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Study on Curricular Construction for Made in China 2025 in Integrated Way Based on Disciplines, Majors, and Courses

Deng Liwei[a,*], Xu Jiazhong[b], Zhang Ruixue[c], Xie Guihua[d]

School of Automation, Harbin University of Science and Technology, Harbin, 150080, China
[a]dengliwei666@hrbust.edu.cn, [b]Xujiazhong@126.com, [c]18103675667@163.com,
[d]xgh200209@163.com
[*]Corresponding author

Abstract: *With the rapid development of 'Made in China 2025' plan and intelligent technology, the training of professionals in local ordinary universities must keep up with changing needs. "Double First-class" and "New Engineering" are essential ways to support the development of manufacturing professionals. This paper starts with a background of "Double First-class" and "New Engineering" development. It explores critical issues such as the training model of ordinary local universities, integrated construction of disciplines and courses, excellent student training, and faculty recruitment. The proposed construction methods can further optimize the talent cultivation model for automation majors, improve the quality of talent cultivation, and provide strong talent support for developing industry sectors under the new situation.*

Keywords: *Made in China 2025 plan; Double first-class; New engineering; Talent training model; Local general colleges*

1. Introduction

To achieve the goals of upgrading and transforming China's manufacturing industry, the 'Made in China 2025' plan is committed to supporting the development of high-end manufacturing enhancing the manufacturing sector's innovation capabilities, technological levels, and competitiveness. The 'Double First-Class' initiative aims to improve the quality of Chinese higher education and its international competitiveness by developing world-class universities and disciplines, cultivating students' innovative spirit, practical skills, and social responsibility, thereby providing strong talent support for national development. 'New Engineering' fosters students' innovative, practical abilities and comprehensive qualities, emphasizing integrating theoretical knowledge and practical experience. This educational approach helps cultivate engineering talent that better meets industry development needs, supporting the realization of the 'Made in China 2025' goals. The 'Double First-Class' initiative and 'New Engineering' are important components of China's education reform and mutually promote and support the 'Made in China 2025' objectives. These educational measures will provide a solid talent foundation for upgrading and transforming China's manufacturing industry, driving it towards more advanced, intelligent, and green development. Therefore, the construction of 'Double First-Class' and 'New Engineering' is aligned with the 'Made in China 2025' goals, jointly promoting the upgrade and transformation of China's manufacturing industry.

Many scholars have conducted studies and explorations addressing the research above issues. Zhang et al.[1] proposed a series of reforms for the “Solid Waste Treatment Engineering Experiment” course to improve teaching quality and student development. Han et al.[2] proposed a framework for constructing first-class majors at local universities by aligning with the laws of higher education development and addressing the needs of national and local economic construction, scientific and technological progress, and social development. Li et.al.[3] proposed an innovative teaching model for the “Civil Engineering Construction” course, focusing on sustainable development and comprehensive student education through dual platforms and integrated evaluations. Lei et al.[4] proposed that practice-oriented entrepreneurship education, supported by institutional environment and infrastructure, significantly enhances innovative talent training in the new economy, particularly under the new normal. Chen et.al.[5]proposed a 3I-CDIO-OBE talent-training model for Chinese engineering education, integrating general, professional, and innovative education to enhance engineering practice teaching in universities.

ISSN 2522-6398 Vol. 7, Issue 9: 242-247, DOI: 10.25236/FER.2024.070937

Liu et al.[6] proposed a talent cultivation model for newly-built application-oriented universities, emphasizing differentiated education systems to address practical needs and enhance competitiveness. However, the studies mentioned above have not addressed the integrated construction of disciplines, majors, and courses within the context of manufacturing talent demand.

Therefore, within the context of the talent demands of 'Made in China 2025,' the question of how to ensure the coordinated and unified development of disciplines, majors, and courses with the goal of integrated construction, thereby effectively enhancing the quality of talent cultivation, has become a critical issue for application-oriented undergraduate universities to consider deeply. In line with the industry's needs for talent cultivation in the automation field, this paper provides a detailed analysis of talent cultivation models and methods to improve talent cultivation quality and efficiency.

2. Content of Talent Cultivation Model Construction

With the advancement of the 'Made in China 2025' plan supporting the development of high-end manufacturing, automation programs in universities are facing new opportunities and challenges. To meet local economies' development needs better, universities must continuously explore new talent cultivation models. Exploring talent cultivation models for automation programs helps improve the quality of talent development, provides solid support for 'Double First-Class' and 'New Engineering' initiatives, and promotes the enhancement of the connotations and sustainable development of automation programs, thus boosting the overall strength and competitiveness of universities. This paper explores critical issues related to the content of talent cultivation model construction, including the talent cultivation model for local universities under the new circumstances, the integrated construction of disciplines, majors, and courses, the training of excellent engineers, and faculty development. The relationship between disciplines, majors, and courses is illustrated in Figure 1.

