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Construction and Practice of Automation Professional Courses for New Engineering Talents Driven by Industry and Empowered by Digital Intelligence

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Abstract: With the development of Industry 4.0 and intelligent manufacturing, automation professional education is undergoing significant transformation. The paper aims to explore the curriculum construction and practice of automation majors under the new engineering talent training model of "industry-driven and digital intelligence-empowered". The important role of automation majors in new engineering education is elaborated; the design and optimization of the curriculum system is proposed based on the requirements of new engineering and industry needs; digital intelligence technology is applied to reform teaching, learning, and evaluation methods; by incorporating ethical and professional development education into the curriculum, the overall quality of automation professionals is enhanced, providing beneficial exploration for the cultivation of new engineering talents.

Keywords: new engineering; industry-driven; automation; curriculum reform

1. Introduction

With the extensive application of technologies such as artificial intelligence, big data, and cloud computing, the traditional engineering education system has become difficult to meet the needs of new types of engineering talents. In 2017, China first proposed the concept of "New Engineering" and launched research and practice projects on New Engineering. The "Fudan Consensus" and "Tianjin University Action" have proposed the construction of an engineering education system that is future-oriented, demand-adapted, and innovation-leading, as well as the six major action plans for New Engineering education. Promoting New Engineering education is an inevitable requirement to cope with the rapid development of informatization, intelligence, globalization, and the transformation and upgrading of industrial structure. It is key to deepening educational reform, enhancing the engineering education of colleges and universities, and building a strong educational country. It is also an important link in promoting high-quality development of the economy and society [1,2].

The major of automation is an interdisciplinary subject, primarily studying the theory of automatic control and its application in various control systems, which is the technical foundation required for intelligent manufacturing. With the development of Indus-

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try 4.0 and intelligent manufacturing, the demand for talents in the automation field continues to grow [3]. To serve the development needs of intelligent control, robotics, and other industries in intelligent manufacturing, to meet the transformation and upgrading of China's manufacturing industry, and to enhance the competitiveness and sustainability of manufacturing, there is an urgent need to cultivate high-quality technical talents who can adapt to the needs of intelligent manufacturing. Colleges and universities, as the main base for cultivating automation talents, improving the quality of education is an important way to train talents and is also the first element of the development and innovation of the intelligent manufacturing industry [4].

This paper mainly focuses on the new trends of in 2017, China first proposed the concept of "New Engineering" and launched research and practice projects on New Engineering. The "Fudan Consensus" and "Tianjin University Action" have proposed the construction of an engineering education system that is future-oriented, demand-adapted, and innovation-leading, as well as the six major action plans for New Engineering education. and industry development, and aims to build and practice the reform of automation professional curriculum based on industry-driven and digital-intelligence-enabled automation professional talent cultivation.

2. Construction and Optimization of the Automation Major Curriculum System Driven by Industry

In the field of automation education, traditional curriculum systems usually focus on the imparting of theoretical knowledge, neglecting the integration of emerging technologies and interdisciplinary knowledge. This falls short of the requirements of New Engineering education for modern engineering practice and the cultivation of innovative capabilities [5]. With the rapid development of technology and industry, the industry's demand for talent is constantly evolving. The lag in curriculum systems may lead to a disconnect with industry development, and subsequently, the risk of being phased out by the industry.

Guided by the OBE (Outcomes-Based Education) philosophy, the paper closely integrates the core requirements of New Engineering education and industry demands, proposing a construction and optimization plan for the Automation Major Curriculum System, as shown in Figure 1. Within the existing curriculum framework of the automation major, practical skills courses are deepened to enhance students' experimental operation and engineering practice skills. Practical teaching segments are set up in professional courses, increasing the proportion of practice, such as corresponding experiments and course designs in courses like Principles of Automatic Control, Industrial Robot Integration Application, Power Electronics Technology, and Electronic Design Automation, in cooperation with enterprises and industries to offer comprehensive design training in automation, robot training, circuit-assisted design training, engineering internships, electronic process internships, and graduation internships. At the same time, courses on innovative thinking and research methods are introduced, such as basic experiments for innovation and entrepreneurship, electronic assembly internships, and academic competitions, to stimulate students' exploratory spirit and innovative capabilities. In addition, humanities and social science courses are integrated, such as ideological and political education, foreign language, physical education, aesthetic education, labor education, and military courses, to broaden students' horizons and cultivate their critical thinking and ethical awareness. Finally, interdisciplinary courses are developed, offering courses like artificial intelligence and intelligent manufacturing, big data, finance, engineering project management, and integrated innovation and entrepreneurship, to promote exchange and integration between disciplines and comprehensively improve students' overall quality.

