Practices in Big Data Technology Curriculum Reform Under the Framework of Emerging Engineering Education

Tao Wu[1], Chi Zhang[2]
[1]*University of Sanya, Sanya, Hainan, China*
[2]*Tsinghua Shenzhen International Graduate School, Shenzhen, Guangdong, China*

Abstract: With the rapid development of information technology and evolving societal demands, traditional engineering education models have increasingly revealed numerous shortcomings, particularly in cultivating innovative and interdisciplinary talents. The proposal of Emerging Engineering Education (EEE) has provided a new direction for the reform and development of engineering education, especially in cutting-edge fields such as big data and artificial intelligence. Focusing on the theme of "Practices in Big Data Technology Curriculum Reform Under the Framework of Emerging Engineering Education," this paper first explores the conceptual foundations of EEE and its challenges to computer science education. Subsequently, it analyzes strategies for optimizing big data technology education within this new paradigm, ultimately proposing a series of practical curriculum reform recommendations. These initiatives aim to better align educational outcomes with current societal requirements for graduates, addressing critical needs in technological innovation, industrial applications, and interdisciplinary competency development. The proposed reforms emphasize three core dimensions: curriculum system restructuring, project-based pedagogical innovation, and enhanced industry-academia collaboration, collectively contributing to the cultivation of future-ready engineering professionals equipped to navigate complex technological landscapes.

Keywords: Emerging Engineering Education; Big Data Technology; Curriculum Reform

1. The Background and Connotation of New Engineering Disciplines

The new engineering discipline was proposed by the state to proactively respond to the new round of technological revolution and industrial transformation, and to support and serve innovation, drive development, and a series of national strategies such as "Made in China 2025". On June 9, 2017, the Ministry of Education held the founding meeting of the expert group for new engineering research and practice and the first working meeting in Beijing, comprehensively launching and systematically arranging the construction of new engineering. More than 30 experts from universities, enterprises and research institutions had in-depth discussions on the new opportunities brought by the new industrial revolution, focused on the new demands of the country and planned the new development of engineering education. They reviewed and approved the "Guidelines for New Engineering Research and Practice Projects" [1] and put forward guiding opinions on the construction of new engineering. On September 17, 2018, the "Opinions of the Ministry of Education, the Ministry of Industry and Information Technology, and the Chinese Academy of Engineering on Accelerating the Construction and Development of New Engineering and Implementing the 2.0 Version of the Outstanding Engineers Education and Training Program" was released [2]. We will spare no effort to explore and form a Chinese model and experience that leads global engineering education, and contribute to the construction of a strong country in higher education. New engineering major, major Pointers to the emerging industry professional, Internet and industry intelligence as the core, including the large data, cloud computing, artificial intelligence, chain blocks, virtual reality, smart science and technology and related engineering professional. New engineering disciplines are based on the application of intelligent manufacturing, cloud computing, artificial intelligence, robotics and other technologies to upgrade and transform traditional engineering disciplines. Compared with traditional engineering talents, what future

emerging industries and new economies need are high-quality, compound new engineering talents with strong practical abilities, innovative capabilities and international competitiveness. New engineering is the China's higher education in response to a new round of technological revolution and industrial revolution put forward the strategic direction of the reform, its core characteristics embodied in three aspects:

The in-depth intersection and cutting-edge integration of disciplines break through the boundaries of traditional engineering, and build interdisciplinary systems such as "Artificial Intelligence +" and "Big Data +", for instance, intelligent medical engineering (AI+ Biology) and quantum information science (physics + computer science). The curriculum system dynamically integrates cutting-edge technologies such as blockchain and the metaverse, strengthens the support of basic disciplines like mathematics and informatics, and cultivates a compound knowledge structure. The synergy and innovation education practice guidance to establish "enterprise proposition - college problem solving" the combat training mode, such as huawei "smart base" plan, big jiang robot joint laboratory. Students are required to complete at least 30% of their credits through project-based learning (such as unmanned vehicle research and development, industrial Internet platform construction), emphasizing the resolution of real engineering problems in national strategic demands such as intelligent manufacturing and carbon neutrality. The ethics of science and technology with global competency and add artificial intelligence ethics, the sociology of engineering courses, such as prejudice, guides the student to evaluate automated driving algorithm gene editing technical risk. Promote a "bilingual + international certification" training system, encourage participation in platforms such as the International College Students' Supercomputing Competition, and cultivate new types of engineers who can not only break through "bottleneck" technologies but also participate in global science and technology governance. In 2024, according to a new engineering professional employment rate by more than 95%, of which 60% graduates into integrated circuit, new energy and other strategic emerging industries, to confirm its tight butt national development needs significant advantages.

