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From "Respective Action" to "Cross-Border Cooperation": A Research on the Training Path of "New Engineering" Talents in Local Applied Universities

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Abstract: It is very important to solve the problem of "clear organizational boundaries" and "individual formation" in the training of "New Engineering" talents for local applied universities in China. This article starts from the background of "New Engineering" Construction, guided by the concept of "cross-border innovation", and explores the path of local applied universities to carry out "New Engineering" talent cultivation through multi-party collaboration and cross-border Cooperation from five aspects: professional setting, curriculum setting, teacher team building, teaching model, and industry-university cooperation. A "five cross" cooperation mechanism with "New Engineering" Construction characteristics has been proposed, which includes interdisciplinary training, Cross-Major training, cross-field training, cross-school training, and cross-university-enterprise training.

1. Introduction

With the accelerated evolution of a new round of technological revolution and industrial transformation, the industrial development of China presents new characteristics of "rapid and variable, highly integrated, and cross-border integration", which puts forward new requirements for the cultivation of high-quality applied talents. In October 2022, the Chinese government proposed the integrated development strategy of "education, technology, and talent" for the first time in the report of the 20th National Congress of the Communist Party of China, which requiring universities to "cultivate more masters, strategic scientists, first-class technology leaders and innovation teams, young technology talents, outstanding engineers, national craftsmen, and high skilled talents"[1]. As an important component of China's higher education system, local applied universities should focus on their own educational orientation and resource endowments, break through the the dilemma of " Respective Action " and "Combined but not integrated" in traditional engineering talent cultivation, accelerate the construction of "New Engineering" Construction and serve the urgent demand for talent supply side in the transformation and upgrading of local economic industries and innovative development.

2. “Respective Action”: The Realistic Dilemma of Engineering Talent Training in China’s Local Applied Universities

The primary task of “New Engineering” Construction is to cultivate higher engineering talents that meet the needs of our time with interdisciplinary training[2]. However, at present, the engineering construction in many applied universities in China is still continuing on the traditional track, and the development of “New Engineering” Construction faces many difficulties as follows:

One is the unreasonable program structure[3]. The “New Engineering” Construction requires breaking down hidden barriers in disciplines, promoting disciplinary integration, and ensuring Access to knowledge from different disciplines for students. However, a lot of applied universities are still limited by their disciplinary organization divisionprograms, Resulting in insufficient communication among different colleges regarding teachers, courses, students, and other aspects. The reform of “New Engineering” programs is only limited to adding a few new courses.

Secondly, there is a lack of awareness in interdisciplinary Programs[4]. The goal of “New Engineering” Construction is to cultivate a group of outstanding engineering and technical talents with multiple abilities and qualities such as innovation and entrepreneurship, as well as Having patriotism and Global Vision. In fact,most of the applied universities focus on distribution of science and engineering programsand neglects the development of Humanities and Social Sciences Programs.Due to most of science and engineering courses are objective knowledge about the natural world, there are certain difficulties in cultivating patriotism and exerting educational functions. Relatively speaking, liberal arts programsprograms and general education courses contain rich ideological and political resources, which can provide ideological and political education for college students. However, based on the consideration of differentiated development strategies, most of local applied universities in the transitional period often prioritize supporting “New Engineering” Construction, while neglecting the investment in humanities programsprograms.As a resulte, these programs are unable to provide enough general education courses for “New Engineering” talents, which resulting in a shortage of knowledge reserves for those students.

Thirdly, the current teaching model lags behind. In many applied universities, the engineering curriculum system and teaching mode are outdated, the textbook content cannot keep up with the needs of the times, the response to major theoretical and practical problems is insufficient, and the curriculum teaching lacks new concepts. Classroom teaching is difficult to effectively meet the needsof cultivating “New Engineering” talents.

Fourthly, the educational community of Industry-University-Institute has not yet formed. A key focus of t “New Engineering” Construction is to explore the multi-party collaborative education models, with the aim of strengthening the connection between universities and Industry, and promoting the coordinated development of higher education and the economy and society. At present, the depth of cooperation between local applied universities and enterprises is not sufficient, and universities have not established enough platforms to allow enterprises to truly participate in the talent training system of universities, resulting in insufficient understanding of new technologies and insufficient cultivation of practical abilities among their students.

3. The New Requirements of New Quality Productivity for the Training of “New Engineering” Talents

After the 20th National Congress, the Party Central Committeeclearly proposed to accelerate the development of new quality productive forces. Local applied universities should further strengthen the “New Engineering” Construction, optimize the program layout of Emerging industries, and play a fundamental supporting role in promoting the development of new quality productivity [5].

One is to further optimize program layout programs to meet the demand of new quality

productivity. They should actively explore disciplinary and curriculum systems that are in line with the development of emerging technologies and industries, allocate their main resources to the growth points of interdisciplinary fields that contribute to the development of new productive forces, in order to adapt to the changes in the total demand and structure of the talent market for accelerating the formation of new productive forces.

