

THE EXPLORATION OF “3D STEREOSCOPIC-SYNERGETIC-OPEN MODE” FOR CULTIVATING GRADUATE STUDENTS MAJORING IN ENERGY AND POWER ENGINEERING IN THE BELT AND ROAD INITIATIVE

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ABSTRACT: *The high-level and international talents support is necessary for the development of the “Belt and Road” (OBOR). The demands raise new requirement for talent cultivation in universities and the traditional cultivating pattern for graduate students is in urgent need of innovation and reform. Three existing problems restricted the quality of talent cultivation. A novel training mode named the “3D Stereoscopic-Synergetic-Open Mode” is proposed by Jiangsu University to solve the existing problems, including construction of 3D international cooperation platform, multivariate synergetic mechanism and opening cultivation system based on demand orientation. The research provides reference for cultivating graduate students against the background of the OBOR.*

KEYWORDS: belt and road initiative, postgraduate education, energy and power engineering, talents cultivation model

INTRODUCTION

“One Belt and One Road Initiative” proposed in 2013, aiming at enhancing complementarity and synergy of development strategies and promote common progress of participating countries through closer international cooperation[1] [2]. The “Vision and Actions on Jointly Building Silk Road Economic Belt and 21st-Century Maritime Silk Road”, Jointly issued by the National Development and Reform Commission, the Ministry of Foreign Affairs and the Ministry of Commerce authorized by the State Council of the People's Republic of China, clearly puts forward that the participating countries should promote policy coordination, facilities connectivity, unimpeded trade, financial integration and people-to-people bonds as their five major goals.

The high-level and international talents support is necessary for the development of the OBOR, especial the talents who own the broad international vision, the intercultural communicative competence and the ability of solving complicated practical problem. The Ministry of Education puts forward that Rearing urgent needed talents meet the demands of advancing the interconnectivity of infrastructure of participating countries. The demands raise new requirement for talent cultivation in universities [3].

Energy cooperation is the key fields of the OBOR [4]. The Joint Ministerial Declaration on Building the Belt and Road Energy Partnership signed on the "Belt and Road Energy" ministerial conference in 2018 said that the Belt and Road Energy Partnership will be built to inject new dynamism into the energy development of the participating countries. The high-level and international talents support in energy and power engineering is indispensable for the infrastructure construction of OBOR. To satisfy the requirements of the high-level and international talents support, the traditional cultivating pattern for graduate students, which is the main approach to cultivate the high-level talents, is in urgent need of innovation and reform. As an example of cultivating graduate students of energy and power engineering in Jiangsu University, to solve the existing problems, a novel training mode named the "3D Stereoscopic-Synergetic-Open Mode" is proposed in this paper. And a first-class base for cultivating the high-level talents in major of energy and power engineering is established, which meets the requirement of OBOR.

Existing problems

The traditional cultivation model for graduate students can not satisfy the requirement of the high-level and international talents support for the development of the OBOR, and the three major problems are listed as follows.

Relative insufficiency of high-quality educational resources in provincial universities

To satisfy the requirements of the high-level and international talents cultivation, high-quality educational resources, the adequate digestion and absorption of oversea high-quality educational resources is necessary. "The National Medium- and Long-Term Educational Reform and Development Guideline (From 2010 to 2020)" puts forward that the multi-level education cooperation and communication in broad fields must be developed to promote internationalization of education. By drawing on the advanced educational ideas and experience, China educational reform development will be promoted. And talents who are familiar with the international rules and have ability to participate in international affairs and international competition will be cultivated [5]. However, relative insufficiency of the oversea high-quality educational resources and practice opportunities of the international exchange and cooperation are ubiquity in the provincial universities. How to introduce and effectively utilize oversea high-quality

educational resources to cultivate high-level talents is one of the major problems.

Lack of synergetic and cooperation mechanism

In the process of traditional cultivation model, relying on the tutors and research groups, the students are unwilling to share their ideas and experience, which causes the problems of restricted educational environment, poor communication. They are used to be self-centered, lack of collective sense of honor, and difficult to participate in international competition. The cooperation mechanism and cooperation and communication platform are necessary to solve these problems.

Closed cultivation system

No matter the curriculum system, teaching methods or the relationship between university and scientific institution, the association mode with foreign universities are closed in traditional cultivation model. Under the model, the students are difficulty to accept new kinds of information, cannot utilize the academic frontier information to develop the original research. It results that the developing awareness and creative ability of students are difficulty to improve. The students' personality development is ignored and the students' subjective roles are not fully reflected during teaching.