2. The Predicament of Computer Education under the Background of New Engineering

With the proposal of new engineering disciplines, the traditional model of computer education is facing huge challenges. Traditional computer education system too focus on the basic theory and single skill training and the cultivation of practice ability, lack of interdisciplinary integration and innovation to meet the social demand for talents. Especially in fields such as big data, cloud computing and artificial intelligence, a single technical skill is often insufficient to meet the complex social demands. Therefore, the curriculum reform of computer education has become an important issue under the background of new engineering.

2.1 The Lag of the Education Model

Traditional computer education places too much emphasis on theoretical teaching and the imparting of basic knowledge, and too much focus on basic theories and the training of single skills, neglecting the cultivation of students' innovation ability and practical ability. The course content often remains at the basic knowledge level and lacks a close connection with the development of the industry, resulting in students lacking the ability to solve practical problems after graduation.

2.2 The Curriculum System is Monotonous

The traditional computer curriculum system is relatively simple. The curriculum Settings mainly focus on programming techniques and algorithm design, lacking systematic explanations of cutting-edge fields such as big data and artificial intelligence. Big data technology itself involves a large number of interdisciplinary areas, including statistics, database technology, distributed computing, etc. Traditional curriculum systems often fail to cover these contents, resulting in students lacking corresponding knowledge reserves when dealing with complex problems.

2.3 Students' Skills are Disconnected from Industry Demands

With the rapid development of big data technology, the industry's demand for technical talents is increasing day by day. It not only requires students to have a solid theoretical foundation, but also strong practical ability, teamwork ability and innovative consciousness. However, traditional computer education often

fails to meet these demands. Although students possess certain technical capabilities, they often lack practical scenarios, do not know how to apply the knowledge they have learned in specific life and production scenarios, and lack the ability to solve practical problems, thus making it difficult for them to quickly adapt to industry demands.

3. The Reform Direction of Big Data Technology Education under the Background of New Engineering

In the future, the volume of global data will continue to grow explosively. It is estimated that by 2035, the global data volume will reach 400ZB (1ZB = 1 Megabyte), and the scale of big data will increase several times or even dozens of times compared to the present. The popularity of various devices (such as smart phones, Internet of Things devices, sensors, etc.) will generate massive real-time data. Enterprises and governments will face huge challenges in how to store, manage and process these data efficiently. Big data technology as computer technology, one of the big data technology has made significant progress in the past few years, and has played a tremendous influence in many fields. With the continuous increase in data volume, the improvement of computing power, and the rapid development of related technologies such as artificial intelligence, the future development of big data will enter a more intelligent, diversified and specialized stage. Against this background, the reform directions of big data technology education may include the following four points:

3.1 Update the Curriculum System and Strengthen Interdisciplinary Integration

Under the background of new engineering, the education of big data technology needs to update and optimize the curriculum system. The course content should not only cover basic programming, algorithms, databases and other technologies, but also incorporate cutting-edge fields such as big data analysis, distributed computing and artificial intelligence, truly meeting the technical requirements of the industry for talents in the big data field. Meanwhile, emphasis should be placed on interdisciplinary integration, incorporating knowledge from disciplines such as statistics, mathematics, economics, and sociology to cultivate students' all-round comprehensive qualities.

3.2 Enhance Practical Teaching and Improve Technical Capabilities

Practical teaching is a crucial link in the education of big data technology. Big data technology itself is a highly practical technology. Students' learning should not only be limited to the mastery of theoretical knowledge, but also apply theoretical knowledge to practical problems through experiments, projects, internships and other forms. Therefore, the curriculum reform should increase the proportion of practical teaching, design more project-driven practical courses, enable students to accumulate experience in actual operations, and enhance their big data technology capabilities.

