World Journal of Educational Studies
Print ISSN: 2959-9989
Online ISSN: 2959-9997
DOI: https://doi.org/10.61784/wjes3154

THEORETICAL EXPLORATION ON THE REFORM OF TRADITIONAL CHINESE MEDICINE DIAGNOSTICS TEACHING EMPOWERED BY ARTIFICIAL INTELLIGENCE

Lei Liu*, Li Zhang, MengXin Xu, YaJing Cheng
College of Integrated Chinese and Western Medicine, Jining Medical University, Jining 272067, Shandong, China.
**Corresponding Author: Lei Liu*

Abstract: As a core compulsory course for Traditional Chinese Medicine (TCM) majors, TCM Diagnostics serves as a critical link connecting basic TCM theories and clinical practice, whose teaching quality directly determines the core competence of TCM talent cultivation. Currently, TCM diagnostics teaching faces practical dilemmas including abstract theoretical knowledge, insufficient practical scenarios, lack of personalized teaching, and rigid evaluation systems, which restrict the quality and efficiency of TCM talent cultivation. With its core advantages in data processing, intelligent simulation, and personalized adaptation, artificial intelligence (AI) technology demonstrates inherent consistency with the core thinking of TCM diagnostics such as "syndrome differentiation and treatment" and "holistic concept", providing a brand-new technological path for solving teaching difficulties and promoting teaching reform. Based on constructivist learning theory, embodied cognition theory and precision teaching theory, this paper systematically analyzes the theoretical foundation and internal logic of AI-empowered TCM diagnostics teaching reform, examines the existing problems in current TCM diagnostics teaching, explores the application paths of AI in theoretical teaching, practical teaching, assessment and evaluation of TCM diagnostics, and proposes targeted safeguard measures, so as to provide theoretical support and practical reference for promoting the digital and intelligent transformation of TCM diagnostics teaching and cultivating high-quality TCM talents who meet the needs of the new era.
Keywords: Artificial intelligence; Traditional Chinese Medicine diagnostics; Teaching reform; Talent cultivation

1 INTRODUCTION

TCM Diagnostics is an important component of TCM, which comprehensively collects disease information through the four diagnostic methods of "inspection, listening and smelling, inquiry, and pulse-taking", and conducts syndrome differentiation analysis combined with theories of yin-yang and five elements, zang-fu organs and meridians. It is the foundation of TCM syndrome differentiation and treatment, as well as the core link of TCM talent cultivation[1]. With the inheritance, innovation and development of TCM cause in China and the in-depth advancement of the "Healthy China" strategy, the society has an increasingly urgent demand for high-quality TCM talents, putting forward higher requirements for the quality and efficiency of TCM diagnostics teaching.

At present, TCM diagnostics teaching in China still mainly adopts the traditional teaching mode, which has many dilemmas to be solved: TCM diagnostics theories are abstract and obscure, and thinking modes such as "syndrome differentiation and treatment" and "judging the interior from the exterior" are difficult to be intuitively presented through traditional teaching methods; clinical practice resources are limited, the training and maintenance costs of standardized patients (SP) are high, and students have insufficient practice opportunities, making it difficult to transform theoretical knowledge into clinical diagnostic capabilities; the teaching process lacks personalized adaptation, making it difficult to take into account the learning foundation and learning needs of different students; the assessment and evaluation system focuses on knowledge memory, neglects the comprehensive evaluation of clinical thinking and practical ability, making it difficult to fully reflect the core competence of students. These problems not only restrict the improvement of TCM diagnostics teaching quality, but also affect the quality of TCM talent cultivation, which is incompatible with the development needs of TCM cause in the new era.

In recent years, with the rapid development of AI technology, technologies such as machine learning, deep learning, natural language processing, and computer vision have been increasingly widely applied in the medical field, injecting new vitality into the reform of TCM diagnostics teaching. AI can efficiently process massive data in TCM diagnostics, simulate the thinking process of TCM syndrome differentiation, construct virtual clinical practice scenarios, realize personalized teaching push and precise assessment and evaluation, which is highly consistent with the needs of TCM diagnostics teaching[2].This study explores the intrinsic logic and application pathways of artificial intelligence-enabled diagnostic teaching reform in TCM, and analyzes the possible problems in the reform process, aiming to provide theoretical support for promoting the digital transformation of TCM diagnostics teaching, improving teaching quality, and cultivating high-quality TCM talents, so as to facilitate the inheritance, innovation and development of TCM cause.

