Education Reform and Development, 2025, Volume 7, Issue 12
https://ojs.bbwpublisher.com/index.php/ERD
Online ISSN: 2652-5372
Print ISSN: 2652-5364

Exploration of Paths for AI-Enabled Construction of Characteristic General Education Courses: A Case Study of the "Metrology +" Model at China Jiliang University

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Abstract: As a crucial component of cultivating well-rounded talents, general education has garnered widespread attention for its characteristic and intelligent development. This paper takes the existing "Metrology +" characteristic general education system of China Jiliang University as the research object, conducts an in-depth analysis of the current status and existing problems of the curriculum system, and focuses on exploring how to leverage artificial intelligence (AI) technology to empower the construction of a characteristic general education curriculum system. By proposing strategies such as AI-driven reconstruction of the characteristic general education curriculum system, innovation of teaching models, resource development and sharing, and quality assessment and optimization, this study aims to construct an intelligent, personalized, and high-efficiency new model of "AI + Metrology +" characteristic general education. It provides a referential path and example for general education reform in universities with industry characteristics and even across universities nationwide.

Keywords: Artificial intelligence; General education; Characteristic courses; Metrology +; Curriculum construction; China Jiliang University

Online publication: December 31, 2025

1. Introduction

General education, as a key link in achieving the goal of cultivating well-rounded talents, is of paramount importance. As the only university in China integrating metrology, standards, quality, market supervision, inspection, and quarantine, China Jiliang University shoulders the mission of serving national strategies and the development of the metrology industry. Constructing a "Metrology +" characteristic general education curriculum system holds significant exploratory value for leveraging the university's characteristic advantages

and cultivating interdisciplinary talents with industry heritage and international perspectives.

2. Current status of general education curriculum system construction at China Jiliang University

China Jiliang University originated from Hangzhou Jiliang School, established by the National Bureau of Metrology in 1978. It was upgraded to China Jiliang College in 1985, renamed China Jiliang University in 2016, and became a university co-constructed by Zhejiang Province and the State Administration for Market Regulation, as well as a key construction university in Zhejiang Province in 2019. The university offers 44 undergraduate programs, including 18 national first-class programs, 4 national characteristic programs, 1 national professional comprehensive reform pilot program, 9 programs accredited by the National Engineering Education Accreditation, and 24 provincial first-class programs. These programs cover 8 disciplines: Engineering, Science, Management, Literature, Law, Economics, Medicine, and Art (**Figure 1**), forming a discipline pattern characterized by strong engineering, integration of science, engineering, and management, and coordinated development of multiple disciplines.

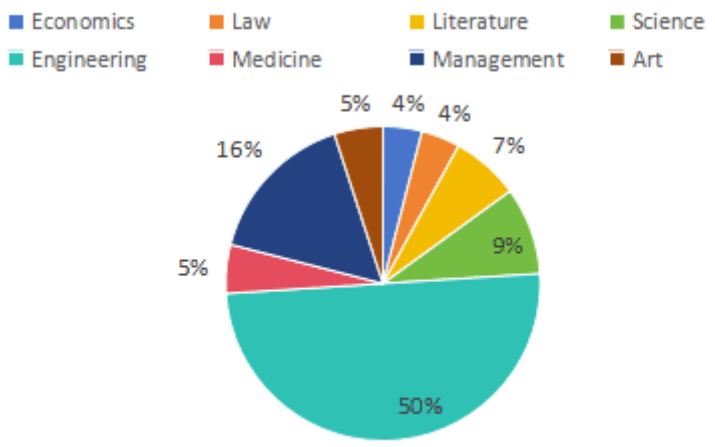

Figure 1. Distribution of undergraduate programs by discipline category.

Adhering to the basic laws of higher education and teaching, as well as the laws of students' physical and mental development, the university takes "fostering virtue through education" as its fundamental task, regards promoting students' all-round development and adapting to social development needs as the fundamental standard, and is guided by the core concept of engineering education professional certification. It coordinates general education and professional education, strengthens innovation and entrepreneurship education, and forms a high-level talent training system centered on student development and oriented by student achievements and social needs.

2.1. Construction of the core general education system

The university's overall talent training goal of "all-round development of morality, intelligence, physical fitness, aesthetics, and labor education" serves as the fundamental guideline. The "Guiding Opinions on Formulating (Revising) Undergraduate Program Training Plans" clearly states that "the concept of general education

should be integrated into the entire process of talent training to promote students' all-round development" and constructs a progressive curriculum system of "General Education Courses - Disciplinary Basic Education - Professional Education". The existing general education curriculum system consists of two parts: compulsory general education courses and elective general education courses. The compulsory general education system mainly includes public basic courses such as College Chinese, Advanced Mathematics, and Foreign Languages. The elective general education curriculum system sets 6 categories: "Chinese Culture and World Civilization", "Social Sciences and Modern Society", "Science and Technology Development and Scientific Literacy", "Art Appreciation and Aesthetic Experience", "Innovation Entrepreneurship and Vocational Education", and "Language and Cross-Cultural Communication". Furthermore, in order to strengthen the cultivation of students' concepts of quality, awareness of standards, and metrological capabilities, a specific "University Characteristics" module has been designed. This module, combined with the previous six categories, forms the "6+1" General Education Elective Curriculum framework (**Figure 2**). In addition to relying on independent applications from on-campus colleges for elective general education courses, the university also introduces high-quality online general education resources such as Erya, aiming to build an "online + offline" diversified curriculum system and enrich students' curriculum choices.

