ISSN: 2637-6067 DOI: 10.6918/IJOSSER.202505_8(5).0016

# Research on the Training Mode of Applied Talents in Big Data under the Background of New Engineering through the Integration of Industry and Education

Xiaohong Cai[1], Xiaoya Cai[1,*] and Xuqiang Zhuang[2]

[1]School of Medical Information Engineering, Shandong University of Traditional Chinese Medicine, Jinan 250355, China

[2]School of Information Science and Engineering, Shandong Normal University, Jinan 250358, China

[*]Corresponding author

## Abstract

**In the context of emerging engineering education (New Engineering), traditional engineering education is in urgent need of reform to meet the demand for applied talents in big data, given the challenges posed by industrial upgrading and new technologies. By analyzing the current status of traditional engineering education, this study proposes a training mode for big data applied talents that emphasizes the deep integration of industry and education. This mode involves optimizing the curriculum system, implementing personalized teaching methods, strengthening the cultivation of practical abilities and innovative entrepreneurship skills, and adopting a student-centered teaching approach. Additionally, strategies such as fostering industry-education integration and promoting learning through competitions are employed to nurture versatile talents equipped with solid professional knowledge, outstanding practical capabilities, and a strong sense of innovation, thereby facilitating the in-depth integration of education and industry.**

## Keywords

**New engineering; Industry-teaching integration; Big data; Talent cultivation.**

## 1. Introduction

In the new era, with the in-depth implementation of major national development strategies such as the "Belt and Road Initiative," "Made in China 2025," and "Internet Plus," the global economic landscape is undergoing unprecedented transformations. The rapid emergence of new economies represented by new technologies and industries has not only driven the optimization and upgrading of industrial structures but also imposed higher requirements on the cultivation of engineering and technological talents [1]. Traditional engineering education faces significant challenges and urgently needs reform and innovation to meet the talent demands of the new economy. Currently, the talent cultivation system for data science and big data technology majors has struggled to keep pace with the rapid development of the industry. The cultivation objectives are generally too broad, the curriculum system overlaps extensively with computer science majors, and the core curricula are outdated, severely constraining the enhancement of students' practical abilities and diluting the uniqueness of the major. Consequently, graduates find it difficult to adapt to the rapidly changing industry demands, leading to a significant disconnect between talent cultivation and societal needs.

The introduction and development of New Engineering represent a proactive response to this challenge [2]. It emphasizes the integration of cutting-edge technologies such as cloud

ISSN: 2637-6067 DOI: 10.6918/IJOSSER.202505_8(5).0016

computing, the Internet of Things, big data technology, intelligent manufacturing, and virtual reality, with a core focus on Internet Plus artificial intelligence, to comprehensively upgrade and transform traditional engineering majors. This interdisciplinary integration not only broadens the horizon of engineering education but also enriches teaching content and methods, making talent cultivation more aligned with actual industry demands. New Engineering aims to cultivate big data application-oriented talents equipped with solid professional knowledge, outstanding practical abilities, strong innovative consciousness, and broad international perspectives to meet the urgent demand for high-quality talents in enterprises under the new economic background [3].

By integrating the cutting-edge concepts of New Engineering with the rigorous standards of engineering education accreditation, the cultivation objective is set to develop versatile talents with a solid foundation in professional knowledge who can flexibly apply multidisciplinary knowledge to solve practical engineering problems [4]. This cultivation objective not only encompasses exquisite skills and extensive knowledge at the technical level but also emphasizes the cultivation of students' comprehensive qualities in management decision-making, effective communication, and team collaboration, enabling them to independently undertake engineering projects. The multifaceted determination of the cultivation objective will lay a solid foundation for students' career development, endowing them with competitiveness and innovativeness in the field of big data applications.

## 2. Reorganize Curriculum Modules and Optimize the Curriculum System

### 2.1. Curriculum System for Data Science and Big Data Technology Major

In the context of industry-education integration, where industries evolve rapidly and technologies are updated frequently, the curriculum has been dynamically and flexibly adjusted [5]. Personalized elective courses have been introduced, allowing students to choose based on their interests and career plans, thereby ensuring the currency and adaptability of the curriculum. The professional curriculum system has been reformed in accordance with the market demand for big data talents, breaking down the traditional disciplinary barriers of computer science majors. The proportion of course structures has been adjusted, reducing purely lecture-based courses and increasing practical and exploratory courses led by students themselves. This reflects the requirements for diversified and personalized development, offering multiple elective courses for students at different stages to choose freely, thereby facilitating individualized and tailored teaching. The curriculum emphasizes the integration of medical and engineering disciplines, encouraging students to engage in interdisciplinary studies across different professional fields to cultivate a more comprehensive perspective and problem-solving abilities.

