

AI-Empowered Multisensory Teaching: Curriculum Reform of Computer Fundamentals for International Medical Students in China

Meng Wang, Fen Zheng*

Faculty of Health Service, Naval Medical University, Shanghai, China

**Corresponding Author*

Abstract: Computer Fundamentals is a core basic course for fostering digital literacy and research capabilities among international medical students studying in China. At present, the teaching of this course for international medical students faces multiple drawbacks: significant disparities in students' prior knowledge, poor adaptability of homogenized teaching models, outdated teaching content failing to keep pace with the development trend of intelligent medicine, and insufficient integration of medicine and engineering. Moreover, the abstract logical nature of computer courses conflicts with medical students' learning habit of focusing on concrete sensory cognition. Traditional didactic teaching cannot meet the demands of cultivating personalized and specialized international medical talents. Accordingly, drawing on artificial intelligence technology and adopting the concept of multisensory collaborative education, this paper constructs a closed-loop whole-process teaching model consisting of pre-class initiation, in-class assistance and post-class consolidation. A multi-dimensional collaborative teaching system integrating vision, audition and tactile perception is built with medical-specialty characteristics, so as to deeply integrate computational thinking with the inherent cognitive logic of medicine and effectively address the pain points of traditional teaching. This research provides practical references for the intelligent and specialized teaching reform of general basic courses for international medical students in China.

Keywords: Artificial Intelligence; Multisensory Teaching; International Medical Students in China; Computer Fundamentals; Teaching Reform

1. Introduction

Against the backdrop of the internationalization of medical education and the rapid development of intelligent healthcare, the education of international medical students in China serves as a crucial window for demonstrating the quality of medical education and deepening international exchanges. It also undertakes the mission of cultivating international medical talents equipped with digital literacy. As a compulsory general basic course for international medical students in China, Computer Fundamentals lays an essential foundation for students to conduct medical data processing, medical image analysis, retrieval of research literature and application of intelligent medical tools. It is also a key link in shaping their digital literacy and research capabilities. Currently, the teaching of Computer Fundamentals for international medical students in China encounters prominent dilemmas in two dimensions: student diversity and curriculum construction. In terms of students, international students differ greatly in regional and cultural backgrounds, disciplinary knowledge reserves and information technology literacy. Conventional homogenized teaching models can hardly accommodate realistic learning needs. In terms of curriculum, existing teaching content is obviously disconnected from the cutting-edge trend of medicine driven by Artificial Intelligence (AI). The insufficient integration with practical medical scenarios weakens students' internal learning motivation and hinders the transformation of knowledge into practical competence. To address the above-mentioned problems, this paper explores a curriculum reform path for multisensory collaborative teaching based on AI-enabled teaching technologies and the cognitive rules of medical students. It aims to offer references for establishing a new Computer Fundamentals teaching system featuring intelligence, specialization and personalization.

2. Analysis of Current Teaching Status

2.1 Basic Characteristics of Students

International medical students in China come from numerous countries and regions worldwide, presenting highly diversified student composition with large gaps in prior learning foundations and learning conditions [1]. Specifically, their proficiency in computer knowledge is highly polarized. Some students from economically developed regions possess basic computer operation and digital learning capabilities and can quickly adapt to course rhythms. By contrast, many students from developing regions receive inadequate basic education resources. A considerable proportion of them have never received systematic computer training before enrollment and thus struggle in course study. Consequently, unified classroom teaching fails to satisfy learning demands of students with varied foundations, which poses substantial challenges to effective classroom delivery.

In the era of booming digital education, AI technology has gradually become an important instrument to empower classroom teaching and bridge learning gaps among students, offering new insights for resolving difficulties in computer teaching for international students [2]. With the accelerated iteration and wide popularization of global artificial-intelligence applications, contemporary international medical students in China generally show strong interest in AI technologies and are willing to take initiative to use intelligent learning tools. Nevertheless, their cognition and practical capabilities for AI applications vary considerably [3]. Most students only make superficial use of AI tools and have not developed the thinking and competence to leverage AI to facilitate specialized study and deepen knowledge comprehension. There exists a mismatch between their enthusiasm for learning and practical application abilities. As revealed by existing teaching-reform studies, although the integration of AI into domestic engineering and medical courses has yielded favorable outcomes in some teaching segments [4, 5], few reform achievements focus on AI-empowered curriculum reform targeting international medical students in China. Therefore, how to organically incorporate AI technologies into classroom teaching and guide

students to utilize AI tools in a standardized and efficient way for specialized learning has become a realistic problem to be solved urgently in teaching reform.