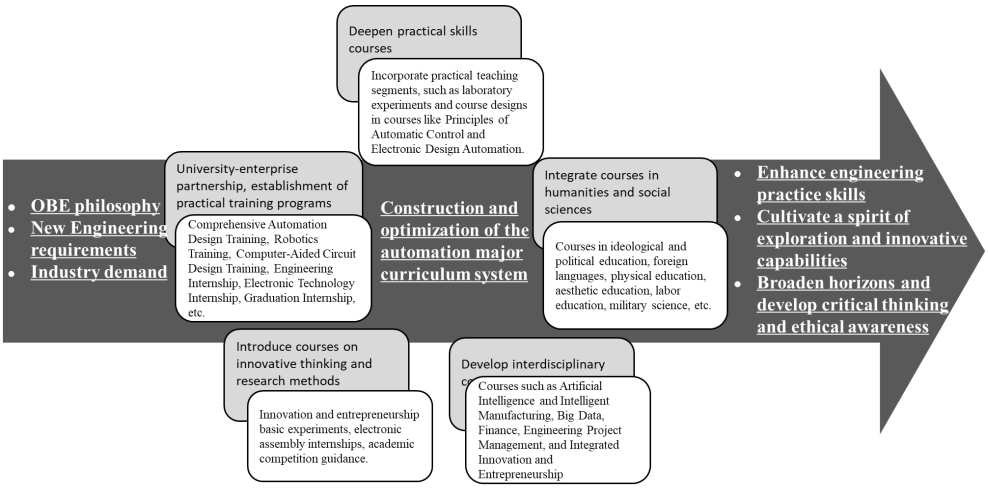

Figure 1. Construction and optimization of the automation major curriculum system.

3. Exploration and Reform of Teaching, Learning, and Evaluation Methods Empowered by Digital Intelligence

Under the current context of educational reform, the rapid development of digital intelligence technology has brought profound changes to the modes of teaching, learning, and evaluation. This study combines the development trend of the automation major and digital intelligence technology, centers on students, updates and enriches teaching content, explores and implements diversified teaching methods, and establishes a diversified teaching evaluation and student capability assessment system, as shown in Figure 2.

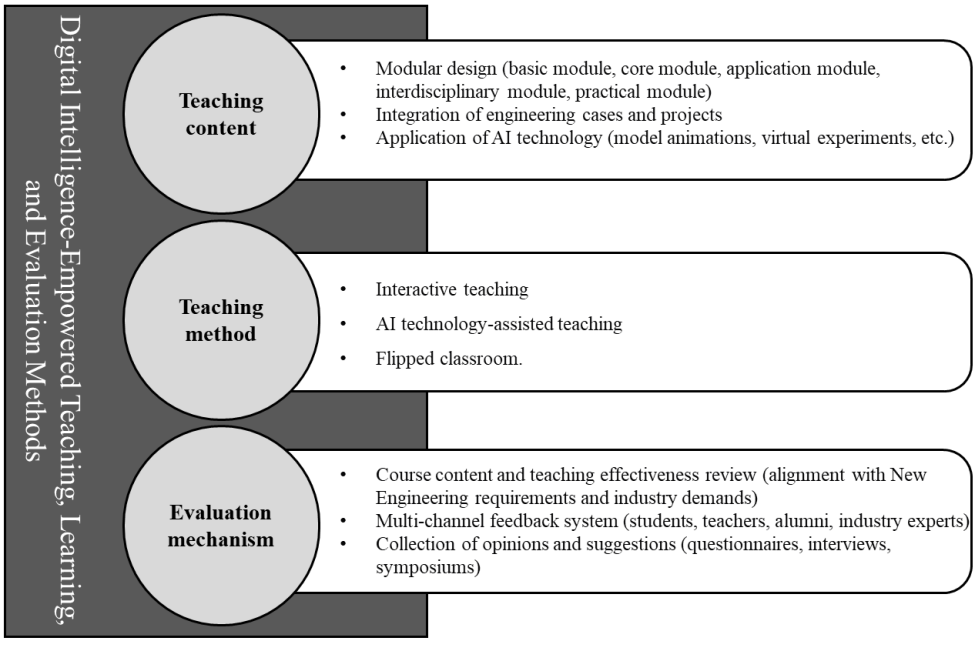

Figure 2. Digital Intelligence-Empowered Teaching, Learning, and Evaluation Methods.