The curriculum system for the Data Science and Big Data Technology Major consists of four modules: general education courses, disciplinary foundation courses, professional education courses, and innovation and entrepreneurship courses. The professional education module is further divided into three sub-modules: core professional courses, extended professional courses, and concentrated professional practice. In the disciplinary foundation courses module, teaching in relevant courses such as mathematical modeling, database principles and applications, and computer fundamentals is strengthened to lay a solid theoretical foundation for students. In the core professional courses module, the allocation of class hours and the semesters in which courses like Data Collection and Processing, Fundamentals of Java Web Programming, and Big Data Processing Technologies are offered have been adjusted. A case library for core courses has been established, and new courses such as Natural Language Processing Technology and Applications and Introduction to Medical and Health Informatization have been added to ensure that students have in-depth understanding and

ISSN: 2637-6067 DOI: 10.6918/IJOSSER.202505_8(5).0016

practical skills in their professional fields. In the extended professional courses module, interdisciplinary courses that reflect the integration of medical and engineering disciplines, such as Health Medical Data Analysis and Applications, Medical Image Processing, Medical Artificial Intelligence, and Statistical Analysis and Applications of Medical Big Data, have been offered to enhance students' interdisciplinary learning abilities. The arrangement of core professional courses and practical teaching has been strengthened to further improve students' job competence.

