Analysis of the Current Situation of the Multi-disciplinary Integrated Curriculum System of New Engineering in China

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Abstract. In order to adapt to the era of "Made in China 2025", many universities have proposed advanced talent cultivation plans, among which engineering universities take the construction of new engineering disciplines as the main direction of reform. This paper analyzes the impact and teaching and research analysis of engineering education professional certification, engineering practice course setting, course content, online courses and the four new disciplines on engineering application in the context of the cross-disciplinary nature of engineering disciplines and the construction of course systems in China. Combined with the national conditions of engineering education in China, some humble opinions are put forward from several aspects such as college settings, teaching methods, employment and practice, and real-time updates of course content.

Keywords: Interdisciplinary integration, engineering major, university education, curriculum system construction.

1 Introduction

With the rapid spread of the concepts of knowledge economy and information society, as well as the need to adapt to the development of applied technologies, China implemented the first ten-year plan outline of its strategy to become a manufacturing powerhouse, titled "China Manufacturing 2025". Relevant data show that after the implementation of the outline, China has been the world's largest manufacturing country for several consecutive years [1]. However, there is still a gap to become a manufacturing powerhouse, and we need to make greater efforts in areas such as precision manufacturing and intelligent manufacturing. The emerging "craftsman spirit" has become the pursuit and goal of pride for the new generation of Chinese people. The shortage of talents in manufacturing applied technologies has become the primary issue at present. The responsibility of cultivating applied talents still falls on the shoulders of universities. Based on this, this paper summarizes the current status of the training model for engineering majors in China, then compares and studies the similarities and differences

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between domestic and international engineering education, and puts forward some humble opinions.

2 The Training Mode of Engineering Specialty in China

2.1 Analysis of Departmental Structure Model

In China's higher education system, the division of colleges into secondary units is typically based on the establishment of secondary disciplines. Even when multiple disciplines are integrated, similar fields are often grouped into a single college. Consequently, the number of colleges in secondary units at Chinese universities generally remains in the double-digit range. For instance, disciplines such as mechanical manufacturing and automation, materials science, computer engineering, and electrical engineering are usually divided into separate colleges rather than merged into a single entity. Inter-college collaboration and interdisciplinary studies are rarely implemented in undergraduate education, only becoming evident during the research-oriented master's and doctoral stages. The current vigorous promotion of New Engineering Education has created favorable conditions for establishing interdisciplinary programs. Many domestic universities have incorporated previously graduate-level interdisciplinary specializations into undergraduate curricula, with some institutions even launching emerging interdisciplinary programs [2]. This development vividly demonstrates China's commitment to aligning higher education with international standards and diversifying undergraduate education through reform initiatives.

2.2 Analysis of Engineering Education Accreditation Status

Since initiating the engineering education accreditation pilot program under the Washington Accord in 2006, China has completed 19 years of implementation. By the end of 2023,321 higher education institutions across the country had accredited 2,395 engineering programs, covering 24 disciplines including mechanical engineering and instrumentation [3]. With over 14,000 accredited engineering programs, China has significantly enhanced graduates 'competitiveness in global job markets [4]. Compared to European and American universities' accreditation systems, Chinese institutions have achieved seamless alignment with international standards. From defining educational objectives to specifying graduation requirements, and from curriculum design to competency matching, Chinese universities have reached the pinnacle of professional accreditation development. Recent years have seen widespread adoption of student-centered pedagogy, with innovative models like MOOCs, online learning platforms, and flipped classrooms emerging [5]. The hybrid learning approach has dramatically improved efficiency, while educators have refined online course materials, building a vast repository of educational resources. The integration of big data, cloud computing, and AI has further enhanced teaching environments and strengthened academic collaboration among universities.