Apart from gaps in students' prior knowledge and the absence of AI-oriented teaching systems, the adaptive contradiction between the inherent cognitive characteristics of medical majors and the knowledge attributes of computer courses also restricts the improvement of teaching effectiveness. Medical diagnosis and treatment take vision, touch, percussion and auscultation as core practical approaches, forming a concrete cognitive system. Long-term professional training enables medical students to prefer intuitive learning methods, and they demonstrate higher acceptance of knowledge presented in concrete and perceptible forms [6]. However, the knowledge system of Computer Fundamentals tends to be abstract and logical, which greatly differs from this inherent cognitive pattern. Students find it difficult to establish systematic computational thinking rapidly and absorb core course knowledge efficiently, which impairs overall learning efficiency and outcomes.

2.2 Current Status of Curriculum Teaching

The Computer Fundamentals courses offered for international medical students in Chinese universities feature relatively rigid teaching systems, with teaching content and models lagging behind the requirements of intelligent-medicine development [7]. Specifically, in terms of teaching content, courses are largely confined to traditional domains, mainly covering basic computer operations, office-software applications and fundamental network knowledge, with an overemphasis on mechanical operational drills and an outdated and unitary system [8]. In terms of teaching approaches, teachers still adopt didactic modes dominated by one-way lecturing, operational demonstration and passive imitation by students. Such modes can hardly arouse students' enthusiasm for autonomous learning and inquiry, resulting in passive learning and mechanical practice. Knowledge internalization remains unsatisfactory. In terms of teaching cases, although current teaching attempts to incorporate medical cases and build disciplinary connections, case design lacks systematicness and professionalism. Medical scenarios are simply applied mechanically, so the integration of medicine and engineering remains superficial

and fragmented. Computer knowledge and medical knowledge stay isolated from each other, making collaborative education hard to realize. Influenced by the above-mentioned multiple factors, the curriculum still needs substantial optimization to meet the cultivation requirements for digital literacy and research capabilities of international medical talents, and cannot well support students' further advanced study and scientific-research practice.

3. Reform Philosophy and Feasibility Analysis

3.1 Adaptive Advantages of AI-Empowered Teaching

The integration of AI technology can effectively solve practical pain points including insufficient personalized provision and the absence of whole-process educational links in traditional teaching. For international medical students in China, there exist prominent disparities in computer foundations, linguistic and cultural barriers, as well as divergences in cognitive patterns. It is difficult for teachers to manually capture each student's knowledge gaps and dynamic learning status. Relying on AI-enabled teaching platforms, teachers can conduct multi-dimensional and accurate diagnosis of international medical students' prior knowledge reserves, in-class learning behaviors, practical-operation completion quality and phased learning outcomes. Visualized learning-situation profiles can be generated based on big-data analysis to identify at-risk learners and deliver timely learning warnings. Accordingly, tiered and categorized teaching plans and learning-support strategies can be formulated for students from diverse cultural backgrounds with varied knowledge foundations [9]. Meanwhile, AI technology can run through the complete teaching chain of pre-class initiation, in-class assistance and post-class consolidation to build a closed-loop teaching system. This model breaks the inherent temporal and spatial constraints of conventional classroom teaching. No longer confined to limited class hours, it can accommodate the differentiated and diversified learning demands of international medical students in China. The platform can dynamically push suitable multisensory learning resources according to learning profiles, fully stimulate international students' curiosity about artificial-intelligence technologies, and guide students to leverage intelligent tools for their

medical-specialty learning. Ultimately, it realizes deep alignment between technological empowerment and the cognitive rules of medical students, and provides technical carriers and data support for the subsequent implementation of multisensory collaborative teaching.

3.2 Core Connotation of Multisensory Teaching

Multisensory teaching takes conforming to the inherent cognitive rules of medical students as its core starting point. This teaching model integrates multiple sensory experiences including vision, audition and tactile-hands-on perception [10], which visualizes and systematizes obscure abstract theoretical knowledge and reduces students' cognitive processing load. The knowledge construction of medical students is inherently characterized by sensory-driven features. During long-term professional training such as anatomical practice, physical examination and clinical inquiry, medical students accumulate clinical professional experience through visual observation of anatomical atlases, auditory identification of heart and breath sounds, tactile perception of pathological palpation and other practical approaches. Gradually, they form a unique learning pattern of "sensory perception, cognitive comprehension, logical construction". Nevertheless, the traditional Computer Fundamentals curriculum emphasizes symbolic and abstract logical deduction, which is obviously misaligned with the sensory-oriented learning path that medical students are accustomed to. This partially explains why international medical students in China tend to experience learning anxiety when comprehending computer principles. Based on these cognitive characteristics, the reform of multisensory teaching draws on the sensory cognitive logic of clinical medicine and abandons the unitary and mechanical mode of knowledge indoctrination. Leveraging AI-enabled visualization, simulation and interactive practical tools, it transforms originally abstract and obscure computer principles into immersive learning experiences that can be seen, heard and perceived through hands-on operations. Such design builds bridges between students' pre-existing medical sensory experience and newly-acquired computer knowledge. Following the cognitive path familiar to medical students, teachers guide

students to gradually integrate computational thinking into their established medical knowledge framework, instead of mechanically memorizing isolated computer operation instructions and theoretical concepts. It ultimately facilitates the profound shift from passive knowledge reception to active knowledge-system construction. This concept complements the AI-empowered whole-process technology mentioned above: AI provides technical tools and learning-situation data support, while multisensory teaching offers cognition-oriented instructional design ideas.