## 2.2. Dynamic professional curriculum system

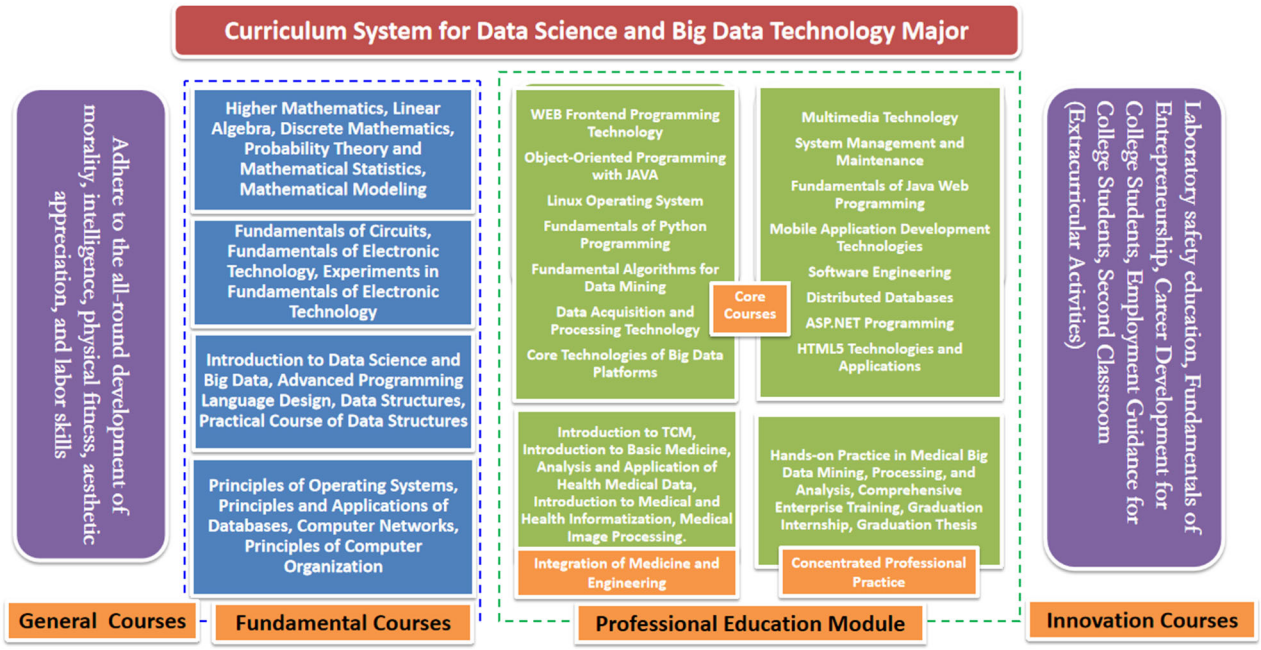


**Figure1.** Dynamic professional curriculum system

Enterprise mentors from Inspur Group have participated in the revision and demonstration of the undergraduate talent cultivation plan for the Data Science and Big Data Technology major. Based on the demands of the big data industry, they have jointly formulated curriculum settings, teaching syllabi, and practical plans to ensure the comprehensiveness and practicality of the curriculum system. Enterprise mentors and on-campus teachers have actively developed high-quality courses and engineering cases, accelerating the iterative updating of course content. They have promoted the scientific alignment of course content with industry standards, production processes, project development, and other industrial demands, constructing high-quality school-enterprise cooperation courses and engineering training case libraries. Enterprise engineers have taught some core courses, guided students' internships and practical training, and participated in students' graduation design and defense, thereby enhancing the quality of the jointly built practical platforms.

# 3. Curriculum Teaching Reform: Constructing Student-centered Personalized Teaching Model

## 3.1. Student-centered Personalized Teaching Model

Based on the fundamental principles of emerging engineering education (New Engineering), we have strengthened the integration of industry and education in accordance with industrial demands, grounded in the standards of international engineering education accreditation, and

ISSN: 2637-6067 DOI: 10.6918/IJOSSER.202505_8(5).0016

centered on students to explore the cultivation mode of applied talents in big data. Adhering to the philosophy of cultivating applied talents, we have carried out reforms and practices in the cultivation mode of talents majoring in Data Science and Big Data Technology based on industry-education integration, systematically optimizing the content systems of on-campus and off-campus internships, practical training, and innovative practices.

The construction of a personalized teaching model is based on a thorough understanding of student differences, pursuing personalization and differentiation in education. This philosophy emphasizes students' autonomy, independence, and creativity, advocating for the integration of students' interests, needs, and potentials into educational considerations to form a comprehensive teaching system. Under the guidance of this philosophy, a series of curriculum teaching reforms have been implemented.

Personalized Curriculum Setting and Diversified Electives: By re-examining the curriculum setup, more diversified and personalized courses have been introduced. Based on the foundational courses of professional disciplines, a rich array of elective courses covering different directions and interest areas has been added. Students can freely choose according to their personal interests and development paths, achieving interdisciplinary integration and broadening their knowledge base.

Project-Based Learning: Professional courses adopt a project-driven teaching method. Through practical project training, students can better apply theoretical knowledge to practice, cultivating problem-solving and teamwork abilities. Project-based practical experiences help students deeply understand professional knowledge while also honing their practical skills and innovative thinking.

Under the reform of a blended online-offline teaching model, a student-centered personalized teaching model has been constructed. Big data technology is utilized to analyze learning needs, achieving personalized and intelligent learning. By comprehensively collecting data on students' learning processes, teachers can better understand students' learning states and provide targeted learning guidance strategies. Online learning platforms can recommend suitable learning resources and activities for students based on their learning history and interests through intelligent systems.

## 3.2. Teaching Model Reforms

A series of teaching model reforms have been implemented for students majoring in Data Science and Big Data Technology: (1) Case-Based Teaching: During the teaching process, cases related to medicine and Traditional Chinese Medicine (TCM) are designed, allowing students to implement these cases through programming, thereby deeply understanding and mastering the application of the Python language in the medical field. This approach not only enhances students' practical abilities but also facilitates the deep integration of the advantages of TCM informatization with internet-based education and teaching. (2) Experimental Teaching: In addition to theoretical teaching, experimental courses can be set up where students use Python for medical data analysis, medical image processing, and other experiments, deepening their understanding of theoretical knowledge through practice. (3) Internships and Practical Training: The school collaborates with multiple enterprises to provide students with opportunities for internships and practical training, allowing them to understand real work environments and better exercise their practical operation abilities, applying what they have learned to actual work. (4) Research Projects: Students are encouraged to participate in research projects, improving their practical and innovative abilities through hands-on operations. At the same time, they can also stay informed about the latest scientific research achievements and technological developments.

ISSN: 2637-6067 DOI: 10.6918/IJOSSER.202505_8(5).0016

# 4. Promoting Learning, Teaching, Practice, and Innovation through Competitions

The educational philosophy of "promoting learning, teaching, practice, and innovation through competitions" has been actively practiced and promoted within the school. Students participate in competitions to acquire knowledge, enhance skills, and cultivate innovative thinking and teamwork abilities in practical settings. This not only fosters the all-round development of individual students but also injects robust vitality into the school's innovation and entrepreneurship education, laying a solid foundation for cultivating versatile talents with innovative consciousness and practical abilities.

