Reform and Practice of Talent Cultivation in New Engineering IT Disciplines

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***Abstract*—This research is grounded in the national development strategies for new engineering fields such as cybersecurity, artificial intelligence, and big data, addressing the specific talent cultivation needs for IT disciplines. It conforms to both national and municipal standards for top-tier disciplines and adopts an outcome-oriented approach to engineering education. The study advances reforms and practical applications of a talent cultivation model that integrates industry and education for new engineering IT disciplines. Through comprehensive reforms and practices, we have established a distinctive talent cultivation plan and developed a tiered, progressive curriculum system that merges theoretical and practical learning. This approach serves as a model for ongoing enhancements in specialized talent development mechanisms within new engineering IT disciplines.**

***Index Terms*—Talent cultivation, New engineering IT disciplines, Curriculum system**

I. Introduction

Since the 13th Five-Year Plan, China's national economy has experienced rapid growth. Cutting-edge IT technologies such as artificial intelligence, big data, and cybersecurity have been incorporated into our country's critical national development plans. These technologies, embodied by initiatives like "Internet +" have become key drivers in advancing technological transformation and upgrading industrial capabilities in China's traditional industries. They play a crucial role in enabling China to achieve independent and innovative breakthroughs in high-tech fields and to make significant leaps forward by overtaking competitors through accelerated development [1].

As crucial centers for fostering virtue and cultivating talent, higher education institutions should play a significant role in meeting the urgent demands of the national strategic plan for high-tech talent in the information and innovation industry [2]. By evaluating the development of IT disciplines such as network engineering, software engineering, computer science and technology, and Internet of Things engineering at Tiangong University, it is clear that existing talent cultivation mechanisms and specialized course systems have been instrumental in developing professionals with strong foundational IT skills. However, there are ongoing issues, such as the traditional nature of the existing curriculum and the need for enhanced practical training features. Therefore, this study proposes a talent development mechanism for IT-related disciplines that aligns with national strategic needs. This involves planning distinctive and differentiated professional development mechanisms to meet the emerging requirements of the information and innovation industry, and establishing a new engineering talent cultivation system that aligns with the national development plans and emphasizes engineering practice capabilities.

Manuscript received May 21, 2024
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II. Teaching Reform Practice Methods

A. Development of a Distinctive Curriculum System

Based on reshaping the objectives for cultivating specialized talents, we have constructed a curriculum system mechanism that matches professional characteristics, focusing on outcome-oriented and continuously improving curriculum construction and evaluation mechanisms. This approach is driven by the "outcome-oriented" philosophy to develop distinctive directions and curriculum systems for new engineering IT specialties [3]. Taking cybersecurity and computer science (with a focus on artificial intelligence) as examples, we have planned the specialty characteristics and training objectives aligned with national strategic needs. We define the professional technical indicators required at graduation and engage in deep discussions and feedback solicitation with enterprises and industry experts in specific professional directions. This helps in determining a curriculum system that supports distinctive professional features, which then forms a core group of courses and a progressive teaching arrangement aimed at cultivating specialized capabilities.

To enhance our professional programs, we have initiated pilot reforms in our experimental classes. In the cybersecurity experimental class, we collaborate with leading companies in the field to develop a core curriculum. This curriculum is based on the knowledge, skills, and qualities required by cybersecurity professionals engaged in national security efforts. By integrating in-school teaching with corporate training models, we effectively enhance students' practical skills and job adaptability.

B. Construction of a Faculty Team in Collaboration with Enterprises

We collaborate with enterprises to build a distinctive professional faculty team, implementing the construction of faculty teams for specialized courses to enhance the practical teaching abilities of our in-house faculty [4]. We have initiated pilot reforms in faculty team co-construction with

enterprises in fields like cybersecurity. We introduce excellent corporate instructors from the cybersecurity sector, create school-enterprise collaborative course teams for core cybersecurity courses, and conduct teaching design collaboratively between university and enterprise instructors. By integrating traditional teaching evaluation methods with corporate assessment practices, we effectively enhance the quality of course instruction.