The second is to deepen the reform of talent training models guided by "New Engineering" Construction. We need to strengthen the integration of science and education, industry and education. From the perspectives of disciplinary development trends and social needs, the application and practice of new technologies, the direction and ability development of engineering education talent cultivation, we will promote the deep participation of enterprises in the process of engineering talent cultivation, continuously update course content, build a high-quality talent cultivation system, and cultivate new and high-quality talents that meet the needs of new productive forces.

Local applied universities are urgently needs to step out of the old pattern of "one college, one department, and one major", actively connect with the development needs of local industries, explore their own unique program structure and talent training models, and effectively enhance their contribution to serving regional social development to confront and rightly respond to the challenges brought by new scientific revolution and industrial transformation.

4. Exploration of the "Multi-Party Collaboration and Cross-Border-Cooperation" Training Model for "New Engineering" Talents in Local Applied Universities

Since 2006, Beijing Institute of Petrochemical Technology (BIPT) has actively explored and practiced the cultivation of high-quality applied talents. In 2020, focusing on Beijing's construction of the "four centers", BIPT has set the goal of developing into a cradle of engineers in Beijing. BIPT has a deep understanding of the New Engineering construction, focusing on the four basic elements of education: profession, curriculum, classroom, and teachers, and has carried out the "Five Connections Action": "schools connecting with industries, disciplines connecting with industries, programsprograms connecting with enterprises, teachers connecting with frontlines, and Leading cadres connecting with government". It actively breaks the boundary wall between universities and enterprises, narrows the gap between theory and practice, and provides high-quality services for the economic and social development of the capital by cultivating "New Engineering" talents.

4.1. Cross-Disciplinary Training: Build A New Interdisciplinary System To Strengthen The Cultivation Of "New Engineering" Talents

Setting up new programs based on industrial demandprograms is one of the six questions in "New Engineering" Construction. BIPT conducts precise research on future industrial development needs in Beijing, promoting the integration of "science + engineering, engineering+engineering", and the intersection of "engineering+medicine, engineering +culture". BIPT vigorously promotes the construction of "artificial intelligence+" and "+Safety Engineer", aiming to establish an interdisciplinary program group led by emerging disciplines and traditional advantageous disciplines. Since 2013, BIPT has newly increased 15 undergraduate programs in emerging fields such as data science and big data technology, drug analysis, etc., including multiple interdisciplinary programs such as artificial intelligence, exhibition, etc., and has stopped recruitment for 14 traditional engineering programs, including measurement instruments and technology. BIPT strives to promote the close connection between its program chain and the industrial chain of Beijing, and provide excellent engineering talent support for the upgrading of Beijing's industries.

4.2. Cross-Program Training: Establish “New Engineering” Experimental Classes To Explore New Models For “New Engineering” Talents

“New Engineering” Construction emphasizes the main approach of intersecting and integrating to cultivate future outstanding engineering talents. For this reason, BIPT boldly breaks through the traditional engineering training models, selects outstanding students from various engineering disciplines to form the “Zhiyuan “New Engineering” Experimental Class”, integrates various teaching resources, highlights the cross integration of “artificial intelligence” and “professional characteristics”, establishes a curriculum system with “four years of continuous and progressive project-based training” as the core, strengthens the cultivation of practical and innovative abilities, and explores a new model for cultivating outstanding engineering talents in Beijing. The enrollment scale of the experimental class is about 90 students per year. After a year of trial operation, the experimental class students ranked among the top in the overall evaluation of English, advanced mathematics, and physics courses.

4.3. Cross-School Training: Encourage Offering Cross-School-Shared Course Construction for “New Engineering” Talents

The core of “New Engineering” Construction is to build a new undergraduate curriculum system [6-7]. BIPT promotes the construction of the new engineering curriculum system from three aspects. Firstly, BIPT has revised the 2023 undergraduate talent training program and required each school to highlight the “Five New” in professional education: "new knowledge, new technology, new processes, new cases, and new processes." BIPT requires all schools to change the traditional subject centered discipline, to optimize the separated subject knowledge, and design a multidisciplinary curriculum system. Secondly, BIPT encourages teachers and schools to break down disciplinary barriers, to form cross-school teaching teams and share high-quality course resources as needed. BIPT has developed a number of first-class undergraduate courses through multiple measures. Thirdly, BIPT permeates engineering culture and ideological elements into its curriculum system in order to cultivate students' patriotism and educational views such as "Engineering with a Big E". Guided by the Outcome Based Education (OBE), BIPT has constructed a "wu yu" education system consisting of core courses, related courses, practical activities, and a second classroom to enhance students' practical abilities and innovative spirit.

