



## ARTICLE

# Mode Analysis and Deepening Path of the Collaborative Education between Local Engineering Universities and Enterprises

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### ARTICLE INFO

#### Article history:

Received: 26 March 2018

Revised: 15 May 2018

Accepted: 8 October 2018

Published Online: 16 October 2018

#### Keywords:

Local engineering universities

University-enterprise collaborative education

Mode

Path

### ABSTRACT

At present, China's local engineering universities have basically formed five modes of collaborative education between Engineering Universities and Enterprises, namely the mode relied on university-enterprise alliance, the mode centered on the "Excellent Engineer Education and Training Program", the mode rooted in key disciplines, the mode based on the innovation and entrepreneurship education activities and the mode of carrying out international joint training, etc. However, in the process of university-enterprise collaborative education, there are still some shortcomings such as long-term deficiency, low fit and insufficient system. Therefore, three main ways to deepen the university-enterprise collaborative education are proposed: The first is to improve and implement the local government's policy guarantee system and incentive measures, fully mobilize and stimulate the enthusiasm and initiative of enterprises to participate in university-enterprise collaborative education; The second is to innovate the long-term operation mechanism of university-enterprise collaborative education, and to open up the last mile of educating and employing people; The third is to innovate the university-enterprise joint university-running mode and build a system of engineering talents that integrates innovation and practical capabilities.

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#### Fund Project:

This article is the phased research result of the National Social Science Fund 2017 Education Youth Project "Research on the Dynamic Mechanism of the Collaborative Development of Universities and Strategic Emerging Industries in the Region" (Project No. CFA170253).

## 1. Introduction

China has a solid foundation for higher engineering education resources. It has a large number of science and engineering universities and a large number of advantageous engineering majors, especially local engineering universities have the historical and geographical cooperation advantages of high-end equipment manufacturing and petrochemical enterprises in the region. Taking Liaoning Province as an example, at present, universities in Liaoning Province have participated in the construction project of excellent engineer education and training programs. Among them, 14 universities have implemented national-level outstanding engineer education and training programs and in conjunction with 54 enterprises and institutions to build a national engineering practice education center, the number of universities and colleges ranked third in the country; 78 undergraduate majors implement the national series of "Excellent Engineers Program", 130 undergraduate majors to carry out the pilot reform of provincial engineering personnel training mode, the practice base of 145 university-enterprise cooperation has become a provincial engineering practice education center and a student off-campus practice education base, and 11 projects have carried out pilot research and practice on the innovation of university-enterprise collaborative engineering talent training system. Therefore, systematically carry out research on the collaborative education of local engineering universities and high-end equipment manufacturing, petrochemical and other well-known enterprises, and cultivate and cultivate engineering talents with rich types and stable quality, which can provide a solid foundation for the improvement of local economic and social development and a first-mover advantage.

## 2. The Main Modes of Collaborative Education between Local Engineering Universities and Enterprises

The typical modes of collaborative education between local engineering universities and enterprises are mainly summarized into five modes:

### 2.1 Carrier-based Collaborative Education Mode

Local engineering universities set up university-enterprise alliances in different fields, focusing on five aspects: collaborative innovation, collaborative education, collaborative employment and entrepreneurship, collaborative services, and collaborative development, conduct organized, distinctive, targeted, and institutional collaborative education. For example, Dalian Jiaotong University has established the "Liaoning Province Rail

Transit Industry University-Enterprise Alliance" under the leadership of "China Rail Transportation Equipment Manufacturing Innovation Alliance". Shenyang University of Chemical Technology, as the chairman unit, has established the "Liaoning Province Petrochemical Industry University-Enterprise Alliance". Liaoning University of Technology, as the chairman of the board of directors, has led the establishment of the "Liaoning Province Auto Parts Industry University-Enterprise Alliance", each of which has established a distinctive "University-Enterprise Alliance Regulations" and "University-Enterprise Alliance Agreement."