2.3 Analysis of Engineering Practice Course Settings

China's three-year higher education system primarily offers vocational programs designed to cultivate blue-collar professionals. The four-year undergraduate system, however, has seen recent transformations under the "Made in China" national strategy, with many institutions shifting toward applied undergraduate education. Despite these efforts, China still lags behind Western countries in engineering practice [6-7]. Cultivating applied undergraduates should emphasize real-world industrial experience. Yet in China, the excessive number of courses, heavy academic pressure, limited internship hours, and companies' reluctance to allow students near core production areas due to technical confidentiality and safety concerns collectively hinder practical training. The "Outstanding Engineers Program" and the transition from general to applied undergraduate education have spurred reforms. Some institutions adopt the "3+1" model [8], essentially consolidating short-term practical training into a single academic year. Others have successfully implemented dual approaches recommending students to enterprises and encouraging student-initiated internships. These enterprises welcome students for immersive engineering training, with many demonstrating significant skill growth and receiving positive feedback, often leading to employment contracts. This model not only addresses corporate recruitment challenges but also solves university employment issues. Such engineering education reforms represent a major step toward aligning China's undergraduate engineering education with international standards [9].

China's higher education system demonstrates greater rigor and professionalism in graduate education compared to its European and American counterparts. The graduate entrance examinations exemplify this rigor through their high difficulty, strict standards, and specialized requirements, effectively screening candidates. The distinction between academic and professional master's degrees reflects a humanized yet rigorous approach, emphasizing theoretical expertise and practical application. The master's curriculum design and learning duration further reinforce this rigor by elevating foundational undergraduate courses, expanding graduation project topics, and consolidating students' competencies. Consequently, China's master's graduates exhibit superior quality and greater societal contribution.

2.4 Analysis of Course Content Design

In China's higher education system, associate degree programs typically span three years, while bachelor's degree programs generally require four to five years. Postgraduate education includes three-year professional master's degrees and three-year academic master's degrees [10], as shown in Table 1. Currently, associate degree programs are often referred to as vocational education, primarily designed to train blue-collar workers. Upon successful graduation, students receive an associate degree certificate. Graduates have two options: employment or further education through the associate-to-bachelor's transfer program. Those who pass the exam advance to the next stage, completing a two-year curriculum and meeting all institutional requirements to obtain both a bachelor's degree and diploma. Consequently, the curriculum content for associate degrees differs significantly from that of bachelor's programs due to their distinct educational objectives. This approach contrasts sharply with the 3-4 year bachelor's degree system in Europe and America, yet aligns well with China's national conditions.

Table 1. Academic System of Chinese Universities.

Rank	Educational system	Rank	Educational system
Junior college education	3-year program	Academic master	3-year program
Bachelor	4-5 years	Doctor	3-6 years
professional master	3-year program		

China's higher education institutions have rapidly advanced in undergraduate education reform, introducing innovative models such as the "academic year + credit" system, 4+1 dual degree programs, and Sino-foreign cooperative education initiatives to foster well-rounded student development. While retaining the essence of traditional curricula while incorporating international best practices, China maintains similar foundational course structures to those in Europe and America with minimal adjustments. Digital teaching methods like online courses, MOOC, and flipped classrooms have revitalized classroom dynamics and boosted student engagement. However, during specialized course implementation, limitations emerge: course schedules often omit self-study time, overcrowded theoretical classes yield mediocre outcomes, and abstract theories become disconnected from real-world applications. Students frequently report that theoretical instruction fails to align with practical course design, as comprehensive engineering case studies and applied knowledge are absent from lectures yet abruptly required during project phases. Bridging theoretical knowledge with engineering practice while continuously updating the relevance between emerging technologies and fundamental theories depends entirely on educators' commitment to curriculum innovation, reflecting both professional responsibility and academic acumen. With forward-thinking approaches, Chinese universities have implemented measures to cultivate new faculty, recruit industry experts, and preserve the legacy of distinguished scholars.

In recent years, universities have intensified efforts in curriculum development (as illustrated in Figure 1), with initiatives like industry-academia collaborative courses, innovation-integrated programs, and ideological-political education courses gaining traction. Institutions are encouraged to partner with enterprises in course development and textbook compilation, creating customized training plans and syllabi based on corporate needs. Corporate mentors are invited to teach specialized courses, and joint engineering case libraries are developed. This approach exposes students to real-world cases from their junior year's specialized courses, progressing through internships and graduation projects to key corporate design initiatives. Graduates can thus bypass the internship phase and seamlessly transition into corporate roles.