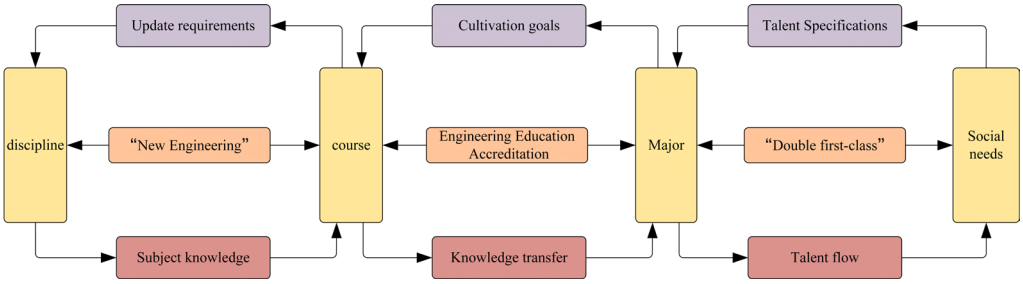

Figure 1: The Relationship between Disciplines, Majors, and Courses

2.1. Research on the Reform of Talent Cultivation Models for Automation Programs in Universities under New Circumstances

Many university programs still use traditional teaching philosophies, neglecting the comprehensive optimization and adjustment of professional knowledge and capabilities in the 'Double First-Class' and 'New Engineering' construction process. Additionally, some challenges have been identified in the teaching process, such as insufficient depth of teaching content, uneven distribution of teachers and students, disconnection between theoretical content and practical application, inability to keep up with talent cultivation in key and emerging fields, and the quality of professional talent cultivation failing to adapt to rapid external changes. Improvements can be made in the following areas to address these issues:

(1) Update practical teaching content and objectives to improve relevance. Adjust practical teaching goals and content promptly based on industry development trends and market demands, enhance the practical applicability of practical teaching, employ diverse teaching methods, and cultivate students' practical abilities, professional qualities, and innovative awareness.

(2) Improve the practical teaching evaluation system. Design appropriate evaluation methods for different practical teaching content and objectives, focusing on practical application and relevance to enhance students' practical abilities and professional levels.

(3) Invite industry experts to participate in practical teaching. Involving professional engineers with industry experience in practical teaching provides students with richer practical experience and professional guidance, helping them better understand industry trends and market demands.

(4) Clarify the talent needs of enterprises. Based on the specific requirements of enterprises, precisely

ISSN 2522-6398 Vol. 7, Issue 9: 242-247, DOI: 10.25236/FER.2024.070937

define the objectives for professional talent cultivation, enhance students' comprehensive qualities and innovative thinking, and help students adapt to industry and market demands.

(5) Comprehensively cultivate students' innovative thinking, skills, and knowledge. Strengthen students' self-directed learning, practical skills, and interdisciplinary abilities. Please encourage students to participate in social practice activities to enhance their quality and creativity and develop their problem-solving and innovative capabilities.

Against the backdrop of 'Double First-Class' and 'New Engineering,' comprehensively cultivate students' innovative thinking, skills, and knowledge, equipping them with the ability to solve practical problems and foster creativity to meet the national and societal demand for high-quality talent. Through these measures, universities can achieve the transformation of talent cultivation models required by 'Made in China 2025' under the 'Double First-Class' and 'New Engineering' framework. The process of transforming the talent cultivation model is illustrated in Figure 2.

