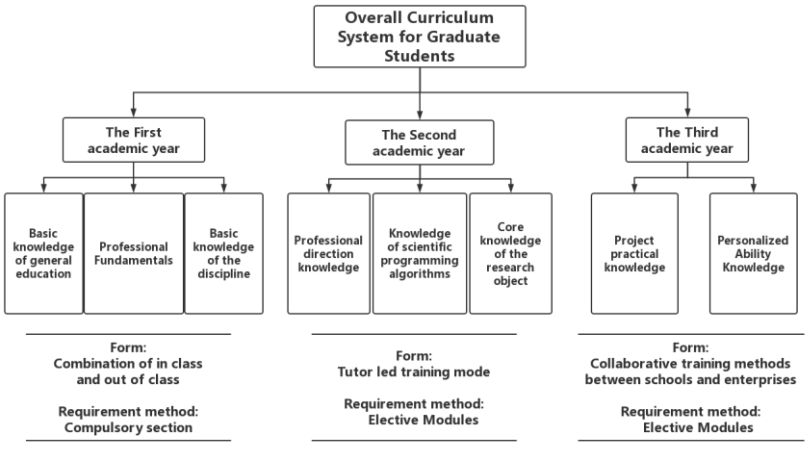

Figure. 1. Curriculum system of transportation graduate students

3.3 Attach importance to the implementation of the school-enterprise co-education mechanism

Although application-oriented colleges and universities emphasized school-enterprise cooperation in cultivating professional graduate students, they demonstrated a signifi-

cant disregard for the actual implementation. Instead, they transformed production internships into enterprise visits, transformed school-enterprise associations into school-led initiatives, and replaced student-centered initiatives with mentor-led passivity. Furthermore, the lack of evaluation, supervision, and management of students by colleges and universities led to the misconception that graduate students should engage in scientific research on the mechanism of integrating production and education. Therefore, the current concept of integration of production and education must emphasize the implementation of the school-enterprise co-education mechanism. This requires incorporating students' development attributes into teaching design, seeking common teaching content with enterprises, and establishing cooperative relationships between students and tutors within and outside the school. Additionally, the evaluation mechanism of university-enterprise co-education should be taken into consideration, with emphasis placed on highlighting the importance of enterprise training by increasing the percentage of credits allocated to the practical stage of graduate students. Instructors within and outside the school should simultaneously implement and evaluate students' expected outcomes. This joint evaluation serves not only as a comprehensive assessment of students' abilities but also effectively sustains the long-term cooperation between the university and enterprise.

3.4 Attach importance to the reflection after the combination of production and education

Application-oriented colleges and universities will require professional postgraduates to practice in enterprises in the third academic year. 46 postgraduates from School of Shipping, Shandong Jiaotong University are randomly selected to conduct a questionnaire survey on industrial practice. The analysis of some data results is shown in Figure 2. 74% of students lack clear internship goals and plans, and do not have in-depth understanding of the industry; Only 28% of students had internships during their undergraduate years, but they said they were just as unable to use what they had learned and their potential as their peers who had not. Students have little understanding of the working process and environment of enterprises. All kinds of school training programs generally ignore the content of students' reflection and perception stage, and only focus on the middle level of the learning process. Therefore, application-oriented colleges and universities should attach more importance to the perception and reflection of postgraduates after practice exercise, add psychological requirements to the training concept of integration of production and education, pay attention to the role of perception and reflection on learning absorption ability, and make clear their goals and plans in the internship process before internship [3], summarize the trend factors that promote the development of the industry and the experience that is conducive to their own learning.