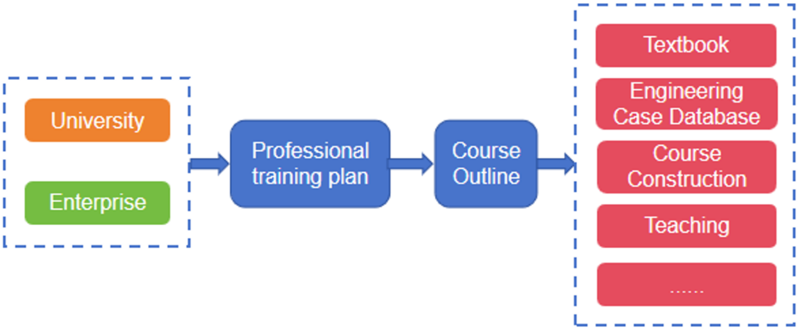

Fig. 1. Flowchart of Course Development

2.5 Integrating Online Course Development with AI-powered Solutions

While China's online education gained widespread recognition relatively late, its development began earlier. The digital transformation has driven major domestic educational platforms to expand online resources, enabling cross-institutional sharing of university teaching materials and accelerating virtual lab development. Through resource-sharing platforms, video lectures, and best practices, supported by video conferencing tools like Tencent Meeting and Zoom, online courses, blended learning, and smart courses have been increasingly adopted by students. When students encounter unclear content in class or experience post-class forgetfulness, they can review and reinforce knowledge through online resources. This not only reduces teachers' after-class tutoring workload but also provides students with flexible time and location options for pre-class preparation and post-class review.

In China's curriculum assessment framework, all courses must evaluate student learning outcomes based on syllabi. With continuous upgrades to online teaching platforms, the examination system has evolved into a more flexible and sophisticated model, featuring automated question bank randomization, system-assisted grading, time-slot-based question distribution, and centralized score consolidation. This innovation not only enhances teaching efficiency but also ensures rigorous online proctoring. Virtual laboratories have become indispensable in experimental and practical courses, enabling students to acquire all required competencies through immersive learning experiences.

The widespread adoption of AI has introduced new challenges to teaching. A key issue for universities is how to guide students to use AI correctly rather than relying on it. Teachers can leverage AI to diversify question types, create case animations, and produce course PPTs. Students, in turn, can utilize AI to adapt question formats, advance their learning, explore extracurricular knowledge, and broaden their horizons.

2.6 Analysis of Interdisciplinary Integration in Professional Development

China has introduced the "Four New Specializations" initiative to develop interdisciplinary programs. This policy framework not only establishes foundations for cross-disciplinary teams in universities but also provides policy support for major research projects. While advancing pedagogical innovation, the initiative simultaneously drives scientific research progress in higher education. However, the institutional affiliation of these specializations determines their core focus. For example, the Robotics Engineering program a new engineering discipline integrating mechanical design, electrical control, and computer programming is housed in the School of Electrical Engineering, with students specializing in electrical control. When established in the School of Mechanical and Electrical Engineering, the program emphasizes mechanical design.

3 Refining the Essence and Discarding the Dross

While China's public university education system remains dominant, it could adopt the federal college model from Western countries. This approach involves establishing federal or independent colleges within strong undergraduate institutions, integrating complementary disciplines to avoid management challenges from interdisciplinary overlaps. By implementing cross-disciplinary openness in teaching methods, equipment, and models, we can cultivate students' diverse skills and harmonious interdisciplinary integration. For the development of "Four New" majors (new disciplines, new majors, new fields, and new talents), pilot programs could be launched to eliminate major-specific biases. Professional instructors would serve as full-time faculty for other colleges, while students would be exclusively enrolled in independent colleges. Training would follow the cultivation plans of these colleges and majors, ensuring both the expertise of instructors and the development of truly interdisciplinary "Four New" talents. This approach would genuinely transform and modernize engineering education.