Figure 2. Elective general education curriculum system of China Jiliang University.

2.2. Analysis of problems in the existing elective general education curriculum system

Currently, the construction of the elective general education curriculum system faces numerous urgent problems. These problems not only hinder the fulfillment of the talent cultivation function of elective general education courses but also impede the university's goal of characteristic development. Specifically, the problems are as follows: Firstly, there is a prominent imbalance in the curriculum system structure. Secondly, the curriculum content lacks innovation and suffers from severe homogenization. Furthermore, mechanisms for cross-college curriculum co-creation are difficult to form. High-quality teaching resources are mainly concentrated

in professional courses, with insufficient attention paid to general education courses. Moreover, most teachers develop general education courses independently ("solo efforts") without cross-college collaboration and integration, failing to achieve effective sharing of general education curriculum resources. These issues reduce teachers' enthusiasm for general education teaching, thereby affecting the educational effectiveness of general education courses and exerting a negative impact on the university's talent cultivation quality.

3. Feasibility and advantages of AI-enabled construction of characteristic general education courses

AI technology has undergone five stages of evolution: initial exploration (1950s–1970s), technical accumulation (1980s–1990s), deep learning (2000s–2010s), the rise of AIGC (2010s–2021), and the diversification and popularization of AIGC (2022–present) [1]. Currently, AI has become a key driving force for social development and has brought profound changes to the field of education and teaching. Wu Yan, Vice Minister of Education, also pointed out that AI will become an important engine for promoting the high-quality development of education and shape new paradigms and forms of education [2].

In the field of higher education, AI applications have extended from teaching tools to curriculum system construction. Nanjing University has launched a "1 + X + Y" core general education curriculum system for AI [3], Fudan University has constructed an "AI-BEST" framework [4], and Beijing University of Posts and Telecommunications has developed systematic teaching materials, courseware, and video resources [5]. These practices demonstrate that AI technology can effectively support personalized learning navigation and precise learning evaluation in general education courses, enhancing students' participation and higher-order learning abilities.

4. Practical paths for AI-enabled construction of the "Metrology +" characteristic general education courses at China Jiliang University

To address the imbalance in the curriculum system structure, AI technology can be used to construct a modular curriculum framework of "Basic General Education - Disciplinary Integration - Industrial Application", organically integrating characteristic disciplines such as metrology and standardization into the general education system.

4.1. Constructing an interdisciplinary curriculum network with knowledge graphs

By building a knowledge graph network integrating metrology and AI, interdisciplinary knowledge points are integrated to form a searchable curriculum resource library. This structured knowledge connection can break disciplinary barriers, enabling students to advance from "basic understanding of AI" to "rational use of AI" and further to "innovative application of AI" [6], making general education courses an important window for students to understand the university's characteristic disciplines.

4.2. AI teaching assistants supporting personalized learning paths

Drawing on the successful experience of Hubei University's "Chemistry and Human Civilization" course [7], knowledge graphs and AI teaching assistants are applied to personalized learning navigation for students of different majors. Based on students' learning history and performance, AI teaching assistants can automatically

recommend resources most suitable for their current learning stage and abilities, such as industry application cases in metrology and interpretations of standardization policies. This broadens students' knowledge horizons and avoids the limitations of single information sources.

4.3. Dynamic optimization of the curriculum weight mechanism

AI is used to analyze students' course selection data and feedback to automatically adjust curriculum weights, ensuring a reasonable proportion of characteristic disciplines in general education courses. For example, machine learning algorithms are used to analyze students' preferences and learning effects in metrology, standardization, and other courses, dynamically adjusting the number of courses offered and the depth of content, thereby achieving a more balanced and reasonable structure of general education courses [8].

5. AI-assisted mechanism for curriculum content innovation

To address the lack of innovation and severe homogenization in curriculum content, universities can develop an AI-assisted mechanism for curriculum content innovation to promote cross-college resource integration and teacher collaboration.

5.1. Generative AI building a characteristic case library

Generative AI (e.g., ChatGPT) is used to quickly integrate industry application data (such as smart city data calibration cases) and the latest academic achievements in metrology, converting them into general education course materials. This mechanism significantly reduces the repetitive work of teachers in course development and improves the innovation and timeliness of curriculum content [9].