## 4.1. Strengthening Discipline Competition Management to Enhance Students' Innovation and Entrepreneurship Abilities

Discipline competition management emphasizes the cultivation of students' comprehensive qualities and the promotion of interdisciplinary integration. By broadening the scope of competition projects and incorporating interdisciplinary content, students are encouraged to better apply multidisciplinary knowledge in competitions, thereby fostering innovative thinking and practical abilities. Relying on the Big Data Professional Innovation Laboratory, students can more easily access competition-related information, promptly match with teams and instructors, and communicate with previous award-winning teams to absorb competition experiences.

The cultivation of innovation and entrepreneurship abilities for students majoring in big data aims to stimulate their innovative potential and equip them with the capacity to innovate and entrepreneur within the big data domain. Firstly, a curriculum system aligned with the demands of the big data industry has been developed, encompassing cutting-edge fields such as data science, machine learning, and big data technologies, providing students with a solid foundation of professional knowledge. Simultaneously, through practical courses and projects, students can apply their knowledge in real-world scenarios, cultivating their ability to solve practical problems. Secondly, students are encouraged to participate in various innovation and entrepreneurship competitions, with the guidance of entrepreneurship mentors, to help transform theoretical knowledge into practical applications and cultivate essential skills for teamwork and project management in real-world work. This not only exercises students' entrepreneurial thinking but also lays the foundation for accumulating practical project experience. Additionally, an innovation and entrepreneurship platform has been actively established, fostering in-depth cooperation with enterprises to provide students with opportunities for entrepreneurial practice. This includes various forms such as enterprise internships and school-enterprise cooperation, enabling students to learn more practical skills in a real business environment and cultivate the ability to understand the market and perceive user needs. Through these efforts, we aim to cultivate big data students with comprehensive qualities of innovation and entrepreneurship, enabling them to embrace an innovative spirit in their future careers and make positive contributions to the development of the big data field.

## 4.2. Leveraging Teaching Innovation Competitions to Comprehensively Enhance Teachers' Teaching Skills

Promoting teaching through competitions is an initiative that stimulates teachers' enthusiasm and potential for teaching innovation. In higher education, teaching innovation competitions serve as a crucial driving mechanism by organizing competitions and selecting winners, providing teachers with a platform to showcase and share their innovative achievements. This model not only plays a positive role in stimulating teachers' enthusiasm and creativity but also optimizes and enhances the education and teaching system. The Teaching Innovation Competition for University Teachers is an effective approach to promoting educational

ISSN: 2637-6067 DOI: 10.6918/IJOSSER.202505_8(5).0016

innovation and improving teaching quality, strengthening reforms and innovations in education and teaching, promoting the innovative development of curriculum ideological and political education, continuously improving the collaborative education mechanism, and advancing the in-depth integration of industry and education. Through competitions, teachers can showcase their unique insights and innovative practices in teaching, share successful experiences, and drive the improvement of education and teaching standards.

Through teaching innovation competitions, teachers can not only keep abreast of the latest developments in their disciplines but also integrate practical competition experiences into course teaching. This teaching approach makes instruction more relevant to actual needs and more conducive to students' all-round development. Teachers are encouraged to share their competition experiences, prompting continuous innovation in teaching methods. By promoting teaching through competitions, teachers actively explore and experiment with instructional design, teaching methods, and curriculum construction, forming a group of teaching paradigms with innovative spirit and practical experience. These successful cases not only provide other teachers with lessons learned and experiences to draw from but also enrich the school's education and teaching resources. Meanwhile, the mechanism of promoting teaching through competitions also stimulates the school's long-term focus on teaching reform, driving continuous updates in educational philosophies and teaching methods, and injecting new vitality into the cultivation of innovative talents and the development of disciplines.

The excellent teaching cases selected through the competition can exert a positive demonstration and leading role in the school's education and teaching work. This atmosphere that values innovation and encourages practice is not only conducive to cultivating more creative and practically skilled outstanding talents but also provides strong support for the school to build an innovative education system. The promotion and application of the concept of promoting teaching through competitions in the field of education will contribute to continuously improving the school's teaching standards and fostering the development of students' more comprehensive qualities.