In terms of teaching content, modular design is adopted, dividing into basic modules (covering the basic theories and skills of the automation major, such as circuit analysis, programming basics, etc.), core modules (in-depth discussion of the core areas of the automation major, such as control systems, robot technology, etc.), application modules (applying theoretical knowledge to practical problems, such as automation system integration, intelligent manufacturing projects, etc.), interdisciplinary modules (crossing with other disciplines such as artificial intelligence, data analysis, etc.), and practical modules

(strengthening practical skills, such as laboratory work, project design, internships). AI technology is used to present engineering application cases of the automation major, combining automation college student competition projects, integrating actual engineering cases and projects into the curriculum, with curriculum content adjusted flexibly according to industry demands and technological development, enhancing the practicality and targeting of teaching.

In terms of teaching methods, interactive teaching methods such as discussion, simulation, and role-playing are used to increase student participation; AI technology is utilized to assist teaching, such as online learning platforms, virtual reality (VR), etc., to enhance the interactivity and interest of teaching; the flipped classroom teaching model is implemented, encouraging students to study independently before class and engage in in-depth discussions during class to improve students' autonomous learning ability and innovative thinking.

In terms of teaching evaluation and student assessment, the curriculum content and teaching effects are regularly reviewed to ensure that the curriculum system is consistent with the requirements of New Engineering and industry demands; a multi-channel feedback system including students, teachers, alumni, and industry experts is established; opinions and suggestions from all parties are regularly collected through questionnaires, interviews, and symposiums; AI technology is used to monitor and analyze student learning behavior and performance in real-time, providing teaching suggestions and learning support. With AI's data analysis capabilities, teaching effects are quantitatively assessed, identifying problems and improvement points, helping teachers to discover problems in a timely manner and formulate specific solutions and improvement measures, forming a diversified assessment system and continuous improvement mechanism.

4. Comprehensive Quality Enhancement of Automation Major Talents through Curriculum Ideology and Politics Integration

In the teaching of automation courses, ethical and social responsibility concepts are deeply integrated in a way that aligns with the local context, using curriculum-based value education as an entry point to effectively cultivate students' comprehensive quality and enhance their lifelong learning ability and sense of social responsibility.

A comprehensive review of curriculum ideology and political elements is conducted, integrating ideals and beliefs, patriotism, legal awareness, social responsibility, cultural confidence, humanistic spirit, academic integrity, and professional ethics into teaching from a historical commonality. For example, in the course of "Principles of Automatic Control," the important contributions of Qian Xuesen to control theory and his patriotic feelings are introduced to guide students' ideals and beliefs and patriotic sentiments; in the chapter "Mathematical Models of Control Systems," the equivalent transformation of models is likened to the principles of interpersonal relationships, advocating the practice of freedom, equality, honesty, friendship, and justice, allowing students to deepen their understanding of fundamental societal values.

The cultivation of students' professional ethics and quality is emphasized by integrating engineering ethics and safety production responsibilities into the curriculum, enhancing students' professional awareness and sense of social responsibility. Through case analysis and project design, students understand and internalize ideological and political content in practice, guiding students to pay attention to the impact of scientific and technological innovation on social development, encouraging students to participate in scientific and technological innovation projects, enhancing their sense of mission and responsibility, and contributing to the country's scientific and technological progress.

5. Conclusions

This paper focuses on the construction and practice of automation major courses for New Engineering talents driven by industry and empowered by digital intelligence,

deeply exploring the transformation challenges faced by automation professional education under the rapid development of Industry 4.0 and intelligent manufacturing. By analyzing industry demands and the characteristics of New Engineering education, a curriculum system for the automation major based on industry-driven needs is constructed, exploring teaching, learning, and evaluation methods empowered by digital intelligence. Through the integration of ideological and political education into the curriculum, this paper also discusses how to comprehensively enhance students' overall quality. This study provides practical guidance for cultivating high-quality automation professionals that meet the standards of New Engineering education and the actual needs of the industry.

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