Mode Construction of Cultivating Professional Degree Postgraduate by Industry-Education Integration

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Abstract. Facing the new round of scientific and technological revolution and industrial transformation, new and higher requirements and challenges are put forward for cultivating the "new generation" of engineering talents. From the perspective of reality and theoretical exploration, the collaboration between the two types of organizations in universities and enterprises in the process of educating people has always lacked theoretical guidance and effective practical paths, and the education reform initiatives of new engineering in recent years also focus on this. Based on synergetic theory, around the core issue of "how to improve the effectiveness of the professional degree training program of industry-education integration", identify the factors of synergetic Industry-Education Integration, Got the synergetic mode of industry-education integration, further explore the similarity of synergetic mode, so as to provide replicable guidance and countermeasure suggestions for different types of industry-education integration projects.

1 Introduction

The society's goal of cultivating professional degree postgraduates is increasing day by day, and it is an inevitable trend to change the training mechanism and mode of professional degree postgraduates. This is also closely related to the national industrial structure and the setting of disciplines. It is also the external driving force for the structural change of the engineering field of the electronic communication engineering discipline. The situation of the industrial structure and the demand for talents deeply restrict the depth and breadth of the development of the discipline. In order to ensure the pertinence and effectiveness of Engineering Practice for Master degree in Electronic communication, strengthen the professional degree postgraduates' engineering practice ability, Innovation and entrepreneurship ability training, to ensure the sustained and healthy development of professional degree postgraduate education, according to the Ministry of Education issued "Some Opinions on Good Training of Full-time Professional Degree Postgraduates". It is necessary to strengthen the training mechanism and the cultivation of innovation and
entrepreneurship ability of professional degree postgraduates, contribute to economic construction and social development\(^1\)-\(^2\).

Since the new century, continuous education reform actions have cultivated and delivered a large number of high-quality engineering and construction talents for economic and social construction, and made significant contributions to the construction of modern industrial system. Globally, most education systems around the world adopt a standardized direct teaching mode, which leads to the graduates becoming the labor force engaged in early repetitive manufacturing work. Nowadays, some graduate training systems for electronic communication engineering professional degrees still use the methods of direct teaching by teachers and passive learning by students. The outdated teaching organization and management mode cannot timely adapt to the large number of demands emerging in the new context. The training gap in practice leads to professional degree postgraduates cannot understand the original engineering situation. Generally speaking, professional degree postgraduates lack the understanding of the product process in the original engineering practice, as well as the knowledge of digital product process and modeling on the original process. As a result, professional degree postgraduates trained by the university cannot connect well with their work content, that is, the talents trained by the university cannot match the industrial demand\(^3\)-\(^5\).

The arrival of the Industry 4.0 era, frontier industries such as new energy, information and environmental protection have achieved breakthrough development successively. This presents a new and challenging requirement for higher engineering education in China, especially for the development of emerging technology breakthrough and emerging industry demand for professional degree postgraduate training. Professional degree postgraduate must have the ability of "practical, intersectional, comprehensive" and other multiple features, the "practical" refers to the ability to do and practice, the "intersectional" focus on professional degree postgraduates' knowledge should be more interactive and extensive, while the" comprehensive "emphasizes the professional degree postgraduates not only have engineering background but also operate in areas such as matter. In a word, the demand for professional degree postgraduates has changed dramatically in the industry and times, and the new industrial mode needs high quality engineering talents with both practical professional technology and cross-comprehensive knowledge background. However, at the same time, influenced by various factors such as development concept, operation mechanism and action guidelines, the education supply side of the original professional degree postgraduate training and industrial demand side still do not fit well, and the separation between "industry" and "education" still exists.