## 5. Organization of the Text

Guided by the open and shared concept of "Internet Plus," we actively promote the construction of an educational resource repository, forming a high-quality resource construction alliance with collaborative participation from sharing entities. The educational resource repository comprises four major categories: a course experiment case library, a comprehensive practical project library, a graduation internship resource library, and a graduation project topic library, providing students with abundant learning resources. By building an educational resource platform, we achieve the co-construction and sharing of resources, facilitating interaction among various entities involved in talent cultivation. Leveraging the school-enterprise cooperation platform to construct a teaching resource repository for industry-education integration is a crucial step in promoting close cooperation between industry and education. The school opens its excellent teaching resources to enterprises while obtaining practical cases and the latest industry trends from them, realizing a two-way flow of resources. The construction of the industry-education integration teaching resource repository enables students to engage with more real business scenarios and problems, enhancing the practicality of talent cultivation, providing students with a better learning environment and career development opportunities. Students' participation in actual projects allows them to better master professional knowledge while also driving innovation and development in enterprises.

### 5.1. Course Experiment Case Library

Based on the latest training programs and the corresponding graduation requirement indicators for each course, we have reformulated the syllabi and experimental syllabi for each

ISSN: 2637-6067 DOI: 10.6918/IJOSSER.202505_8(5).0016

course, compiling a course experiment case library. This library includes 152 new course experiment cases, such as Hadoop High Availability (HA) environment setup, MapReduce application development, Servlet MVC pattern experiments, Spring and Mybatis integration experiments, banker's algorithm simulation experiments, data visualization with Matplotlib, seaborn, and pyecharts, and data collection using the Scrapy crawler framework. For example, the experiment case library for the "Python Programming Basics" course encompasses a wealth of practical cases designed to help students deeply understand and proficiently master the fundamental concepts and application skills of the Python programming language. It includes basic experiments, such as the use of variables and data types, and the practice of conditional statements and loop structures, as well as technical application experiments involving practical programming tasks related to file operations, function definition, and invocation. Interdisciplinary experiment cases guide students to integrate Python programming with other disciplinary fields, allowing them to enhance their programming skills through continuous challenges while cultivating innovative thinking and practical problem-solving abilities.

## 5.2. Comprehensive Practical Project Library

The comprehensive practical project library not only includes comprehensive practical projects from standalone practical courses in the professional practice module but also encompasses process-based assessment comprehensive practical projects added after optimizing the course assessment methods in core professional courses following teaching reforms. For example, the comprehensive project practical assessment for the "Data Mining Basic Algorithms" course requires students to complete a specific data mining project, comprehensively applying their knowledge and skills in data mining basic algorithms to implement a cutting-edge data mining algorithm or a real-world data mining case, collaborating as a team to complete the project. The project requirements include data collection and cleaning, feature engineering, model selection and training, model evaluation and optimization, experimental report writing, and presentation and defense, accounting for 10% of the total grade.

The comprehensive practical projects aim to enable students to apply the knowledge learned in courses to solve real-world problems through actual teamwork, such as conducting data mining and analysis using relevant data from TCM and herbal medicine. The project content covers various aspects, including technological research and development, innovative design, and social services, providing students with a comprehensive practical platform. Each project has clear objectives, tasks, and assessment criteria to stimulate students' teamwork, innovative thinking, and problem-solving abilities. By participating in comprehensive practical projects, students can better integrate and apply their professional knowledge, enhance their comprehensive qualities, and be well-prepared for their future careers.

## 5.3. Graduation Internship Resource Library

The graduation internship resource library encompasses a wide range of resources that provide students with internship opportunities and support. It includes internship plans and arrangements, introductions to internship enterprises, internship project cases, course training and lectures, internship assessments, and provides diverse internship position information, details on internship project objectives, implementation plans, job responsibilities, and templates for internship reports and assessment forms to help students standardize their records and summaries during the internship. The graduation internship resource library is dedicated to providing students with comprehensive internship support to help them better integrate into the actual work environment, enhance their professional skills, and be well-prepared for their future careers.

By establishing a regular "visiting enterprises to expand job opportunities" mechanism and conducting activities such as industry-academia-research seminars and visits to graduate internship units, we continuously deepen school-enterprise cooperation, striving to lay a solid

ISSN: 2637-6067 DOI: 10.6918/IJOSSER.202505_8(5).0016

foundation for higher-quality and more sufficient employment for graduates. The seminars and visits to employers serve as a two-way communication and selection platform for students and enterprises. School-enterprise cooperation and industry-education integration can effectively promote student entrepreneurship and employment, playing a positive and guiding role in enhancing students' employment positioning.