Reform and innovation

For solving the three major problems, and satisfy the requirements of OBOR of the high-level and international talents cultivation, the “3D Stereoscopic-Synergetic-Open Mode” for cultivating graduate students is constructed in Jiangsu university after years of exploration.

Construction of 3D international cooperation platform

To solve the problems of relative insufficiency of the oversea high-quality educational resources and practice opportunities, Jiangsu University promotes talents introduction center and international joint research center, which builds the 3D stereoscopic international cooperation platform, as shown in Figure 1.

Most of the OBOR-participating countries are developing countries, therefore, higher education in China has obvious comparative advantage. Depending on the national key discipline, international joint research center and introducing talents base, the domestic and OBOR-participating countries graduate students can share the high-quality educational resources of worldwide.

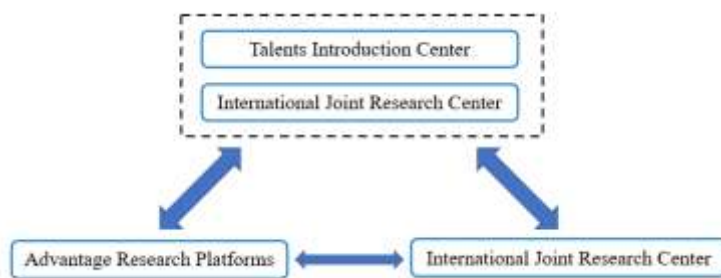


Figure 1. 3D Stereoscopic International Cooperation Platform

(1) Gathering high-quality educational resources

Base on the advantage research platforms of energy and power engineering disciplines in Jiangsu university, especially the fluid machinery disciplines, such as “National Research Center of Pumps”, “National Key Discipline of Fluid Machinery and Engineering” and “Jiangsu Province Dominant Discipline of Power Engineering and Engineering Thermal Physics” , The “High-end Fluid Machinery Equipment and Technology Overseas Expertise Introduction Center for Discipline Innovation” (“111”Center) and “International Cooperative Research Center for Fluid Engineering Equipment Energy-Saving Technology” are established for gathering the academic masters and famous experts in related fields. The excellent postgraduate tutor teams were formed by these experts and hundreds of professors from Jiangsu University.

(2) Expanding international cooperation and joint cultivation of graduate students

Jiangsu University devotes a lot of effort to the development of international exchange and collaboration, and establishes long-term stable cooperation with 42 colleges and universities all over the world, and signs collaboration agreements with 10 universities for establishing the cooperation mechanism of joint cultivation of graduate students, exchange of academic backbone, international collaboration projects and so on.

Focus on the characteristics of energy and power engineering, several research teams cooperated with the foreign famous experts to undertake collaboration projects and joint cultivation of graduate students. For examples, the research team of hydraulic machinery cavitation has cooperated with a French research institute since 2012, and solved several key technical problems in high-end application in new energy and environmental protection field, published more than 30 SCI papers together, cultivated 6 doctoral and 38 master students. The research team of Charged multiphase flow theory and engineering application has cooperated with the university in Thailand for more than 20 years, established an International Joint Laboratory together, and undertook an International cooperation key project, which was supported by National Natural Science Foundation of China, this International Joint Laboratory attracts

students from the countries along the Belt and Road countries such as Thailand and Pakistan to pursue PhD degree.

(3) Deeply cooperation with international academic organization and famous universities

Through the “bringing in” and “Going out” Strategy, the international cooperation with the famous academic organizations and universities was developed deeply. Jiangsu University hosted the 11th International Symposium on Measurement Techniques for Multiphase Flow (ISMTMF) and the 14th Asian International Conference on Fluid Machinery (AICFM), and is a co-organizer of 26th IAHR Symposium on Hydraulic Machinery and Systems. The domestic and OBOR-participating countries graduate students can obtain the oversea high-quality educational resources and practice opportunities from these conferences and organizations.

Construction of multivariate synergetic mechanism

According to the problems of lacking synergetic mechanism and cooperation and communication platform, the multivariate synergetic mechanism has been established for improving the pertinence of talent cultivation serving for the OBOR projects, which includes the synergy of discipline advantage and production advantage, the synergy of excellent resources and training process, and the synergy of talent base and cultivation unit, as shown in Figure 2. The demand-oriented multivariate synergetic mechanism makes the various educational factors including advantaged disciplines, production capability, excellent resources, training process, practice and culture work together in order to achieve the goal of strengthening the students’ abilities of scientific research, innovation and international communication.