Aiming at the common problems existing in the training of electronic communication engineering, such as disconnection between theoretical learning, practical ability training, to promote the capacity development of professional degree postgraduates of electronic communication engineering, looking for an effective way to improve the quality of cultivation of professional degree postgraduates, we carry out reform on the cultivation of practical ability of professional degree postgraduates. This project is aimed at the actual situation of the professional degree postgraduates as the object, who are from school of electronic communication engineering in Liaoning Technology University, carrying out research on the cultivation mechanism of postgraduate education, seeking to build a cultivation mode of professional degree postgraduate based on the synergetic theory of industry-education integration, and analyzing the cultivation objectives. To establish an orderly regulation of teaching resources for the cultivation quality of professional degree postgraduates and further integrate the dynamic mode, so as to form an orderly organization and management system.
2 Industry-education integration and synergy

The integration of industry and education is different from the concepts of school-enterprise cooperation and industry-academia cooperation, which has such characteristics as plurality and openness. After a period of rapid development, the longitudinal research on the integration of industry and education has been relatively abundant. In addition to the discussion of its connotative characteristics, many scholars pay attention to the influencing factors of the integration of industry and education. In addition to talents, capital and institutions as the main influencing factors of industry-education integration with high recognition, the vision of both industry and education will also affect the effect of industry-education integration to some extent. In terms of performance evaluation, it mainly focuses on the quality of talent training and the development and transformation of scientific research achievements. In the discussion of industry-education integration mode, scholars mostly build industry-education integration modes based on theories such as triple helix, sustainable development and strategic alliances [6-9].

Since the reform and opening up, the phenomenon of light teaching and practice has generally existed in China's higher engineering education. As a result, most teachers lack engineering practice experience, and graduates lack engineering practice ability and professional quality, which cannot fully meet the literacy requirements of engineering and technology talents for economic transformation and upgrading.

Synergetic theory provides new ideas for exploring the synergetic mode and path of industry-education integration. The synergetic theory emphasizes the synergy and self-organization within the system, as well as the synergy inside and outside the system, which provides new ideas and theoretical basis for system evolution and change, and has certain inspirational effects on the integration process of both industry and education, as well as the interaction process between them and other external organizations. The industry and education system are naturally cross-border, that is, there are extensive and frequent exchanges and interactions between industry and education, the government and research institutions, and the system can be divided into corresponding subsystems, and the synergy is to achieve a comprehensive mode of mutual coordination among the subsystems within the integration of industry and education. The integration of industry and education is the optimal combination between the subsystems within the integration of industry and education under different environmental conditions. This has implications for the units whose professional degree graduate education is in teaching type, and it is important to improve the quality of professional degree graduate training in terms of higher education satisfaction.

The "realization mechanism" of the synergetic element refers to the formal implementation stage of the industry-education integration project and the implementation of the cooperation intentions of both industry and education into concrete synergistic actions. First at all, resource sharing, which includes: first, the two sides jointly invest funds to support the implementation of activities in the project; second, site and equipment sharing, enterprises provide sites and equipment for professional degree postgraduates to practice so that they can be more fully exposed to real engineering scenarios, and the university will also provide on-campus sites and some advanced equipment to enterprises to help them achieve technological breakthroughs; third, manpower sharing, enterprise instructors participate in the design of training programs and lectures for professional degree postgraduates, and help professional postgraduates grasp the direction of their chosen topics and provide internship practice opportunities, while experts and scholars from universities also go into enterprises to train professional degree postgraduates in real production scenarios and help enterprises solve relevant technical problems. Secondly, the
platform is co-constructed, and the two sides jointly build the following three types of platforms: First, project platform, universities will undertake some horizontal topics, which also need to use the resources of enterprises, and the technological innovation of enterprise's department products also need the participation of school research force. The project platform jointly built by both sides provides diversified choices for the practical ability cultivation of professional degree postgraduates. Second, practice platform, which mainly includes university-enterprise joint laboratory, off-campus practice base, etc., which provides opportunities for professional degree postgraduates to contact with real engineering scenes, discover and solve real engineering problems. Third, communication platform, such as seminars and regular project meetings, etc., the communication activities are conducive to synchronize the project progress, discuss and solve the project problems together, and can further explore the demand for industry-education cooperation; fourth, coordination platform, such as leadership groups and coordination groups, promote smoother and more organized communication between industry and education. Finally, based on the resources invested together and the platform constructed, the university and the enterprise can collaborate in the co-education of professional degree postgraduates, which can be manifested in the form of designing practical training programs for professional degree postgraduates according to the project demand, setting up dual tutors and providing internship opportunities for professional degree postgraduates.