In the realm of online education, UK universities have achieved comprehensive implementation across all faculty, courses, and students. China has yet to reach such a scale in this domain. While platforms like Chaoxing FanYa, MOOC, and National Excellent Courses have made significant strides in online teaching and open courses with nearly every university launching several courses annually this remains insufficient to support the vast scale of China's education system. Moreover, the limited capacity of existing platforms makes sudden expansion of massive online courses highly stressful, prone to errors, and difficult to avoid teaching mishaps. Therefore, to fully implement online education, China should draw extensively from UK universities' models and experiences in platform development and resource integration. By establishing distinctive online platforms with full campus coverage and promotion, institutions can achieve efficient management and tailor platform designs to their unique characteristics, maximizing efficiency with minimal effort.

With the annual increase in graduates and stagnant job market demand, employment challenges have become the top priority for Chinese universities. This issue is also a global concern. At the 2014 World Economic Forum in Davos, China launched its

"Mass Entrepreneurship and Innovation" initiative, marking the beginning of nationwide efforts to foster student entrepreneurship [11]. The government actively supports innovation and entrepreneurship among current students and graduates within five years, with talent scouts identifying promising talents. Many small and micro enterprises benefiting from national policies have emerged, temporarily alleviating employment difficulties. The close integration of industry-academia-research collaboration and the commercialization of university faculty's research achievements can serve as incubation bases for engineering students' practical training, addressing both the lack of practice opportunities for students and labor shortages in research teams. Although different from Europe and America, the practical training years in their curricula remain highly valuable. Given China's vast geographical resources, while implementing practical training years, schools often face uncertainties such as insufficient job openings or poor production efficiency in partner organizations, leading to frequent plan cancellations. To establish successful connections between universities and relevant enterprises, it is recommended to create a nationwide enterprise demand platform. Such platforms should extend beyond existing individual recruitment websites to facilitate direct negotiations between universities and enterprises regarding internships and employment. By decentralizing information flows, both institutions can move beyond traditional interpersonal networks into broader "Internet+" cloud platforms, achieving mutual benefits and collaborative development. Of course, it's impossible for companies and schools to establish trust immediately upon initial contact. To ensure fair two-way selection, companies provide information on their benefits, development direction, and business scope, while universities recommend students for pre-practice professional competency assessments. This ensures that schools understand the companies and feel confident in sending students for internships, while companies recognize the schools' commitment to rigorous student training.

In curriculum design, it is recommended to update course content in real-time based on China's national conditions. Core courses should be regularly updated according to national standards, while specialized courses should align with social development trends and maintain accuracy. University faculty should broaden their perspectives by actively participating in professional activities such as industry standard development, technical exchanges, industry forums, and bidding evaluations. This approach enhances their professional expertise while keeping pace with industry developments and mastering technological advancements. Regarding the integration of specialized courses with engineering practice, China could adopt the European and American model of combining theoretical instruction with course design, streamlining unnecessary content to improve students' learning efficiency and engagement.

To expand the scope and depth of AI powered education, we should guide students to use AI responsibly. Educators should proactively incorporate AI into teaching, implement positive evaluation systems, and maintain rigorous oversight. Teachers should employ AI tools to monitor students' usage patterns, ensuring they utilize AI for genuine learning rather than seeking shortcuts. Universities can collaborate with leading AI platforms to define practical teaching applications, while also supporting continuous model upgrades and improvements.

The institution establishes a second classroom program to expand interdisciplinary studies and cross-team collaboration. A standardized second classroom transcript system is implemented, with methods including: (1) integrating first-and second-classroom grades, (2) recognizing second-classroom achievements independently, and (3) standardizing the system. These measures enable students to broaden their professional knowledge and earn academic credits through second classroom activities, thereby enhancing their recognition of such programs (as shown in Figure 2).