3.3 Introduce Cutting-Edge Technologies and Strengthen Industry Connections

To narrow the gap between education and industries, curriculum design should draw more on industry demands and incorporate cutting-edge technologies. The rapid development of big data technology has driven the rise of fields such as cloud computing, artificial intelligence, and the Internet of Things. Computer education should keep pace with technological development, update course content in a timely manner, and maintain synchronization with industry demands.

3.4 Promote School-Enterprise Cooperation and Cultivate Compound Talents

The new engineering discipline emphasizes the integration of industry, academia and research. In the education of big data technology, schools should actively promote cooperation with enterprises and design courses and practical projects that better meet the needs of the industry. Through school-enterprise cooperation, students can be exposed to the cutting-edge technologies in the industry earlier, understand the development trends of the industry, and enhance their practical working abilities. Enterprises can also provide resource support to schools, participate in the process of curriculum design and teaching, and promote curriculum reform and development.

4.Sanya University's Practice in the Curriculum Reform of Big Data Technology

4.1 Integration and Update of the Curriculum System

Under the background of the construction of new engineering disciplines, the integration and update of the curriculum system of the big data major need to be oriented towards industrial demands and construct a three-layer progressive curriculum framework of "basic theory-core technology-industry application". The curriculum system design follows the requirements of the "Next Generation Artificial Intelligence Development Plan" [4] and the "Strategic Action Outline for Promoting Big Data" [5], deeply integrating traditional computer science with disciplines such as statistics and management, to form a curriculum ecosystem featuring "solid mathematical and physical foundations, complete technical chains, and clear application scenarios". On the curriculum system, according to the requirements of the enterprise big data relevant position, the big data technology involved in the integration, the core module of enterprise core competency requirements for large data engineers focused on the distributed system development (87%), machine learning model (76%), cloud native technology stack (68%), three areas. This course system is based on the principle of "working backward from job capabilities to course design", focusing on the dual career paths of big data development and data analysis, and constructing a "three-level capability ladder" training model: basic programming ability → distributed system development ability → intelligent data application ability. Redesign the course content based on the required skills of these positions. The course can be divided into the basic programming module, mainly learning programming languages such as Java, Scala, etc. The Linux Basic module mainly covers the fundamental principles and usage of the Linux system. In enterprises, it is a basic ability for programmers to be proficient in using the Linux system. The basic modules of big data mainly cover the principles of distributed systems (HDFS architecture design), parallel computing frameworks (Hadoop/Spark ecosystem analysis), and data storage and processing technologies (NoSQL databases, data lake architecture). These are the cornerstones of big data technology. The data analysis and mining module deeply integrates statistical methods with machine learning techniques, offering courses such as "Introduction to Data Science" and "Machine Learning", with a strong focus

4.2 Project-based Teaching and Introduction of Industry Cases

In the teaching process, You Chuiju, Liu Chibiao, Sun Lili, etc. believe that project-based teaching [6] should become the core form. By applying big data technology to real industry cases, students can better understand how technology solves practical problems. The deepening of project-based teaching requires breaking through the traditional "experimental box" model and constructing a complete commercial closed loop from data collection to value creation. Therefore, in each course, corresponding industry cases have been added in a targeted manner to guide students in solving such industry case problems. This helps students understand the real needs of enterprises and the thinking and process of solving problems, and cultivates students' professional qualities. Sanya college for big data major courses in several project, such as the big data analysis project practice, the big data visualization, etc., let the students learn a ranging from large data analysis, to the system implementation, to the web site set up the whole process of project development, lets the student will learn how to specific application to the project development, has a more in-depth understanding. It can enhance students' technical skills and teamwork abilities, help them improve their cognitive and technical confidence, and lay a solid foundation for their future career paths.

4.3 Professional Practice Platform

Under the background of new engineering disciplines, the big data major in application-oriented undergraduate universities is characterized by strong practicality, application and comprehensiveness, which requires schools to provide a highly professional practice platform in the practical design link of the big data major. Zhu Linglong, Cao Haixiao, Kan Xi et al. [6] hold that a professional practice platform not only includes professional laboratory hardware, but also a platform that can sustainably provide real projects derived from production practice. Sanya college of information and intelligence engineering college for nearly four years more than 20 million yuan investment funds, perfect the experimental facilities, has a new super calculate center, large