The integration of industry and education is not only a simple combination of teaching activities of universities and production activities of enterprises only, but also a complex system, in the process of synergy, it is not enough to rely only on the synergetic goal to supervise and restrain the cooperation behavior of schools and enterprises, but also need to set up certain restraint mechanism. For example, a monitoring organization is formed within the industry education system, regular feedback is given by the professional degree postgraduates involved in training, and external third-party monitoring is accepted. The constraint mechanism is helpful for the industry and education to achieve better synergistic effect. "Feedback mechanism" is a synergistic element. The integration of industry and education is cyclical. During the course of a cycle, the participants will produce academic and commercial achievements (such as patents, papers and designs), and at the end of the project, the effect of talent training will be shown. Both sides should make an overall evaluation of the project effectiveness based on their own feelings and external evaluation, evaluate the difference between the project results and the expected value, and form feedback to decide whether to continue to carry out the next cycle of the project and even expand the scope of cooperation. The fundamental purpose of performance feedback is to summarize the bright points reflected in the current cycle of industry-education integration projects, and review the problems and shortcomings, so as to produce meaningful experiences to help continuously optimize and iterate the collaborative mode of industry-education integration engineering talent cultivation, enhance the efficiency of the mode, and thus improve the effectiveness of engineering talent cultivation[8].

3 Professional training mode

The cultivation of practical ability of professional degree postgraduate education and the continuous improvement of cultivation quality are important concerns in the sustainable development of higher education. Due to the relatively solidified training mode, the professional degree postgraduate training system in colleges and universities often causes some deviations in the knowledge, ability, quality and other aspects of the economic and social needs of the professional degree postgraduate. What the economy and society need is the specialized talents closely focused on science, technology and industrial structure, which is also the important goal of our professional degree postgraduate education,
requiring that the knowledge, skills and innovation ability acquired by professional degree postgraduates in school should be closely integrated with the needs of the economy and society. The acquisition of such knowledge needs to be completed in practice, which means that the teaching reform content of "education by category" is reflected in the innovation platform and practice base.

Clarify the requirements for the development of the integration of industry and education, can integrate the strategy of prioritizing education and talent first into various policies. Combined with the national implementation of innovation-driven development, new urbanization, manufacturing power strategy, further coordinate and optimize the education and industrial structure, simultaneous planning of the development of policy measures and ways to achieve the integration of industry and education.

To improve the mechanism of close collaboration between higher education institutions and backbone enterprises in the industry, small and medium-sized entrepreneurial enterprises, to jointly create an ecosystem of collaborative innovation and enhance the upgrade of innovative industrial capacity. To adapt to the country's new-type urbanization development with urban agglomerations as the main body, enhance industrial bearing capacity and innovation capacity, and build an integrated industry-education network with orderly hierarchy, complementary functions, resource sharing, and close cooperation.

After years of reforming the talent cultivation mode of professional degree postgraduates and continuous exploration of school-enterprise cooperation, a variety of school-enterprise, school-local, bureau-school, mining-school and other cooperative internship modes have been formed. However, most school-enterprise cooperation is often formal and lacks deep integration, especially lack of understanding of national and local, economic and industrial development, resulting in the systemic, long-term and systematic depth of school-enterprise cooperation floating on the surface. As a result, the systematical, long-term and systematic aspects of school-enterprise cooperation are superficial, and there is no real integration of industry and education. How to construct the long-term mechanism of the industry-education integration? How can we guarantee the sustainable and effective operation of the partnership? To answer these questions, it is necessary to further deepen the faculty construction, practice base construction, innovation and entrepreneurship education and management mechanism in the cultivation of professional degree postgraduates, and many pioneering works need to be further implemented.