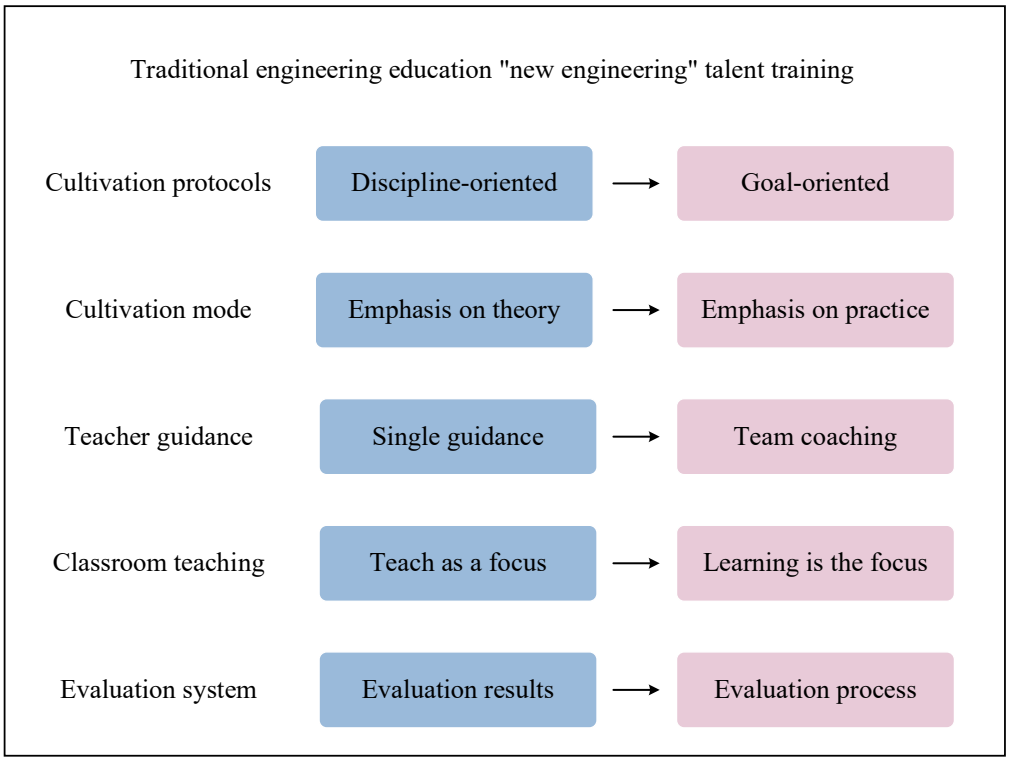

Figure 2: The Process of Talent Cultivation Model Transformation

2.2. Integrated Construction of Disciplines, Majors, and Courses Under New Circumstances

In local application-oriented undergraduate universities, there is a problem of insufficient correlation between disciplines, majors, and courses, leading to a disconnect in the talent cultivation process. It is necessary to focus on interdisciplinary and cross-professional knowledge structures and competencies and reform the traditional curriculum system by integrating practical teaching and cross-disciplinary, networked professional courses to address these issues. Given the limited resources and funding of application-oriented undergraduate universities, the focus of discipline, primary, and course construction should shift from pursuing comprehensiveness to pursuing distinctive features. Specifically, this involves developing a discipline, principal, and course system that aligns with national needs, the university's positioning, and societal demands to meet the goals of application-oriented talent cultivation. Additionally, use professional software and hardware resources, build a curriculum development platform, integrate and optimize course content, adjust course structures, and create a curriculum system centered on competency development to achieve sustainable development of application-oriented talent cultivation and promote the continuous progress of application-oriented undergraduate universities.

ISSN 2522-6398 Vol. 7, Issue 9: 242-247, DOI: 10.25236/FER.2024.070937

2.3. Strengthen school-enterprise cooperation to promote implementing the 'Excellent Engineer 2.0 Plan'

To address issues such as students' lack of understanding of enterprise talent needs and limited opportunities for participation in enterprise practice, further explore effective school-enterprise cooperation mechanisms. Establishing school-enterprise cooperation platforms and modern industry colleges, adhering to the principle of aligning discipline development with industry needs and talent cultivation with societal service, and signing contracts with relevant enterprises jointly cultivating talent for society. Based on continuing to strengthen the implementation of the 'Excellent Engineer 2.0 Plan,' our automation program will continuously improve cooperation methods, mechanisms, assessment standards, and related systems for school-enterprise collaboration in talent cultivation. Additionally, establish practical internship bases and work with enterprise experts and engineers to jointly develop training goals and teaching plans to understand better the direction of professional development and the latest industry demands, making timely adjustments and optimizations to talent cultivation programs to enhance quality and effectiveness. During the cooperation, personnel training will be conducted to ensure that professional courses and industry standards are accurately aligned, integrating teaching with production. Teachers will be responsible for delivering professional courses, while enterprises will handle practical training content. With a solid theoretical foundation, students will focus on knowledge application and practical training, continuously improving their innovation capabilities through participation in practice projects, thus enhancing the quality of automation program education under the 'Double First-Class' and 'New Engineering' framework.

2.4. Building a Faculty Team that Meets the Talent Cultivation Requirements Under New Circumstances

It is essential to enhance professional faculty members' theoretical foundation and teaching capabilities to meet the requirements for talent cultivation under the 'New Engineering' framework and engineering education accreditation. To achieve this, build teaching teams and course groups based on the automation program's needs and the faculty's academic research directions. Additionally, keep abreast of research trends closely related to the industry and local economic development, establish relevant academic research teams, and vigorously develop distinctive and advantageous disciplines aligned with professional construction and research directions to create an integrated faculty team that balances research and teaching. Furthermore, it is necessary to significantly enhance faculty members' engineering practice experience and experience in cultivating application-oriented talents. Address issues such as unreasonable faculty title structures and insufficient engineering backgrounds by actively recruiting outstanding doctoral graduates and strengthening the engineering practice abilities of young teachers. Additionally, a suitable number of industry and enterprise experts should be hired as adjunct faculty to guide practical teaching and graduation design phases, thereby ensuring effective talent cultivation under the 'New Engineering' framework.