4.4. Cross-Fields Training: Establish an Interdisciplinary Teacher Team for “New Engineering” Talents

A high-level teacher team in a single discipline cannot meet the training needs of versatile talents. The cultivation of “New Engineering” talents requires the establishment of interdisciplinary teaching teams, integrating teachers from different schools and fields to jointly guide students. BIPT continues to strengthen the construction of interdisciplinary teacher teams in order to activate the knowledge productivity and educational potential of Basic Academic Organizations.On the one hand construction of scientific research teams, BIPT breaks down the invisible disciplinary barriers, uses major programs as the driving force encourages teachers to form innovation teams across different disciplinary and departmental and guides teachers to transform from “unarmed rag-tag team” to “ Moving as one in battle by integrating resources “. BIPT encourages teachers to explore and enrich the innovation education resources of professional courses around the development trend of their profession to meet the demand for deep interdisciplinary training in “New Engineering” talents. On the other hand,BIPT has carried out a wider and deeper integration of teaching organization on the basis of the existing departmental structure. BIPT has broken down barriers

between departments and sent ideological course teachers from Marxist colleges to various colleges and programsto form a cross team which has 18 teachers from 8 Teaching departments, 12 programs. Under the leadership of the School of Marxism, This team is organized to explore ideological and political resources in different professional courses such as engineering, science, economics, management, and literature. They have offered a series of distinctive courses such as “Exploring Beijing”, “dual carbon research”, “School History, Culture, and Professional Education”, information technology courses, and etc., swhich is in line with BIPT's training objectives.

4.5. Across-Schools-And-Enterprises Training: Strengthen the Mechanism of Community of Industry-University-Institute Cooperation for “New Engineering” Talents

The cultivation of “New Engineering” talents has a strong resource dependence, because outstanding engineering talents cannot be trained solely in school laboratories, they must be cultivated through industry university cooperation. This requires universities to seek resources from the outside world and create conditions for students to enable them to truly face the front line of industry and continuously Develop the ability to solve complex engineering problems in engineering practice. BIPT has leveraged the tradition of practical education and taken the construction of “New Engineering” Construction as an opportunity to strengthen its own educational characteristics. BIPT has implemented the “Five Connections Action”, which includes: “schools connecting with industries, disciplines connecting with industries, programsprograms connecting with enterprises, teachers connecting with frontlines, and Leading cadres connecting with government”. Through the “Five Connections Action”, BIPT have broken through the traditional organizational barriers between schools and enterprises, promoted the deep participation of the industry in the entire process of talent cultivation through multiple channels, and have focused on the advantageous resources of the government, universities, industry, enterprises, and other sectors to form a multi subject collaborative mechanism. Through multi field, multi-channel, and multi subject collaboration, BIPT have built a number of modern industrial colleges, Found a way to truly implement the concept of “cross-border training” in new engineering education. For example, BIPT closely cooperates with the Beijing Municipal Administration of Work Safety to jointly establish the “Beijing Institute of Work Safety Engineering Technology”, jointly carry out talent training, scientific research, and technological services in the field of chemical safety in Beijing. BIPT has collaborated with Huike Education Technology Group Co., Ltd to establish the Huike Big Data Industry College.with “production, learning, research, and innovation” as the core elements, The two sides strengthen the interaction between schools and enterprises, achieve a positive interaction between the teaching process and the development of enterprises and the big data industry, and adapt to the needs of the new generation of information technology development. BIPT has collaborated with Zhongguancun Pharmaceutical Valley Biological Industry Research Institute to establish the Biomedical and Health Industry College, built a diversified practical technology platform that integrates “education, production, research and development, training, and service”, and cultivated interdisciplinary talents in fields such as artificial intelligence and i medical devices required for the life and health industry cluster. BIPT also dispatched some backbone teachers to government departments and industry enterprises for on-the-job training through the “Five Connections Action”, established a two-way flow mechanism for teachers in university and enterprise, promoted teachers to go deep into the front line of production and familiarize themselves with the forefront of technology and engineering practice applications, improved teaching abilities through cross-border learning, and created an integrated “New Engineering” talent training model.

5. Conclusion

The practical results show that BIPT has initially formed a “New Engineering” talent training model of “cross -disciplinary training, cross-program training, cross-field training, cross-school training, and cross-school-enterprise training” by carrying out the “Five Connections Action”. BIPT has achieved good results in terms of program construction, curriculum reform, teacher growth, and student development, which can provide reference for the “New Engineering” reform in other local universities.

Through comprehensive exploration and practice, BIPT has cultivated a group of “New Engineering” talents with excellent quality and comprehensive development. They are the new generation in the prime area with pure and high-quality thinking, scientific literacy with connotation, exquisite and distinctive skills, and courage to tackle challenges. Students have repeatedly achieved excellent results in various competitions, such as winning one national first prize and being awarded the Excellent Organization Award in the 16th National College Student Energy Conservation and Emission Reduction Social Practice and Technology Competition of the Construction Bank Cup in 2023. Eight programs of BIPT have been approved as national first-class undergraduate program , such as Chemical Engineering and Technology, Mechanical Engineering and etc. The “Exploration and Practice of High Quality Applied Talents Training Models in Local Universities for Deepening Practical Education” won the second prize of the 2021 Beijing Higher Education Achievement Award.

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