The two work together to advance the medicine-engineering-integrated reform of Computer Fundamentals for international medical students in China.

4. Implementation Path of Whole-Process Curriculum Reform

Under the AI-empowered multisensory teaching model for Computer Fundamentals, a three-stage complete teaching workflow is constructed: pre-class activation, in-class facilitation and post-class reinforcement. The overall implementation path is shown in Figure 1.

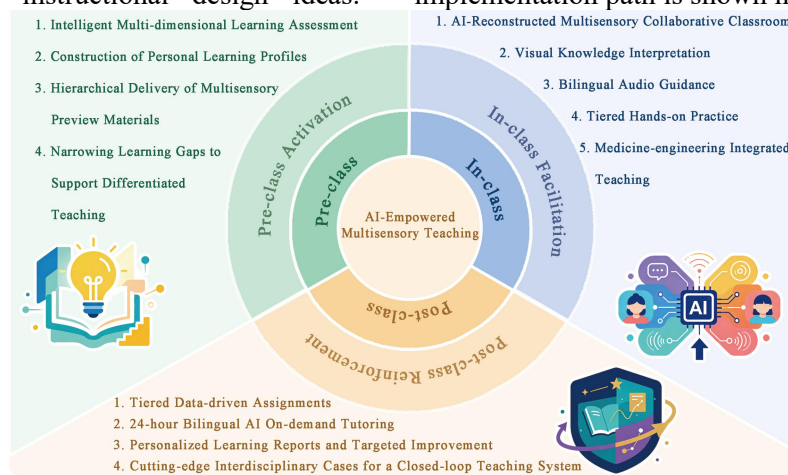


Figure 1. Three-Stage Teaching Implementation Workflow of AI-Empowered Multisensory Teaching

Specifically, pre-class activation focuses on prior-period learning-situation evaluation and personalized preview guidance. The AI system conducts comprehensive assessments of students' computer foundations and AI-related cognitive levels. Big-data analysis is adopted to characterize learning profiles, classify students into different competence levels, establish personal learning-situation archives, accurately identify knowledge gaps, and provide data support for tiered teaching and personalized resource push. For students with weak foundations, the platform pushes multisensory preview materials including graphic documents and operational demonstration videos to make up for prerequisite knowledge. For advanced students, expanded content such as the application of AI medical tools and medical-data processing is provided. Differentiated preview narrows gaps in students' prior knowledge and guarantees the smooth progression of subsequent classroom teaching.

In-class facilitation takes multisensory collaborative learning as the core. AI-enabled real-time support reshapes classroom forms and

abandons the traditional one-way knowledge indoctrination, turning abstract concepts into intuitive presentations and conducting teaching tailored to individual characteristics. At the visual level, AI visualization tools convert obscure content such as program principles and data logic into dynamic diagrams and simulation animations. Combined with medical images and anatomical atlases, professional teaching contexts are built to reduce the difficulty of theoretical comprehension. At the auditory level, a bilingual voice-teaching system explains knowledge points and reminds operational steps in real time to satisfy the language-learning needs of international students in China. Meanwhile, teaching is carried out with clinical cases such as heart-sound collection and medical speech recognition, helping students establish associative thinking between computer technologies and medical diagnosis through auditory perception. At the tactile-operation level, tiered practical-training projects are designed centering on tasks such as medical-data sorting and medical-image preprocessing, enabling students to internalize knowledge

through hands-on practice. In addition, AI tracks the whole practical-training process in real time, captures operational errors and pushes corrective demonstrations. An in-class learning closed loop featuring instant diagnosis and dynamic optimization is formed. The concept of medicine-engineering integration is deeply embedded throughout teaching procedures. The underlying logic of AI-medical applications including intelligent image analysis and clinical big-data modeling is interpreted to break barriers between theoretical learning and professional application, and enhance students' learning initiative and professional identity.