3. Specific Methods for Constructing Talent Cultivation Models

3.1. Integrated Construction of Disciplines, Majors, and Courses: Concepts and Implementation

Establish an overarching concept for the integrated construction of disciplines, majors, and courses, fully considering their close connections and interactions during development. Effective methods should be employed when planning the integrated construction of disciplines, majors, and courses to ensure mutual support and joint development. For application-oriented undergraduate universities with limited resources and funding, the focus of the discipline, central, and course construction should shift from comprehensive coverage to distinctive features, developing advantageous disciplines, specialized majors, and high-quality courses that align with national needs, the university's positioning, and societal demands. Additionally, to motivate students to engage in self-directed learning and develop their ability to think independently and solve problems, local universities should implement innovative experimental courses and reduce the number of foundational courses lacking innovative elements. In application-oriented institutions, strengthening cooperation with enterprises and society, offering practical courses and vocational skills training, and enhancing students' practical abilities and professional qualities will improve education quality. These measures help enhance students' innovative awareness, refine the teaching system, and better meet societal demands for talent.

ISSN 2522-6398 Vol. 7, Issue 9: 242-247, DOI: 10.25236/FER.2024.070937

3.2. Strengthen the implementation of the 'Excellent Engineer 2.0 Plan' to firmly establish the concept of integrated construction of disciplines, majors, and courses and build engineering practice platforms

Understanding the 'Excellent Engineer 2.0' concept and firmly establishing the idea of integrated construction of disciplines, majors, and courses is a crucial prerequisite for implementing the Excellent Engineer Education Plan. Implementing the Excellent Engineer Education Plan is significant for improving engineering education quality and driving industry upgrading and transformation in the intense competition and accelerated development in higher education. Make full use of social resources, actively expand cooperation with enterprises with good development prospects, establish industry-academia-research collaborative mechanisms, and jointly build internship bases. Additionally, teaching and training platforms should be built based on the needs of automation program courses, and related resources should be shared with partner institutions to provide students with diverse practical conditions. These measures will enhance students' practical abilities and support the advancement of the Excellent Engineer Education Plan. Furthermore, by carrying out collaborative projects with enterprises and working with industry experts to deepen practical teaching content, support enterprises and research institutions' involvement in engineering education activities, achieving complementary advantages among universities, enterprises, and research institutions in talent cultivation.

3.3. Optimize the teaching quality assurance system to ensure the effectiveness and efficient implementation of engineering education

It is necessary to assess and manage the automation program comprehensively. Firstly, from the perspective of engineering talent cultivation, aspects such as curriculum development, teaching resources, research achievements, and faculty teams should be evaluated. Additionally, the teaching quality evaluation scheme should be reformed by introducing a systematic evaluation approach and incorporating evaluation results into faculty performance assessment indicators to ensure fairness And meet the requirements of engineering education accreditation. Implement incentive policies to reward teachers with outstanding teaching achievements, achieving precise teaching quality management. Improve the corresponding incentive mechanisms to support faculty and students in closely linking research outcomes with societal market needs, addressing real-world challenges. This is crucial for advancing higher education development, improving educational quality, and promoting innovation and entrepreneurship. Enhance the teaching evaluation system and feedback mechanisms for the automation program, revise and improve internal management systems, strengthen school-enterprise cooperation, optimize the allocation of teaching resources, and improve the quality of automation program education to cultivate more outstanding engineers with practical and innovative capabilities.

4. Conclusions

Against the talent needs outlined in 'China Manufacturing 2025,' application-oriented local universities' automation programs must coordinate the relationships between 'Double First-Class' and 'New Engineering' initiatives while exploring high-quality application-oriented talent cultivation models that meet local economic development needs. To achieve this goal, comprehensive construction and reform are required in areas such as integrated construction of disciplines, majors, and courses, cultivating excellent engineers, and faculty development. This paper proposes specific construction methods, including offering innovative experimental courses, optimizing teaching content, strengthening practical teaching, and collaborating with enterprises to cultivate talent. Implementing these methods can stimulate students' enthusiasm and initiative, enhancing their overall capabilities and innovation awareness. The proposed methods are derived from educational theory and practice and are practical and actionable. Additionally, these methods can cultivate high-quality application-oriented 'New Engineering' talents that meet local economic development needs and can serve as a reference for teaching reforms in other 'New Engineering' disciplines.

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ISSN 2522-6398 Vol. 7, Issue 9: 242-247, DOI: 10.25236/FER.2024.070937

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