To enhance the practical and innovative capabilities of our faculty team, we have established a faculty development mechanism in collaboration with enterprises. We have set up a school-enterprise joint faculty team for distinctive courses, adopting a model that combines corporate instructors with professional teachers to collaboratively develop core specialty courses [5]. Professional teachers refine the course objectives and theoretical foundations; corporate instructors build practical content and technical systems. With a division of labor and cooperation, both parties leverage their respective strengths to construct the course content, effectively supporting the comprehensive development of students' abilities.

C. Construction of a Distinctive Practical Teaching Platform

We continuously refine and enhance the practical teaching platforms and information management tools for new engineering disciplines, consistently applying the "student-centered, continuous improvement" philosophy of talent cultivation [6]. We are developing iterations of a virtual simulation experimental teaching platform that supports "independent learning and self-conducted experiments," effectively transforming traditional practical teaching paradigms and teaching contexts. Reforms to the student practical ability evaluation mechanisms are underway, ensuring that the informatized experimental teaching platform becomes a vital asset for achieving specialized professional capabilities.

Simultaneously, we are conducting both "horizontal" and "vertical" transformations in the construction of the new engineering practical teaching system. Horizontally, we leverage the construction and integration of the new engineering virtual simulation practical teaching platform for the informatized management and evaluation of distinctive practical teaching. Vertically, we fully tap into and integrate resources from professional practice platforms, university research platforms, student innovation platforms, and corporate research and development platforms, implementing tiered and progressive "vertical transformations" in students' practical and innovative training.

III. Effectiveness of Teaching Reform Practices

Under the initiatives of teaching reform practices, several new engineering disciplines have successfully established distinctive course clusters aligned with national strategic development and talent demands, significantly enhancing the quality of talent cultivation [7]. Among these, we have developed practical course clusters for the cybersecurity discipline, establishing a specialized practical course group centered around courses such as "Intrusion Defense and Internet Security Protocols, Endpoint Security and Access Control, Network Attack and Defense, and Web Penetration Testing Techniques Internship.

For the Computer Science and Technology program, we have constructed a core professional course group with artificial intelligence as the featured direction. Building on traditional computer science foundational courses [8], we have formed a progressive curriculum system that includes "Mathematical Foundations of Artificial Intelligence, Machine Learning, Natural Language Processing, Computer Vision, and Intelligent Mobile Robotics.

The Software Engineering program aligns with national standards and engineering accreditation standards, defining "Innovative Thinking," "Practical Ability," and "Engineering Quality" as the three core competencies of talent [9]. Jointly with enterprises, we have formulated training programs and teaching plans. Based on this, we have constructed multiple course groups with clear objectives: Computer Science Basic Courses, Programming Skills Development, Software Project Building Skills, Distinctive Software Integrated Design Skills, and Distinctive Software Development Corporate Internships and Practice Courses.

Throughout the course development process, the team adhered to outcome-oriented, continuous improvement standards required by engineering accreditation. The systematic design and quality consciousness of professional courses by the construction team effectively supported the development of top-tier professional courses and distinctive practical teaching resources, resulting in a series of teaching quality achievements. For instance, in 2021, the "Computer Networking" and "IoT Application Development Course Design" courses were recognized as top-tier courses by Tianjin City; the Software Engineering program effectively supported the achievement of course objectives for professional engineering accreditation using the established "Big Data Experimental Teaching Platform." In 2022, the Software Engineering program received national engineering education professional accreditation; the Cybersecurity program developed the "Information Security Cloud" cybersecurity experimental teaching platform. In 2023, the "Database Principles and Applications" course was recognized as a national top-tier course.

IV. CONCLUSION

This research, based on professional surveys, adapts the demands of the new engineering IT fields outlined in the national strategic plan into the professional training mechanism. It sensibly establishes a distinctive talent cultivation positioning and output areas by combining strengths in professional teaching and scientific research. By integrating tiered and progressive new engineering practical elements into the training plan, this study continuously transforms the talent cultivation model and optimizes the talent training scheme.

The research constructs and reforms the curriculum system and talent model for new engineering specialties such as cybersecurity. Through the integration of industry and education, it effectively supports the development of the information and innovation industry in IT talent cultivation. This has led to innovative talent cultivation models and

practical education systems that support the specialization of IT-related disciplines. The study actively explores ways to enhance and upgrade the content of engineering IT disciplines, showing significant application effects and providing a valuable model for demonstration and wider adoption.

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