2 EXISTING PROBLEMS IN CURRENT TCM DIAGNOSTICS TEACHING

2.1 Abstract Theoretical Teaching, Difficult to Realize Intuitive Presentation

TCM diagnostics theory has strong abstractness and holism. Core contents such as "yin-yang syndrome differentiation", "zang-fu syndrome differentiation", "qi-blood and body fluid syndrome differentiation", as well as thinking modes such as "judging the interior from the exterior" and "knowing the whole from a small part", are difficult to be intuitively presented through traditional blackboard writing, PPT explanation and other methods. For example, the characteristics of TCM "pulse conditions" such as floating, sunken, slow, and rapid are difficult for students to accurately understand and grasp only through teachers' oral description and demonstration; the logical process of "syndrome differentiation and treatment" is complex and abstract, making it difficult for students to quickly establish a systematic syndrome differentiation thinking framework. This abstract teaching method leads to great learning difficulty for students, who are prone to develop fear of difficulties, and it is difficult for them to deeply understand the core connotation of TCM diagnostics theory, which affects the teaching effect. This is also one of the most prominent problems in current TCM diagnostics teaching.

2.2 Insufficient Practical Teaching Resources, Limited Practice Opportunities for Students

TCM diagnostics is a highly practical discipline, and practical teaching is a key link in cultivating students' clinical diagnostic ability. However, current TCM diagnostics practical teaching in China faces the dilemma of resource shortage: on the one hand, the number of clinical practice bases is insufficient, especially the shortage of grass-roots practice bases, making it difficult to meet the practice needs of large-scale students; on the other hand, the training, recruitment and maintenance costs of SP are high, the simulation scenarios are limited, it is difficult to simulate various complex clinical cases, and repeated use is hard to achieve, resulting in serious insufficient practice opportunities for students, who have difficulty transforming theoretical knowledge into clinical diagnostic skills. In addition, in traditional practical teaching, it is difficult for teachers to provide precise guidance to students, and some students have slow improvement of practical skills due to lack of targeted guidance, making it difficult to form standardized four diagnostic operations and syndrome differentiation thinking, which has a large gap with the needs of clinical posts.

2.3 Rigid Teaching Mode, Lack of Personalization and Interaction

At present, TCM diagnostics teaching still mainly adopts the traditional teaching mode of "teacher lecturing + student listening", with rigid teaching mode and lack of interaction and personalization. As the core of teaching, teachers dominate the entire teaching process, and students passively receive knowledge, lacking opportunities for active thinking and interactive communication, making it difficult to stimulate learning interest and initiative. Meanwhile, due to differences in students' learning foundation and understanding ability, the traditional teaching mode is difficult to take into account the learning needs of different students, unable to realize "teaching students in accordance with their aptitude", resulting in poor learning effect for some students, who cannot fully exert their learning potential. In addition, the utilization of online teaching resources is insufficient, lacking in-depth integration with offline teaching, making it difficult to form an "online + offline" mixed teaching mode, which further restricts the improvement of teaching quality.

2.4 Single Assessment and Evaluation System, Difficult to Fully Reflect Students' Competence

The current assessment and evaluation system of TCM diagnostics teaching is still dominated by theoretical examinations, focusing on examining students' memory and mastery of TCM diagnostics theoretical knowledge, lacking comprehensive evaluation of students' core competence such as clinical practical skills, syndrome differentiation thinking ability, and communication ability. This single assessment and evaluation method leads students to pay excessive attention to the recitation of theoretical knowledge, neglect the training of practical skills and the cultivation of syndrome differentiation thinking, making it difficult to adapt to the needs of clinical posts. Meanwhile, the assessment and evaluation lacks process evaluation, only taking the final examination score as the sole criterion for evaluating students' learning effect, making it difficult to comprehensively and objectively reflect students' learning process and comprehensive competence, and unable to provide effective reference basis for teaching improvement.

2.5 Insufficient Inheritance of Tacit Knowledge, Difficult to Effectively Transform Famous Veteran TCM Doctors' Experience

The essence of TCM diagnostics lies not only in explicit theoretical knowledge, but also in the tacit experience accumulated by famous veteran TCM doctors. These experiences mostly rely on the "master-disciple" mode for inheritance, which is highly subjective and empirical, making it difficult to be systematically transmitted through traditional teaching methods. Currently, famous veteran TCM doctor resources are scarce, and the coverage of the "master-disciple" mode is limited, making it difficult to meet the demand for large-scale talent cultivation; meanwhile, the clinical experience of famous veteran TCM doctors is mostly scattered in individual diagnosis and treatment practices, lacking systematic sorting and digital transformation, making it difficult to become shareable teaching resources, resulting in the risk of discontinuity in the inheritance of TCM tacit knowledge, which affects the depth and quality of TCM diagnostics teaching.