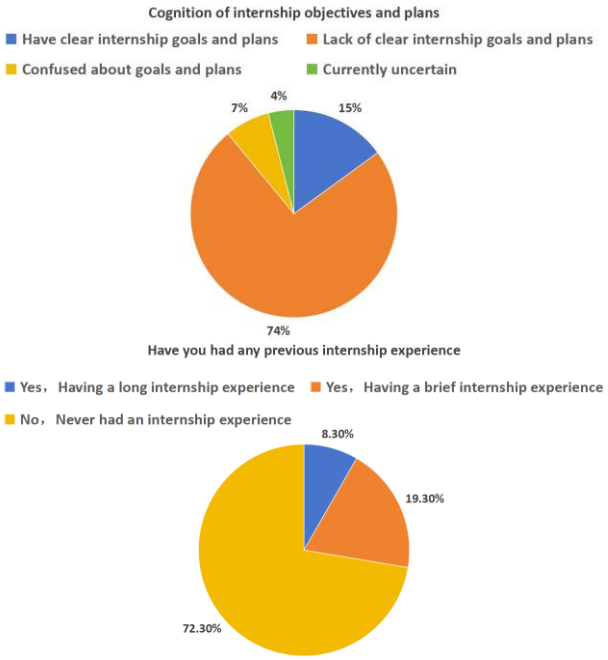

Figure. 2. Summary Chart of Questionnaire Survey Results

4 Conclusion

Based on the multi-dimensional innovative framework system of industry education integration, propose updated training and optimization suggestions to address the current shortcomings of training.

4.1 Improve the fusion culture environment

Enhancing the learning environment that incorporates both production and education is the fundamental basis for application-oriented colleges and universities to cultivate talents. In terms of the external social environment, government entities should formulate and refine pertinent policies and regulations, augment the motivation of transportation colleges and universities to integrate production and education, and contribute to the establishment of a more robust platform network in collaboration with enterprises. Adhering to the principle of dependency theory, the integration of industry and education in applied universities in China is situated at the boundary of the higher education system, with its advancement lagging behind that of central research universities. Consequently, it is essential for other transportation research universities to provide support and establish a favorable external environment. Rational utilization of university and enterprise resources can be achieved in a hierarchical manner, with the educational en-

vironment adhering to a framework that embodies the principles of "focusing on objectives" and "focusing on courses". It is evident that the integration of production and education serves as an effective solution to address numerous challenges faced by transportation graduate students.

4.2 Optimize the curriculum system according to the teaching needs

The core of training professional talents is to set up professional courses that meet the needs, and the quality of courses affects the quality of talents. Colleges and universities should highlight the basic application attributes of course content and highlight the concept of "focusing on goals" and "focusing on courses". In order to improve students' ability to solve practical technical problems, the school will develop industry innovation, build course modules based on "basic knowledge + practical skills + comprehensive skills", promote the organic integration of subject knowledge and industry needs, and avoid the situation of lagging construction and deviating from the actual application of the curriculum [4]. It is the basic requirement of application-oriented curriculum construction to closely connect with the development needs of the local transportation industry and reasonably integrate the characteristics and job demands of the transportation industry with the course content.

4.3 Set up a two-teacher education team

The role of educators in the realm of advancing the mode of integration of production and education is of paramount importance. The establishment of a university-enterprise dual-teacher team can effectively leverage the advantages of the integration of production and education, thus fostering the dissemination of the "emphasizing majors" and "educating people" training principles. Emphasis is placed on the necessity for application-oriented colleges and universities to establish specialized teacher teams that can effectively support the implementation of courses. The supervisor assumes the primary responsibility for the training of graduate students. By adopting the school-enterprise dual teacher system, these institutions strive to cultivate the professional application abilities of graduate students, cultivating a close and collaborative consultation mechanism based on the school leadership team and research projects. This system entails providing students with comprehensive collaborative guidance throughout the entire process. Finally, the establishment of a double-qualified teaching team fosters a problem-driven cooperation, seamlessly integrating student practice with enterprise projects, ultimately forming a novel industry-university-research alliance system.

4.4 Innovation evaluation system

Developing a flawless and suitable evaluation system represents the ultimate obstacle to the efficient operation of a training mechanism. The implementation of a scientific and rational evaluation system that incorporates talent cultivation, enterprise benefits, and technological innovation as indicators is crucial for achieving maximum optimization effects [5]. Such an evaluation system should effectively align with the core values

and training objectives of professional degree graduates, seamlessly integrate the concept of school-enterprise integration within the graduate training framework system, and reflect the comprehensive value of students' professional competence and unique capabilities following a collaborative training approach between academia and industry. In order to innovate the evaluation system, it is imperative to disrupt the prevailing practice that solely relies on the publication of degree papers as a proof of students' expertise. Instead, the achievements of students' practical experience and collaboration with mentors should be incorporated into the evaluation system implemented by schools. Furthermore, a third-party evaluation system should be introduced, whereby the evaluation role is assigned to multiple stakeholders within the professional graduate training system under the school enterprise model, including enterprise trade unions and scientific research organizations.

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