### 2.2 Planned Collaborative Education Mode

Local engineering universities center on the national and provincial "Excellent Engineer Education Training Plan", by inviting enterprises to participate in engineering personnel training goal formulation, curriculum system settings, education and teaching quality evaluation, teaching content update and teaching method reform, etc. to develop elite, well-organized, coordinated and guaranteed universities and enterprises to collaborative education. For example, Dalian Jiaotong University, Liaoning University of Petroleum and Chemical Technology, Shenyang University of Technology and Shenyang University of Chemical Technology have formed a three-level management mechanism of "excellence plan" through the improvement of the engineering talent training system and management system of the "Excellence Plan" to ensure that the work of the new mechanism for university-enterprise collaborative education in the "Excellence Plan" is implemented item by item. The first level is to establish a "Excellence Program" leading group at the university level, with a focus on policy, human and financial support; The second level is based on the establishment of the "Special Committee for Teaching Excellence in Excellence" and the "Expert Working Group for Education and Training Program for Excellence Engineers", and employs professors with rich experience in teaching, research and engineering, and senior engineering and technical personnel of the company as members, responsible for guiding and making important decisions in the student development process of the "Excellence Program"; The third level is the establishment of the "Excellence Planning Working Group" in the pilot university, which is responsible for the specific implementation of the collaborative education related work in the "Excellence Plan".

### 2.3 Diversiform Collaborative Education Mode

Local engineering universities carry out order-based, orientation-oriented, and customized engineering personnel training mode and training mechanism reform to promote

the deep integration of university-enterprise supply and demand. For example, Shenyang University of Chemical Technology has set up Jingbo class in chemical engineering and technology, and has cultivated talents with university and enterprise of Jingbo Agrochemical Technology Co., Ltd., and students study in university for three years, in the last year, they go to enterprise to conduct internships. Dalian Jiaotong University carried out the five-year dual-professional compound training mode and practice of "traditional professional + software engineering", send students with certain professional background to the software college for two years.

#### **2.4 Innovative and Entrepreneurial Collaborative Education Mode**

The local engineering universities are based on the whole process of innovation and entrepreneurship education activities, and through the establishment of a fully functional and innovative entrepreneurial activity platform with enterprises, a variety of innovative and entrepreneurial education projects and competitions are carried out, collaborating to build a "big project" talent training system that combines application capabilities with innovation capabilities. For example, Liaoning University of Technology and Jinzhou Wonder Auto Group Co., Ltd. carried out all-round collaborative education, the university and enterprise jointly established the "Wonder Motorcade" university student innovation team. From 2011 to 2017, the Wonder Group sponsored the motorcade more than 1.8 million Yuan. Since the motorcade was established, it has won many achievements in domestic and international competitions. It won the second best result in the 2016 China University Students Formula Electric Car Competition. In 2017, it participated in the Japan International Competition and won the runner-up. In the past three years, the students of the automotive design team have obtained 11 patents, published 7 scientific papers and 4 software copyrights. It has become a powerful and influential university student automotive design innovation team in China.

#### **2.5 International Collaborative Education Mode**

With the implementation of the national "the Belt and Road" strategy and the acceleration of "going out" in universities, some local engineering universities have paid more and more attention to cultivating international engineering talents, and actively cooperate with well-known overseas companies to jointly cultivate international talents in higher engineering fields. For example, Liaoning Petrochemical University and Singapore's Rodrigo Petrochemical Engineering Co., Ltd. jointly established the "In-

ternational Engineering Practice Education Center", and actively carry out students' overseas engineering practice training, employment and engineering design and research and development and other collaborative education activities. Nearly 100 students have gone to Singapore to work. On the whole, the exploration of the collaborative education mode of Liaoning local engineering universities and enterprises has played an important role in demonstrating and guiding the adjustment of engineering personnel training structure, improving the quality of engineering talent training, promoting engineering education and teaching reform, and enhancing the employment ability of engineering graduates.