data innovation laboratory, and artificial intelligence laboratory, virtual reality lab and other professional laboratory, for students in this major learn professional technology provides the necessary experimental environment. By leveraging the powerful computing resources of the supercomputing center, a full-strength version of the Deepseek large model was deployed, laying a solid foundation for teachers and students to learn cutting-edge technologies. To calculate center for experimental platform for practice and innovation, support for students to attend all kinds of course contests and large projects, including "Internet +", "challenge cup" and other comprehensive event and "green computing", "artificial intelligence innovation contest" and other professional tournament award more than 200. Sanya University, taking supercomputing as a platform, provides high-performance computing services and applications for the field of air, land, space and sea information processing in Hainan. Its outstanding technical level and excellent service capabilities have been highly affirmed by the Hainan Provincial Government, and it won the third prize of Hainan Provincial Science and Technology Progress Award in 2021.

On May 23, 2023, the "Geely Xingrui Data Intelligence Industry College" jointly established by Sanya University and the R&D Center of Geely Automobile was officially inaugurated. Relying on Geely Automobile's advantages in business scenarios, data resources, technical research and application in the field of automotive digitalization, It has further promoted the collaborative training and industry-education integration of high-level undergraduate programs such as Data Science and Big Data Technology, and intelligent science and technology. This year, relying on the cooperation mechanism of the industrial college and using the locally deployed Deepseek large model, we will collaborate with Geely to develop intelligent agents related to the education and automotive fields. Let students have the opportunity to come into contact with and learn the most popular technologies in the field of artificial intelligence at present. In conclusion, by building a "course - projects - platform" three-dimensional linkage system, the practice of big data sanya college professional theory knowledge to the effective transformation of engineering ability, for the construction of free trade port in hainan conveying big data talents with innovative practice ability. This construction path, which is driven by industrial demands and centered on the advancement of capabilities, provides an important reference for the cultivation of new engineering talents. It enables talent cultivation to shift from passive adaptation to active leadership of industrial transformation, offering a vivid sample for the reform of higher engineering education in the digital economy era. Make the integration of industry and education concrete, encourage students to step out of the classroom and participate in technological research and development and innovative practices, give students the opportunity to get in touch with real enterprise project practices, and guide students to actively innovate in practice.

5. Conclusion

Under the background of new engineering disciplines, computer education, especially big data technology education, is facing unprecedented opportunities and challenges. In order to better meet the social demand for compound and innovative talents, colleges and universities must constantly innovate their educational models, optimize the curriculum system, increase the content of practical teaching, promote the integration of disciplines and industries, and cultivate engineering and technical talents who not only have a solid theoretical foundation but also possess strong practical ability and innovative spirit. The curriculum reform of big data technology education will be an important link in this process, and its effectiveness will directly affect the quality of cultivating future technical talents.

Acknowledgments

This paper is supported by Sanya University's Specialized Training Program for Middle-aged and Young Teachers (Teaching Category) (Project No.: SYJPZQ2024023)

References

[1] The Ministry of Education has officially released the "Guidelines for New Engineering Research and Practice Projects". 2017-06-1

[2] Opinions of the Chinese Academy of Engineering on Accelerating the Construction and Development of New Engineering Disciplines and Implementing the 2.0 version of the Outstanding Engineers

Education and Training Program The website of the Chinese government 2018-09-17

[3] Tan Ruimei, Zhou Xianchun, Xu Yanlong, et al. Research on the Construction of Big Data Analysis Course Group in Applied Undergraduate Colleges under the Background of New Engineering [J]. Industry and Technology Forum, 2024, 23 (14): 237-239.

[4] Notice of The State Council on Printing and Distributing the Development Plan for a New Generation of Artificial Intelligence. Chinese Government website, July 20, 2017

[5] "Action Outline for Promoting the Development of Big Data". Chinese Government Website, August 31, 2015

[6] You Chuiju, Liu Chibiao, Sun Lili, et al. The Construction of the "1214" Engineering Practice System for New Engineering Disciplines Driven by Project-driven Innovation Classes [J] Computer education, 2024, (5) : 193-197.

[7] Zhu Linglong, Cao Haixiao, Kan Xi, et al. Research on the Construction of Data Science and Big Data Technology Major in Applied Undergraduate Colleges under the Background of New Engineering [J] Information System Engineering, 2024, (03): 166-169.