5.2. AI-driven matching for cross-college teacher collaboration

An AI-driven curriculum co-creation platform is developed to support cross-college teacher team formation, resource matching, and intelligent feedback. The platform also provides collaboration tools, resource sharing spaces, and teaching feedback systems to promote knowledge exchange and teaching innovation among teachers [10].

5.3. Virtual laboratories expanding practical teaching

AI-based virtual laboratories for metrology and standardization are constructed, and standardized simulation scenarios (e.g., application of AI algorithms in quality inspection) are developed, enabling students to understand the practical application of characteristic disciplines through virtual experiments. This practice-oriented teaching model effectively addresses content homogenization and enhances students' sense of participation and learning effectiveness.

6. AI-enabled curriculum evaluation and update system

To ensure the cutting-edge nature and practicality of curriculum content, universities need to construct an AI-enabled evaluation and update system for general education courses.

6.1. Multi-dimensional intelligent evaluation system

Based on the OBE concept and entropy weight calculation method [11], an intelligent evaluation system covering

four dimensions—knowledge, skills, thinking, and values—is constructed. Evaluation results are intuitively presented in forms such as competency radar charts, helping teachers understand students' learning status and adjust teaching strategies in a timely manner.

6.2. Automated content update system

AI is used to monitor cutting-edge disciplinary developments (e.g., papers, industry reports) and automatically trigger curriculum content iteration. The system automatically compares changes in industrial needs, accurately identifies outdated or disconnected content in materials, and provides specific optimization suggestions, ensuring that curriculum content remains synchronized with industrial development. Additionally, the system supports flexible template library management, allowing universities to customize standard formats and content frameworks, achieving curriculum updates that comply with national standards while incorporating industrial cutting-edge and school-based characteristics.

6.3. Dynamic optimization platform for interdisciplinary courses

Combining AI analysis and teacher feedback, a dynamic optimization platform for interdisciplinary courses is built. The platform real-time monitors students' course selection preferences, learning effects, and feedback data, automatically recommends interdisciplinary knowledge connections (e.g., integration of metrology and ethics), and optimizes the content structure of courses.

7. Future outlook and challenge response

The prospect of AI-enabled construction of a characteristic general education curriculum system is broad, but it also faces challenges that require proactive anticipation and response strategies.

7.1. Ethical risks of technology application

AI technology may bring ethical issues such as data privacy and algorithmic bias in the process of curriculum content generation and evaluation. To address this challenge, universities should strengthen AI ethics education and establish an AI curriculum content review mechanism to ensure technology is used for good [12].

7.2. Demand for improving teacher competence

Currently, frontline university teachers generally lack systematic understanding and teaching experience in AI. To solve this problem, universities should strengthen AI literacy training for teachers, establish an "AI + Discipline" teacher development community, and encourage teachers to participate in AI general education course development. For example, Beijing No. 80 Middle School has collaborated with technology enterprises to establish AI laboratories, providing teachers with practical platforms and teaching guidance to enhance their AI teaching capabilities [13].

7.3. In-depth integration of technology and education

AI technology needs to be deeply integrated with education and teaching, avoiding technology from overriding education. Universities should adhere to the principles of "people-oriented, active embrace, guided application, and maximizing benefits while avoiding harms" to ensure AI technology serves educational goals [14].

7.4. Improvement of resource sharing mechanisms

AI general education course construction requires a sound resource-sharing mechanism to avoid teachers working in isolation. Universities should establish curriculum resource libraries, encourage teachers to share AI course development experiences and teaching resources, and foster a culture of collaborative innovation [15].

8. Conclusion

The construction of an AI-enabled characteristic general education curriculum system is a key strategy for universities to respond to the digital transformation of education. By building knowledge graphs, developing intelligent matching systems, establishing virtual laboratories, designing multi-dimensional evaluation systems, and implementing automated update systems, universities can effectively address the imbalance in the general education curriculum system and insufficient content innovation, promote cross-college resource integration and teacher collaboration, and enhance the educational effectiveness of general education courses.

However, the process of AI-enabled education also faces challenges such as ethical application of technology, improvement of teacher competence, in-depth integration of technology and education, and improvement of resource sharing mechanisms. Universities need to adhere to the "people-oriented" educational philosophy, balance technology application and educational goals, and promote in-depth integration of AI technology and characteristic general education courses through policy guidance, institutional guarantees, and continuous training, thereby cultivating interdisciplinary talents adaptable to an intelligent society.

AI empowerment is not about replacing teachers but enhancing their teaching capabilities; it is not about weakening disciplinary characteristics but expanding application scenarios of disciplines; it is not about solving all problems but providing new ideas and tools. In this process, universities should uphold their original mission of education, ensuring that AI technology truly serves the goals of talent cultivation and the characteristic development of the university.

Disclosure statement

The author declares no conflict of interest.

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