### **3. Problem Exploration of Collaborative Education between Local Engineering Universities and Enterprises**

#### **3.1 Insufficient Long-term Effectiveness of Collaborative Education between Engineering Universities and Enterprises**

The local government's guarantee system for enterprise interests is still not perfect. The university-enterprise collaborative education lacks a strong and close interest bond, and the enterprise has a low sense of interest in the university-enterprise collaborative education. Local governments lack the support policies and reward and punishment systems that really encourage enterprises to participate in collaborative education, and ensure the interests of both universities and enterprises through clear laws and regulations. However, some preferential policies such as enterprise tax reduction and subsidies for accepting internship training for university engineering students have not yet made substantial progress, and there are widespread deviations in implementation, inadequate supervision or assessment mechanisms, or inadequate implementation. For example, some of the existing policy documents are mostly formulated by the education sector. The participation of enterprises is not high. Most enterprises passively participate in the collaborative education mode of government establishment, university leadership, and enterprise participation, which lack of subjective enthusiasm.

#### **3.2 Low Integrating Degree of Collaborative Education between Engineering Universities and Enterprises**

Enterprises lack the willingness to act and continuous motivation to participate actively. At present, the problem of restricting the operation mechanism of university-enterprise collaborative education is more obvious, and the desire of enterprises to actively participate in the con-

struction of higher engineering education system is lower. Most enterprises are reluctant to accept student internship training on a large scale, and there is a widespread phenomenon of "university heat and business cold", which can be mainly summarized as: First, the reality of the instability of the economic benefits of enterprises and the heavy burden of production and operation affects the enthusiasm of enterprises to accept the internship training of university students. Second, the enterprises are concerned about the personal injury, safety hazards and safety responsibility during the production internship. Third, the company's core process, key production technology and confidentiality factors of important research and development technology; Fourth, universities and enterprises have a very limited financial support for student internship training. Taking student safety as an example, enterprises have a strict and complete three-level safety education system and responsibility system. Employees need to undergo strict, periodic, safety education and pre-job training to get a job. For interns who lack systematic security education and only stay in the company for a short period of time, the willingness to accept the company is not obvious.

### **3.3 Inadequate Systematicness of Collaborative Education between Engineering Universities and Enterprises**

The teaching mechanism to promote seamless integration and deep integration of school-enterprise has not been completely straightened out. There are still defects in the comprehensiveness and systematicness of enterprises participating in the construction of engineering education teaching system in colleges and universities. The main problems are as follows: the number of enterprise research and development personnel, senior engineers and professional technicians participating in engineering teaching is still insufficient; the form of enterprise participation in curriculum system construction, teaching application knowledge, joint instruction curriculum design and graduation design is still simple; The quality monitoring and evaluation system of enterprises participating in intramural simulation teaching and off-campus internship training is not systematic; The randomness and variability of the participation of enterprise experts in the research, formulation, updating and revision of engineering talent training programs are large, and the recommendations are based only on the actual needs of enterprises, which lack of objective understanding of the law of talent cultivation and reasonable consideration of the construction of students' knowledge systems.

## **4. Deepening Path of the Collaborative Education between Local Engineering Universities and Enterprises**

### **4.1 Improve and Implement the Local Government's Policy Guarantee System and Incentive Measures, Fully Mobilize and Stimulate the Enthusiasm and Initiative of Enterprises to Participate in University-Enterprise Collaborative Education**

First of all, the local government has comprehensively formulated the management methods for school-enterprise collaborative education. The local government will work with enterprises and universities to formulate policy documents such as the "Management Measures for School-enterprise Collaborative Education" and the "Regulations for School-enterprise Collaborative Education" to further clarify the specific standards and requirements for school-enterprise collaborative education. For example, in the "2000 Target: American Education Act," the United States wrote "Strengthening the links between schools, parents, and industrial enterprises, and encouraging the development of a more systematic industrial training system through the establishment of the National Technical Standards Committee."<sup>[1]</sup> Then, strengthen the regulatory duties and regulatory functions of local governments. Local governments should continue to give policy incentives such as tax and fee reduction, land transfer, financial support, human compensation, talent invocation and insurance payment to enterprises that actively participate in diversification and substantive synergy. Through government-led or entrusted third-party professional evaluation agencies, the classification and inspection of school-enterprise collaborative education incentive policies will be carried out in a normal manner, and the scientific implementation and comprehensive implementation of existing incentive policies and key measures will be promoted. Finally, improve the corporate assessment system. Exploring the scale and quality of accepting the internship training of college students as one of the important conditions for the annual performance appraisal of enterprises, and fully constraining the responsibility and obligation of enterprises to undertake higher engineering education.