Guided by the concept of integration of industry and education, we study and practice the cultivation system of professional degree postgraduates' engineering practice ability with the synergy of "professional basic ability-engineering practice ability-innovation and entrepreneurship ability-professional ethics and literacy" and "on-campus teaching-off-campus engineering practice base", and build the cultivation mode of professional degree postgraduates' engineering practice ability with multi-level progressive practice process and segmented learning mode.

4 Synergetic mode construction

4.1 Mode construction

The idea of constructing the synergetic mode is: based on the internal demands and external impetus, the synergistic subjects develop the idea of carrying out the synergy, then interact several times to determine the synergetic goals, and finally achieve the synergetic goals through a series of synergistic measures. To apply the synergetic mode to industry-education integration projects is to present the inner motivation of both industry and education, the external motivation of the government as the core third-party organization,
the formation and realization process of the project and the final performance feedback and other synergetic elements in a clear hierarchy to the relevant subjects, and to integrate all the synergetic elements into one. Therefore, the construction process of synergetic mode is to extract the synergetic elements first, then sort out the hierarchy between the elements, and finally integrate the platform. Shown as Figure 1.

![Diagram showing the integration of industry and education](image)

Fig. 1. Integrated configuration of industry and education

Establish a reasonable cultivation mechanism of industry-education integration in professional degree research, and form a written report. Including: the allocation of teacher resources of professional degree postgraduates' tutor and enterprise tutor in the mechanism of integration of industry and education, the initial formation of dynamic mode of integration of industry and education, and after certain practice; the construction and formation of the mode of integration of industry and education of professional degree research and related cultivation methods, and seeks to further enhance the innovation and creativity ability of professional degree postgraduates.

### 4.2 Case of integration of industry-education

Background of the business that cooperates with the school: Liaoning Hans Mining Engineering Group Co., Ltd. is a high-tech enterprise located in Fuxin National High-tech Development Zone, Liaoning Province. It has Liaoning Hans Machinery Manufacturing Co., Ltd., Fuxin Technical University Liwei Science & Technology Co., Ltd. and other enterprises. At present, the main businesses of the company are: research and manufacturing of open-pit mine construction machinery; in-service remanufacturing of open-pit mine construction machinery; professional contract of open-pit mine perforation and blasting, as well as digital mine research and construction with information integration and intelligent equipment as the leading technology. The group production of coal winning machine for coal mine fully mechanized working face one of the most important equipment is widely used in the coal mine, coal mining machine uses in the coal directly underground mining, and the coupling interaction between coal and rock, its working performance affected by coal and rock characteristics significantly, often in the equipment selection and design, adopt a muscle to pull the car type selection design principle, caused by air carrier is serious, in order to explore the method of high efficiency cutting and low energy consumption operation of shearer, from the perspective of cutting and energy saving, aiming at the dynamic problem of shearer operation load, a dynamic model of cutting under random load was established, and a mechanical performance test system of shearer complete equipment was invented, and an evaluation system of shearer operation energy
consumption was constructed; according to the characteristics of hard coal rock and viscous coal rock which are not easy to be broken, the coal rock pre-splitting unloading device and control method, the coal rock pre-splitting and cutting pick combined crushing system, low energy consumption special-shaped cutting pick shearer drum were invented; according to the cutting medium change, adjust the height and the speed of shearer, invented the active infrared coal and rock identification system, active incentives infrared imaging of coal rock interface recognition device and method, has completed the characteristic signal of D-S evidence theory fusion recognition, and implements the autonomous navigation, autonomous positioning, autonomous cutting of shearer, effectively reduce the cutting loss.