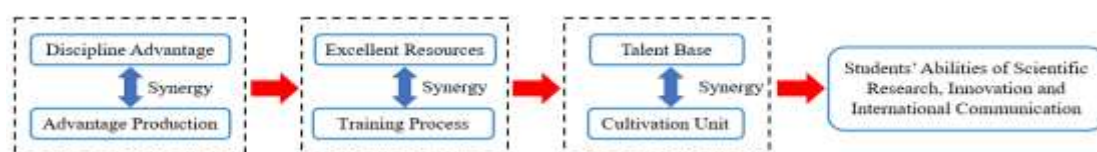


Figure 2. Multivariate Synergetic Mechanism

In respect of the synergetic effect of discipline advantage and production advantage. The cooperation resources integration of university and companies, which is beneficial to break the industry barriers and establish the platform of cross-border cooperation.

In respect of the synergetic effect of excellent resources and cultivating process, by connecting requirement-based project and project-based curriculum with education chain, talent chain, industry chain and innovation chain, the industry-university-research international innovation platform and cross-regional cooperation platform are established for improving the students’ abilities of international communication and innovation.

In respect of the synergetic effect of talent base and cultivation unit, with coordination and complementarity between the practice on international cooperation platform and training process, the abilities of scientific research, innovation and international communication are improved. On the basis of curriculum learning, with international platform, scientific research projects, exchange projects, international conferences and competitions as the carrier of ability training, and coordination linkage of platform resources and basic elements of graduate training as resource guarantee, the aim of improving abilities and qualities of students is achieved. Based on the multivariate synergetic mechanism, the University-Enterprise Alliance for educating and cultivating international talents has been established. More than 40 domestic well-known enterprises join the alliance by which Jiangsu University promote the cooperation between enterprises and government departments or organizations. In 2017, Jiangsu University sponsored Belt and Road Forum on International Cooperation in Talents' Education and Cultivation, which is an international platform for domestic and foreign graduate students participating in OBOR projects.

Construction of opening cultivation system based on demand orientation

To solve the problems caused by closed cultivation system, the demand-oriented open cultivation system is established based on requirements of OBOR cooperation programs. The system strengthens the interconnection of training links and educational resource. By different kinds of research programs, three kinds of talents, academic, professional and engineering talent who have their own training methods and development under the system, as shown in Figure 3. For the flexibility of training objectives on course selection and competency requirement, the open financial aid policy has been carried out, the open teaching ideas has been encouraged, the open curriculum system has been constructed, and the variety and flexible teaching contents and methods has been adopted. The system improves the pertinence and effectiveness of talent cultivation.



Figure 3. Opening Cultivation System

The demand for talents is diverse, such as the demand of companies for engineering talents, the demand of transformation of scientific and technological achievements for professional talents and the demand of frontier research on basic science for academic talents. Under the open cultivation system, many different joint graduate programs have been carried out by the cooperation with colleges, universities and international organization, the cooperation in teacher training with 9 universities in developing countries, the agreement of customized training of master students based on School-enterprise cooperation.

In recent years, 152 National Natural Science Foundation Projects and 15 international cooperation projects have been undertaken in our discipline, and 90% of the academic graduate students participate in these projects. 1200 more graduate students including 83 coming from OBOR-participating countries in energy and power fields have been cultivated in Jiangsu University. Many of them participate in some important projects which service the OBOR.

Many of the high-level talents make contribution to the energy and power engineering infrastructure construction of the OBOR-participating countries, such as the Nepal hydroelectric project, Egypt intelligent greenhouse irrigation systems. For examples, a Nepal master student is serving as technical director in Nepal hydroelectric project, who used to study the pumped-storage hydroelectricity in our university. Several domestic Ph.D. students have taken part in construction of some pump stations in the countries along the Belt and Road. And we also cultivated many talents for the universities in the countries along the Belt and Road, for instance, a Ghana student published many high quality SCI papers during his Ph.D. period, and became a lecturer in a university of Ghana after his graduation.

CONCLUSION

According to the new requirement for graduate students' cultivation, the training mode of energy and power engineering students has been innovated and reformed. "3D Stereoscopic-Synergetic-Open Mode" has been established and achieved fruitful results. Main contents are listed as following:

3D international cooperation platform is constructed based on top-level talent bases and research platforms. The excellent resources for high-level talents cultivation gathered together on the platform, which included excellent research platform, postgraduate tutor team, plentiful international practice opportunities, and sufficient research projects.

The multivariate synergetic mechanism has been established including the synergy of discipline advantage and production advantage, the synergy of excellent resources and training process and the synergy of talent base and cultivation unit. By the mechanism, the pertinence of talent cultivation serving for the OBOR projects has been improved.

The demand-oriented open cultivation system is established based on requirements of OBOR projects. The system strengthens the interconnection of training links and international educational resource. Various demands for talents are satisfied under the open cultivation system.

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