### **4.2 Innovate the Long-term Operation Mechanism of University-Enterprise Collaborative Education, and Break through the "Last Mile" of Education and Employment**

First, establish a school-enterprise consultation mechanism and a regular joint mechanism. Promote the establishment of expert advisory groups by universities, enterprises and regional industry associations, strengthen the



school-enterprise collaborative development, and build a cross-complementary teaching system of "school curriculum + enterprise curriculum" with professional competence training as the core, establish a school-enterprise cooperation project, and systematically work processes and a rich teaching model in the form of professional ability development.

Secondly, improve the school-enterprise linkage to carry out the mechanism of innovation and entrepreneurship. Based on the university's superior characteristics of engineering majors, the school-institution (department) two-level scientific and technological innovation competition activities will be carried out regularly, and a flexible and innovative innovation and entrepreneurship training mechanism will be explored. Create a variety of school-enterprise activity brands, such as the professional skills competition sponsored by the company, the Innovation and Entrepreneurship Competition, and continuously expand the depth and breadth of the company's participation in education and teaching reform.

Finally, explore the establishment of a stable and rich "zero-run" engineering talent supply mechanism and early warning mechanism for talent training needs. In response to the actual needs of enterprises, adjust professional training standards, revise training programs, optimize the training process and strengthen quality evaluation,<sup>[2]</sup> Timely increase the teaching content of cutting-edge technological innovation, production process evolution and production process optimization. Strengthen the number of school-enterprise joint preparation of syllabus and featured textbooks, and strengthen student application skills training. Improve the formulation of job standards, and realize the close connection between professional chain and industry chain, course content and professional standards, teaching process and production process.

#### **4.3 Innovate the University-Enterprise Joint School-running Model, and Build a System of Engineering Talents That Integrates Innovation and Practical Ability**

First of all, gradually shift the focus of work, the secondary school as the implementation of the university and enterprise collaborative education and the implementation of the entity, and actively promote the grassroots teaching units to participate in the university-enterprise collaborative education. Explore new modes and new mechanisms such as joint-stock schools, university-enterprise joint-run schools, university-enterprise alliances, order-based cooperative schools, and enterprise-named schools, support universities and enterprises to jointly develop school standards, standardize school procedures, clarify the rights and responsibilities of both parties, and improve the

mechanism of benefit sharing and risk sharing.

Second, strengthen cooperation with enterprises to build an internship training and teaching base. Choose famous enterprises and local engineering colleges to jointly establish a comprehensive practical teaching platform, and cover the simulation and teaching base of the whole industry chain to simulate the real production environment and equipment control of the enterprise. Focus on the comprehensive function building of student learning, teacher training and corporate training, and comprehensively enhance the effectiveness and effectiveness of collaborative education.

Finally, build a talent training system that integrates innovation and practical ability. At present, the reform direction of higher engineering education is the cultivation of talents under the concept of large engineering, that is, on the basis of disciplines, more emphasis is placed on the systemic and integrity of engineering practice and engineering education itself. To this end, it is necessary to attach great importance to the diversity of students' knowledge and the diversity of abilities, and to emphasize the practicality of engineering education while cultivating students' creativity. In order to adapt to this concept of large-scale engineering education, on the one hand, local engineering colleges and universities should actively carry out research-based learning and innovative experimental project training programs.

Institutions funded students to carry out research-based learning and innovative experimental projects in a project-based manner, enabling some capable students to enter research-based learning and innovative experimental research earlier, and improve students' innovation level. On the other hand, university-enterprise cooperation promotes the construction of innovation and entrepreneurship platform. In accordance with the needs of enterprise engineering projects and the future development direction, colleges and universities infiltrate engineering education ideas in the main teaching links, and strengthen students' practical ability and engineering innovation ability.

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