# Construction of the Engineering Practice Education System in Local Application-Oriented Universities From the Perspective of New Quality Productivity

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**Abstract**

The development of new quality productive requires higher engineering education to adapt. Local universities should integrate these new demands into their engineering practice education systems, focusing on practical and innovative forms of education. Beijing Institute of Petrochemical Technology is an example, emphasizing the fusion of academic learning with industrial application and promoting interdisciplinary collaboration. Their goal is to produce exceptional engineering talent capable of driving the progression of new quality productive through diverse pathways for engineering practice education.

**Keywords:** new quality productivity, engineering practice system, application-oriented university

## 1. Introduction

The urgent development of new high-quality productivity necessitates the training of a substantial number of innovative and comprehensive engineering innovation talents in colleges and universities. General Secretary Jinping Xi stressed that "we should optimize the program setting and personnel training mode of universities according to the development trend of science and technology so as to promote high-quality development". In the future, the demand for talent in emerging industries and the new economy has surpassed the traditional scope of engineering training, emphasizing practical skills, innovation, and a global perspective (Zhou, & Guan, 2017). This necessitates that engineering education in universities keeps pace with the times and aligns closely with the evolving needs of emerging industries. However, due to the intensive and cyclical nature of practical teaching conditions, content, environment, and personnel in universities, there is a certain lag in responding quickly to changes at the forefront of science and technology (Jia, P 2024). Currently, there are still some issues in the training of engineering talents in Chinese universities, such as an overemphasis on theory at the expense of practical skills and a disconnect between engineering practice education and the real-world needs of the industry (Sun, Fu, Liang, *et al.*, 2011), insufficient depth of collaborative education, low sharing degree of high-quality teaching resources,weak engineering practice and innovation abilities among graduates,as well as a lack of interdisciplinary skills and craftsmanship spirit are some of the challenges in the training of engineering talents in Chinese universities. The aforementioned issues result in deficiencies within the current engineering practice model for cultivating outstanding engineering talents. Therefore, local application-oriented universities must comprehensively reform the engineering talent training system, with a particular focus on overhauling the engineering practice education system as a crucial starting point. This is essential to cultivate high-caliber engineering and technical professionals who can meet the requirements of national strategic development and enterprises, while enhancing the talent support system for advancing new quality productivity.

## 2. The Key Reform Direction of Engineering Practice Education Under the Background of New Quality Productive

Engineering practice is a crucial component of talent training in application-oriented universities and plays an essential role in nurturing innovative talents across various majors (Sun, Yu, & Liang, 2019). In the context of advancing new quality productivity, the reform of the engineering practice education system in local

application-oriented universities should prioritize the following aspects:

*2.1 Strengthen the Deep Integration of Engineering Practice and Innovation Ability*

New quality productive underscores the pivotal role of practice and innovation in driving the advancement of productive forces. As such, local application-oriented universities must establish an education system with engineering practice at its core and innovation ability training as its guiding principle. This involves elevating the proportion of practical courses, offering abundant hands-on opportunities for students to engage with practical issues and hone their problem-solving skills. Additionally, through initiatives such as establishing innovation laboratories and projects, students' enthusiasm for innovation can be stimulated while cultivating their innovative thinking.

*2.2 Promote the Close Connection Between Engineering Education and Industrial Development*

The advancement of new quality productive necessitates close collaboration between universities, enterprises, and industries to jointly drive personnel training and technological innovation.Local application-oriented universities should tailor the content and format of engineering practice education in close alignment with the requirements of regional industrial development. By engaging in partnerships with local enterprises and industry-university-research cooperation projects, students can actively participate in real engineering endeavors, gain insights into cutting-edge industrial technology and market dynamics, enhance their professional acumen and practical skills, ultimately fostering a robust environment for industry-university-research collaborative education.

*2.3 Promote Interdisciplinary Integration and Comprehensive Practice*

The development of new quality productivity often requires the comprehensive use of multidisciplinary knowledge. Therefore, local application-oriented universities should strive to break down disciplinary barriers, foster the interdisciplinary integration of different fields, and establish an interdisciplinary comprehensive practice education system. This can be achieved by introducing interdisciplinary courses and creating interdisciplinary practice platforms to cultivate students' interdisciplinary thinking and comprehensive abilities, enabling them to better adapt to complex and dynamic engineering practice environments.

*2.4 Establish a Continuous Improvement and Quality Assurance Mechanism*

The reform of the engineering practice education system is an ongoing process that requires the establishment of an effective quality assurance mechanism.Regular evaluation and feedback on the reform results are essential to this process. By gathering input from students, teachers, and enterprises, the engineering practice education system can be continuously improved and optimized to ensure it remains aligned with current trends and responsive to the development needs of new quality productive forces.