In response to the needs of industry and the urgency of enterprises, Liaoning Technology University began to seek the reform and transformation for training electronic communication engineering professional degrees, which is urgently needed by the group, and realized that the integration of industry and education should be one of the key paths for development. The professional degree postgraduate program was launched. At the early stage of the project, a professional steering committee with a "dual system" structure was established, consisting of enterprise instructors and mentors in the fields of theoretical analysis and practical engineering involved in the research content, and a project responsibility system was implemented, with the project decomposed into sub-projects and members of the project team divided into tasks. In order to make the project complete and conducive to the integration of production and education of professional degree postgraduates, relevant different instructors and corporate mentors will appropriately participate in the research of this project. After the project is issued, the group will clarify the division of labor among the sub-projects, implement the tasks and divide the execution. In the implementation of the project, the communication, timely inspection, timely summary, to ensure the smooth progress of the project research. The project team will conduct research step by step, collect and analyze and state data, carry out theoretical research, and construct a training mechanism for the industry-education integration for professional degree postgraduates. Evaluate the implementation leadership of the project team, enterprise mentors, practice base managers, etc., carry out mid-term inspections, and make periodic summaries and feedbacks.

After this stage of innovative practice, the two sides formed a modular teaching system for wisdom interconnection and control, mining intelligent communication, and incorporated the latest scientific and technological achievements of Liaoning Hans Group into the teaching materials of many courses and teaching, which greatly enhanced the practicality and foresight of the professional degree postgraduates' courses. With the deepening of integration, both sides are also constantly optimizing the mode and details of cooperation. Give full play to the location advantage of "professional degree postgraduate in the school-factory ", the two sides build a virtual-real training base together, and the enterprises accept professional degree postgraduates to the factory for production practice, so as to meet the demand of professional degree postgraduates for new knowledge and new technology; build a mechanism for cooperation between industry and education and implement a stable and effective organizational structure.

5 Construction analysis

The interconnection of teaching mode and practice links of professional degree postgraduates promotes the improvement of professional degree postgraduates' practice ability. In the study of practice ability to promote the cultivation of professional degree postgraduates need to follow: 1) adapt to the principle of overall matching and individual motivation; 2) the principle of synergistic promotion and common development. The main ways to promote the training mechanism of professional degree postgraduates by practical
ability are as follows: 1) natural integration; 2) Through the tutor's course group; 3) Policy approach; 4) Adjustment of educational structure and methods.

In practice, it mainly promotes the integration of industry and education through the way of subject combination of supervisors, improves the relevant ability of professional degree postgraduates to adapt to the requirements of economy and society, and cultivates the innovation and professionalism of professional degree postgraduates.

The learning methods, teaching methods and teaching means of professional degree postgraduates are the basis to guarantee the teaching quality of professional degree postgraduates. The scientific and reasonable method and complete teaching means can ensure the training quality of innovative talents. By means of integration platform, strengthen the professional degree postgraduates' innovation practice ability, which is conducive to the strengthening of the professional degree postgraduate practice teaching, and helps cultivate specialized talents suitable for the requirements, while the experience of graduate students in the industry-education integration platform promotes the growth of professional degree postgraduates in all aspects and enables them to better adapt to their future careers.

6 Conclusion

The collaborative mode of professional degree postgraduate cultivation in industry-education integration is a complex organizational system that includes universities, enterprises and government, integrates all the synergistic elements that affect the effect of industry-education integration, takes university-enterprise collaborative cultivation and "two-chain integration" as the main goal, and carries out collaborative cultivation of professional degree postgraduates by means of resource input and platform construction based on resource interaction, and feedback on the synergistic effect to promote continuous close collaboration between industry and education. In addition, the characteristics of the synergetic mode are discussed, that is, humanity education, systematicness, dynamic and equifinality. From the perspective of universities and enterprises, for the collaborative path selection Suggestions, in particular, Universities should refine the layout of school-enterprise meetings by discipline or profession and build a big data platform for industry-education integration projects, in order to improve the efficiency of collaborative path selection, while the enterprise should consider its scale, future direction and business layout in order to increase the range of synergistic path selection.

Authors’ contributions

The contributions of the authors of this article are equal.

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