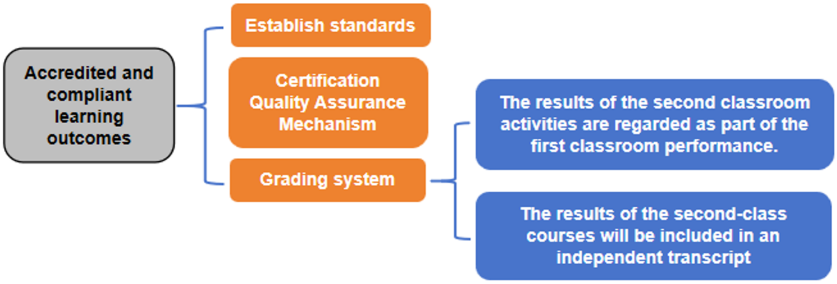

Fig. 2. Methodology for Establishing the Second Classroom Transcript System

4 Conclusion

Based on the training mode of engineering specialty in China, this paper summarizes the differences and advantages of the curriculum content of undergraduate, master's and doctoral programs in China. Drawing lessons from the education mode of Europe and America, and combining with the national conditions of China, the following ideas are put forward:

1. In the construction of four new specialties, independent colleges should be established to manage students, and professional teachers can be hired from senior teachers of professional colleges to teach.

2. It is recommended that schools or collaborative large-scale websites establish specialized online platforms for curriculum development, ensuring comprehensive coverage and promotion within the campus.

3. To achieve seamless employment and talent cultivation, it is recommended to establish a nationwide enterprise demand platform.

4. The curriculum content should be updated in real time according to China's national conditions, with basic courses being improved on schedule based on national standards, and specialized courses following social development trends to ensure innovation and accuracy.

5. Expand the scope and reach of AI-powered education.

6. Expand interdisciplinary and cross-team development in extracurricular activities, and establish a standardized second-classroom transcript system to ensure its rationality and consistency.

Although the national conditions and education systems of European and American countries differ significantly from those of China, they share the same goals in engineering accreditation and student-centered, outcome-oriented educational philosophies. Under the overarching trend of a global community, engineering education across nations can integrate and complement each other, fostering the cultivation of outstanding engineering talents.

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References

1. National Bureau of Statistics. Statistical Yearbook [EB/OL]. http://www.stats.gov.cn/ [2019-04-08]
2. Ye Meilan, Chen Guixiang. New Engineering Education Construction in Newly Established Local Undergraduate Universities: Issues, Principles, and Countermeasures [J]. Journal of Educational Science, Hunan Normal University. 2019,18(5):116-121.
3. China Engineering Education Accreditation Association, Education Quality Assessment Center of the Ministry of Education. Notice on the Release of the List of Engineering Education Accredited Programs [EB/OL]. (2024-07-01) [2025-06-30] https://www.eqea.edu.cn/pgcenter/tzgg84/628488/index.html
4. Hu Dexin. Comparative Study and Reference on International Reforms of Engineering Education Accreditation Systems under the Background of the New Industrial Revolution [J]. Higher Education Management. 2019,13(5):72-81.

5. Wei Yitong, Wang Jixin, Ding Ru. Research on the collaborative knowledge construction model guided by deep learning in a blended learning environment [J]. China Electro-education. 2019,392(9):128-134.
6. Wu Bo, Zhang Song, Yu Bo, et al. A review and mechanism study on the multidisciplinary integration education system in UK engineering universities [J]. Journal of Changchun Institute of Technology (Social Sciences Edition). 2023, (24) 1: 67-72.
7. William G.[7] William G. Tierney. Higher Education: Handbook of Theory and Research[M]. California:2008.
8. Guo Cuilan. Analysis of Construction Strategies for First-Class Majors in Applied Undergraduate Institutions [J]. Vocational and Technical Education. 2019,40(26):34-37.
9. Jiang Bo, Li Jun, Chen Leilei. Exploring and practicing the construction path of first-class courses based on OBE concept in online-offline hybrid education [J]. Heilongjiang Education (Theory and Practice). 2025 (06):58-61.
10. Hou Cuihong, Zhou Zhen, Liu Junhuan, et al. Multidimensional Review and Innovative Development of Joint Training Bases for Professional Degree Postgraduates [J]. Henan Chemical Industry. 2025,42(06):59-62.
11. Wu Jie, Niu Yanfei. Talent cultivation mechanism for innovation and entrepreneurship in higher education under innovation-driven development [J]. Education and Career. 2019, (23):63-67