## 3. Construct the Practical Education System in Local Application-Oriented University

BIPT is a prestigious application-oriented university known for its distinctive engineering practice characteristics. The institution upholds the educational philosophy of "advocating practice and giving equal emphasis to knowledge and practice", with the aim of establishing itself as "the cradle of engineers in the new era". In recent years, BIPT has demonstrated a deep understanding of new quality productivity within the context of outstanding engineer training. Leveraging its disciplinary strengths, location advantages, and talent demand characteristics, BIPT places significant emphasis on integrated teaching methods and collaborative education models through university-enterprise partnerships. By exploring an"open sharing, teaching fusion, innovation-driven, collaborative teaching" engineering practice education system, BIPT aims to cultivate exceptional engineering talents equipped with practical abilities and innovative spirits that align with the needs of the new era. This approach contributes positively to Beijing's economic chain development and industrial transformation and upgrading efforts.

*3.1 School-Enterprise Cooperate to Build an Enterprise Practice Course System Highlighting the Cultivation of Engineering Practice Ability*

Since its establishment in 1978, BIPT has been dedicated to engaging with enterprises and serving at the forefront. The institution places significant emphasis on the pivotal role of "school-enterprise cooperation and collaborative education" in cultivating applied talents. Through partnerships with 181 enterprises and institutions such as Yanshan Petrochemical and Zhongguancun Software Park, BIPT has established an industry-university cooperation education mechanism focused on achieving mutual benefits and long-term stability. This collaboration has resulted in a "six elements" enterprise practice mode that is outcome-oriented. BIPT's talent training objectives prioritize enterprise practice as a focal point, integrating cutting-edge technology and real engineering cases from partner companies into students' courses and projects.This approach aims to develop exceptional engineering skills, design capabilities, and innovation acumen through internship modules closely aligned with industry demands. By addressing issues such as

unclear internship positioning, vague implementation strategies, or poor effectiveness within enterprise internships, BIPT seeks to bridge the gap between academic education and industry requirements. The institution has jointly developed 15 engineering training projects and courses with partner enterprises while co-authoring three textbooks. Additionally, they have collaborated to establish an engineering practice teaching team aimed at collectively monitoring the quality of practical training throughout the process to continually enhance teaching standards.BIPT's integrated industry-education practical education model has garnered recognition through accolades such as two second prizes for national teaching achievements, four first prizes for Beijing teaching achievements, along with two second prizes.

### *3.2 Integrate Industry and Education to Build a Practical Education System With Engineering Design Ability as the Main Line*

In response to the evolving demands of new quality productivity and the characteristics of outstanding engineers, BIPT has undertaken a comprehensive approach to integrate industry and education, emphasizing practical education while establishing a corresponding practical education system. The institution seized the opportunity presented by the 2023 training program revision to organically combine experimental courses, course design, internships, professional practice, graduation projects, undergraduate research training (URT) projects, discipline competitions, social practices and other practical components into an overarching "four-year continuous line" framework that spans from new student orientation to post-graduation employment. This progressive practice education system is designed to ensure that practical teaching reflects integrated social and engineering practices in a systematic and complex manner. BIPT has strategically integrated various forms of practice such as professional practice, innovative entrepreneurship practice, labor practice, social practice among others into its curriculum. By creating fusion characteristics within its "professional + practice" and "innovative entrepreneurship + practice" bases through organic integration of different types of practices on campus—revealing distinct engineer training features specific to the school's capital district. Furthermore, BIPT has recognized the need for intelligence talent development aligned with new productivity demands. In response, the institution is leveraging its existing engineering institute as a foundation for constructing an intelligent campus focused on enhancing engineering education teaching scenes. This initiative includes organizing support from advanced industry-based practicum sites aimed at promoting comprehensive upgrades in concept, content, and delivery methods within practicum courses—to ultimately enhance applied personnel training quality.

### *3.3 Improve the Innovation Ability by Science and Innovation Projects*

BIPT has made significant strides in innovative entrepreneurship education, emphasizing high-quality applied personnel training and adhering to the "application-oriented, practice-focused, full-coverage" educational concept. The institution has implemented a progressive 'double-gen" education model that integrates innovation entrepreneurship education with professional education, practice teaching, and campus culture. This approach is structured around the principle of focusing on innovation consciousness for freshmen,improving innovation ability for sophomores, and engaging in innovative entrepreneurial practice for juniors and seniors. To transform traditional innovative training methods from "theory +practical training" to a more collaborative "project + course" mode aimed at enhancing innovation abilities through teamwork learning guided by projects. BIPT has also fostered an environment conducive to cultivating an innovative culture that encourages risk-taking and resilience through initiatives such as the Research and Training Program (URT) for College students over 20 years.This program encourages students from diverse majors to collaborate on practical engineering research problems while nurturing their abilities within an atmosphere that values both innovation and failure tolerance. The institution has established an open and comprehensive mechanism for incubating innovation and entrepreneurship projects by offering specialized courses in innovation, organizing lectures on entrepreneurship, hosting discipline competitions, and facilitating science-related activities. Additionally, BIPT provides mentor-ship opportunities focused on entrepreneurship development while leveraging its existing school-enterprise cooperation platform along with other stakeholders' advantages. Through mass entrepreneurship initiatives, discipline competitions, and interdisciplinary connections, BIPT aims to help students develop holistic professional competencies while fostering independent behavior capabilities essential for personal growth.