### 5.4. Graduation Project Topic Library

The graduation project topic library covers hot issues within the field of big data, aiming to provide students with a wide range of in-depth research directions. This topic library includes carefully selected and designed graduation project topics, covering various aspects such as theoretical research, practical application, and innovative design. Each topic is accompanied by detailed research background, objectives, methods, and potential research outcomes. This helps students choose appropriate graduation project topics based on their interests and professional directions, encouraging in-depth research and enhancing their ability to solve practical problems. The graduation project topic library aims to stimulate students' academic interests and guide them to demonstrate their professional qualities and innovative abilities in their graduation projects.

During the graduation project phase, students need to undergo special training for graduation theses, conduct necessary research, select graduation project topics under the guidance of supervisors, consult and collect literature materials, comprehensively apply their learned knowledge and skills to complete the proposal, conduct system design, development, and debugging, write graduation theses, and pass the defense. The graduation project is a comprehensive teaching link that cultivates students' engineering practice abilities, theoretical research abilities, and innovative consciousness. Enterprise mentors from companies like Inspur and full-time school teachers jointly guide students in thesis topic selection, system design, system testing, thesis writing, mid-term inspections, thesis reviews, thesis evaluations, and graduation defenses.

The graduation project topics are more inclined towards the direction of medical and health big data, aiming to cultivate students' research abilities in the interdisciplinary field of TCM and modern technology, focusing on combining traditional TCM theories with modern big data technologies to explore the application and innovation of TCM in modern healthcare. The topics cover various aspects such as quality control of Chinese herbal medicines, auxiliary technologies for TCM diagnosis and treatment, and informatization management of TCM, aiming to promote academic research and technological innovation in the fields of TCM and herbal medicine through students' research and practice.

## 6. Conclusion

Under the background of emerging engineering education (New Engineering), the industry-education integration model for cultivating applied talents in big data, through curriculum system optimization, teaching model innovation, and in-depth school-enterprise cooperation, effectively promotes the organic linkage between the education chain, talent chain, industrial chain, and innovation chain. Focusing on the cultivation of applied big data talents as its core, and taking the deep integration of enterprises and school education as its path, this new industry-education integration talent cultivation model applies modern information technology throughout the entire process of talent cultivation and deeply integrates it with education and teaching, providing strong support for talent cultivation in the big data era.

ISSN: 2637-6067 DOI: 10.6918/IJOSSER.202505_8(5).0016

## Acknowledgements

This work is supported by Research Project on the Development Plan for Higher Education of Shandong University of Traditional Chinese Medicine (GJYJY202245);The Second Batch of Artificial Intelligence-Empowered Teaching Reform Projects at Shandong University of Traditional Chinese Medicine: "Digital and Intelligent Course Construction Team for 'Fundamentals of Python Programming'";2024 Educational and Teaching Research Project (Experimental Teaching Special) of Shandong University of Traditional Chinese Medicine: Innovative Research on Experimental Teaching Empowered by AIGC in 'Fundamentals of Python Programming' (SYYB2024016);School-Level Ideological and Political Education Demonstration Course at Shandong University of Traditional Chinese Medicine: 'Fundamentals of Python Programming'; Project from the "Internet + Education" Applied Research Base of Shandong Normal University.

## References

[1] Dong Jun. Exploration of the Reform of the Training Model for Emerging Engineering Talents Based on Artificial Intelligence Technology [J]. Science, Technology and Innovation, 2022(22): 33-35.

[2] Yang Chaoxian, Xin Guixin. Exploration of the Construction of Surveying Courses for Non-Surveying Majors under the Background of Emerging Engineering [J]. Journal of Higher Education, 2024, 10(27): 126-129.

[3] Liu Keming. Exploration and Practice of the Innovation and Entrepreneurship Talent Training System in Local Universities under the Background of Emerging Engineering [J]. Jiangsu Science & Technology Information, 2024, 41(16): 14-17.

[4] Wang Zhifeng, Yang Xiaoyu, Wu Zhengyang. Cultivation of Intelligent Manufacturing Engineering Talents for Industry 4.0 [J]. Higher Education Development and Evaluation, 2024, 40(05): 105-118.

[5] Chen Yaxiong, Xiong Shengwu, Yuan Jingling. Practical Exploration of the Cultivation of Professional Master's Degree Candidates in Artificial Intelligence Based on Industry-Education Integration [J]. Software Guide, 2024, 23(08): 156-160.