Post-class reinforcement achieves targeted reinforcement and long-term improvement based on whole-process learning-situation data. AI integrates learning data including in-class responses and practical-training records, evaluates individuals' mastery of knowledge, and automatically generates tiered post-class assignments. Students with weak foundations complete targeted practical drills to consolidate basic skills, while high-achieving students participate in advanced practice related to medical scientific research. The platform builds an all-weather bilingual intelligent Q&A channel to resolve post-class learning problems without temporal-spatial constraints. The system summarizes frequently-occurring wrong questions and personalized knowledge vulnerabilities, and generates exclusive learning reports and special review resources to support personalized improvement. Meanwhile, cutting-edge cross-field cases integrating artificial intelligence and medicine are delivered on a regular basis to guide students to independently explore the application value of technologies and continuously foster the thinking of medicine-engineering integration. Eventually, a closed-loop education system is formed with interconnected pre-class, in-class and post-class sessions.

5. Reform Value and Prospects

This AI-empowered multisensory collaborative teaching reform accurately adapts to the student characteristics, linguistic and cultural features and professional cognitive rules of international medical students in China. It effectively addresses core problems of traditional Computer Fundamentals courses, including outdated content, rigid models, poor adaptability and disconnection between medicine and

engineering. Through whole-process AI teaching empowerment, personalized, targeted and intelligent teaching is realized. With multisensory collaborative instructional design aligned with the unique cognitive patterns of medical students, students' fear of learning is alleviated, learning interest is stimulated, and rapid construction of computational thinking is facilitated.

Furthermore, the reform promotes coordinated development between Computer Fundamentals courses and medical professional education, accomplishing the core objective of general basic courses serving professional talent cultivation. It helps comprehensively enhance international medical students' digital literacy, research capabilities and overall professional competence, and provides solid support for talent cultivation of international medical students. In future research, the AI-driven teaching-resource library can be further optimized, scenario-based medical teaching cases can be enriched, and the evaluation system for multisensory teaching can be improved. Intelligent teaching reform will be continuously deepened to build featured and intelligent high-quality courses suitable for international medical students.

6. Conclusion

Curriculum reform of Computer Fundamentals for international medical students in China is an inevitable requirement for the internationalization of medical education and the development of intelligent education. Faced with practical challenges including large gaps in students' prior knowledge and insufficient curriculum adaptability, AI technologies are adopted to build a whole-process teaching system covering pre-class, in-class and post-class stages. Combined with the concept of multisensory collaborative learning, instructional design is reconstructed to effectively resolve pain points of traditional teaching. Abstract computer knowledge can be adapted to the cognitive rules of medical students, realizing individualized teaching and medicine-engineering integration. This reform offers new ideas and practical paths for intelligent teaching reform of general basic courses for international students in China, and carries important practical significance for improving the quality of international medical-talent cultivation.

References

- [1] CHENG C, CAO S. Study on the Status and Influencing Factors of International Medical Students' Digital Literacy in China's Universities . *Health Vocational Education*, 2026, 44(9): 126-30.
- [2] BAIDOO-ANU D, ANSAH L. Education in the Era of Generative Artificial Intelligence (AI): Understanding the Potential Benefits of ChatGPT in Promoting Teaching and Learning . *Journal of AI*, 2023, 7: 52-62.
- [3] ZHOU Z, LIU D. Survey and preliminary exploration on the reform of computer fundamentals courses for international medical students in China . *Beijing Biomedical Engineering*, 2026, 45(4): 404-10.
- [4] LIU C, XUN M, HAN L, et al. Current status and prospects of AI-driven reforms in medical education . *Basic Medical Education*, 2024, 26(10): 890-4.
- [5] SUN D, ZHU C, XU Z, et al. A Study on Analysis of College Students' Programming Learning Behavior Based on Generative Artificial Intelligence . *E-education Research*, 2024, 45(3): 113-20.
- [6] WANG Y, WU B, ZHANG N. Research and Practice on Teaching Reform of Computer Fundamentals B for Medical Students . *Medical Education Management*, 2023, 9(S1): 32-6.
- [7] WANG K, CAO T, LI W, et al. Instructional design and practice of AI agent-based communication principles course . *Computer Education*, 2026, (8): 116-24.
- [8] FU X, ZHANG X, WANG Y. Exploration of medical computer technology education under the new medical education reform—a case study of Shanghai University of Medicine and Health Sciences . *Medical Education Management*, 2026, 12(1): 34-40.
- [9] XIA Q, YANG Y, TIAN X. How Generative Artificial Intelligence Empowers University Teachers' Teaching Innovation — A Case Study of the Massachusetts Institute of Technology . *China University Teaching*, 2025, (12): 83-91.
- [10] LI Q, LI Y, WANG S, et al. Application of Multisensory Teaching in Clinical Probation Teaching of Urology . *Contemporary Medicine*, 2015, 21(18): 163-4.