### *3.4 Establish a Closed-Loop Improved Quality Assurance System*

In response to challenges in applied talent training such as unclear professional goals, unreasonable curriculum design, and a lack of evaluation and feedback processes, BIPT has adopted a student-centered approach with an output-oriented focus on continuous improvement. The institution has prioritized key elements and critical links in talent training while establishing a comprehensive "four-dimensional integration" teaching quality evaluation system

encompassing the dimensions of curriculum, faculty, profession, and school (department). Course evaluations are conducted across five categories: theory, experiment, practice, practical training, and ideological and political education. Over the past three years, school leaders have dedicated significant hours to attending these evaluations alongside undergraduate participation rates averaging at 85.2% per semester. Teacher evaluations have been integrated into title promotion assessments for seven consecutive years—where teaching effectiveness is used as a primary basis for evaluation. Additionally, BIPT organizes on-campus professional evaluations every five years based on national engineering education certification standards. The institution also emphasizes annual assessment optimization within teaching units by placing importance on process and effectiveness indicators related to talent training—accounting for 40.0%~80.0% of the overall assessment proportion. Through regular self-evaluation practices, BIPT aims to continually enhance the efficacy of its applied talent training through ongoing improvements aligned with their "continuous improvement" philosophy.

## 4. Reform Results

### *4.1 Marking Achievements in Programs Construction*

BIPT has achieved significant recognition in the realm of applied talent training. Notably, 7 programs at BIPT have successfully obtained national Engineering Education professional certification, while an additional 7 programs have been honored with the distinction of being designated as national first-class undergraduate major construction points. Furthermore, 3 programs at BIPT have earned the status of Beijing key construction first-class programs. Impressively, state-level, provincial, and ministerial-level first-class majors now constitute a substantial portion. In addition to these achievements,BIPT received commendation from Expert Group of the Ministry of Education in 2018 for its outstanding performance in applied talent training—a testament to its leadership among Beijing universities in this domain.

### *4.2 Fruitful Results in the Reform field of Integrated Industry and Education*

Over the past two years, BIPT has secured approval for 4 national first-class courses while adding 56 new educational reform projects at provincial and ministerial levels. Notably, its graduate employment implementation rate has consistently ranked among the top municipal universities for three consecutive years. The institution's success in educational reform has garnered widespread recognition, with over 3,500 students from more than 20 universities inside and outside Beijing participating annually in engineering training at BIPT's national Engineering Practice Education Center. This achievement has been widely reported across various media outlets including China Education Daily, People's Daily App, Beijing TV—highlighting the effectiveness of industry-education integration initiatives alongside talent training mode reforms.

### *4.3 Improved Quality of Applied Talents*

BIPT has made significant strides in enhancing students' innovative and practical abilities, as evidenced by their outstanding achievements. Since 2014, students have garnered an impressive total of 2,575 awards in discipline competitions at provincial and ministerial levels—demonstrating their prowess in various fields. The institution's commitment to fostering talent is further reflected in its high graduate employment rate of 98%, with over 75% securing positions within enterprises. Employers have expressed strong interest in hiring BIPT graduates, citing their advantages in engineering technology development and their ability to assume leadership roles such as project leader, manager, and technical backbone.Employers also commend the firm professional knowledge and skills demonstrated by graduates—a testament to the effectiveness of the education provided at BIPT. The satisfaction levels among graduates have notably increased according to third-party evaluations such as Michael's Company.Graduates from BIPT exhibit clear advantages in terms of job satisfaction, average monthly salary, and career stability compared to peers from similar institutions—highlighting the positive impact of the institution's educational programs on student outcomes.

### *4.4 Growing Social Service Capacity for the Region*

In 2022, BIPT allocated 37% of its competitive funds towards the transformation of technology, consultation, service, and achievement transfer. The institution achieved breakthroughs in integrating key technologies such as complex environment special welding robots, high-precision medical rehabilitation robots, industrial big data, and intelligent control technology. BIPT's advancements in safety production and emergency management technology have played a crucial role in ensuring the safe operation of Beijing city. Furthermore, BIPT has made significant contributions to major national strategic projects such as Daxing International Airport, the Winter Olympics infrastructure, the West-East gas pipeline network, and the Hong Kong-Zhuhai-Macao Bridge. These endeavors have showcased BIPT's capabilities and expertise in serving large-scale national initiatives.

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**Authors' contributions**

Dr. Hongmei Jin was responsible for study design, data collection and drafted the manuscript. Prof. Jianshu Cao revised it. All authors read and approved the final manuscript. All authors contributed equally to the study.

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