3 INTERNAL LOGIC AND CORE PATHS OF AI-EMPOWERED TCM DIAGNOSTICS TEACHING REFORM

3.1 Empowering Theoretical Teaching

The abstractness of TCM diagnostics theory is the difficulty in teaching. AI technology can realize the intuitive presentation of theoretical knowledge through various ways, helping students build a systematic knowledge system.

First, construct a TCM diagnostics knowledge graph. Using AI's natural language processing and knowledge graph technology, integrate the basic theories, syndrome differentiation methods, key points of the four diagnostic methods, common diseases and other contents of TCM diagnostics to build a structured TCM diagnostics knowledge graph. The knowledge graph can intuitively present the correlation between various knowledge points, allowing students to clearly grasp the knowledge context and form systematic knowledge cognition, avoiding knowledge fragmentation. Meanwhile, the knowledge graph can realize intelligent retrieval and associated query of knowledge points, and students can quickly obtain relevant knowledge through keywords, deepening the understanding and memory of theoretical knowledge, which is also an important direction of current digital inheritance of TCM knowledge. For example, Lu et al. applied the combination of AI and knowledge graph to TCM diagnostics teaching[3], solved the problem of abstract theory in traditional teaching through knowledge visualization, and provided technical support for precise teaching of the course; Cheng et al. took TCM diagnostics as an example to construct a knowledge graph for TCM courses[4], helping students systematically sort out the knowledge framework and strengthening the inheritance effect of classic theories; Xiao et al. analyzed the evolution context of TCM diagnostics teaching research with the help of scientific knowledge graph[5], clarified that digital-intelligence empowerment is the core hot spot of current teaching reform, and provided academic basis for the positioning of research directions.

Second, realize the visualization of abstract theories. With the help of computer vision, animation production and other technologies, transform abstract TCM diagnostics theory into intuitive images and animations. Through 3D animation demonstrating the process of "zang-fu syndrome differentiation", the clinical manifestations and key points of syndrome differentiation of different zang-fu organ lesions can be intuitively presented; through pulse condition simulation animation, the formation mechanism and characteristics of pulse conditions such as floating, sunken, slow and rapid can be displayed, allowing students to intuitively feel the differences between pulse conditions; through tongue image recognition technology, the color, shape, tongue coating and other characteristics of tongue images of different syndrome types can be displayed, helping students master the key points of tongue diagnosis. In addition, virtual reality (VR) technology can be used to construct a virtual classroom for TCM diagnostics theory, allowing students to "interact" with TCM classic theories and famous doctors' thoughts in the virtual environment, enhancing the fun and initiative of learning, and solving the problem of boring traditional theoretical teaching.

Third, assist in the study of classic ancient books. Using AI text recognition and semantic analysis to carry out digital processing and interpretation of TCM classic ancient books, transform profound ancient Chinese into easy-to-understand modern language, and excavate the diagnostic experience and syndrome differentiation rules in the ancient books, providing rich materials for theoretical teaching. Meanwhile, the artificial intelligence system can push personalized classic study content according to students' learning progress, helping students gradually improve their understanding and application ability of TCM classic theories and consolidate the theoretical foundation.

3.2 Empowering Practical Teaching

Practical teaching is the core of TCM diagnostics teaching. AI technology can enrich practical teaching resources and improve students' clinical diagnostic ability by constructing virtual practice scenarios and intelligent auxiliary systems.

First, build a virtual clinical practice platform. Using virtual reality (VR) and augmented reality (AR) technologies to construct highly simulated TCM clinical diagnosis and treatment scenarios, simulate the clinical manifestations, four diagnostic processes and syndrome differentiation and treatment procedures of different diseases. Students can conduct syndrome differentiation analysis on the collected disease information by interacting with virtual patients. The virtual scenario can simulate various complex clinical cases, including common diseases, frequently-occurring diseases, difficult and complicated diseases, etc., and students can practice repeatedly to accumulate clinical experience, breaking through the limitations of single cases and limited practice opportunities in traditional practical teaching. Yi et al. developed a remote bionic recurrent pulse diagnosis instrument based on TCM image thinking, realized the digital recurrence and remote transmission of pulse conditions[6], solved the problems of accurate replication and difficult inheritance in pulse condition teaching, and enriched the digital resources of clinical practical teaching.

Second, develop an intelligent standardized patient (AISP) system. Traditional SP have problems such as high training cost, limited simulation scenarios, and difficulty in repeated use, which can be effectively solved by the intelligent standardized patient system. The AISP system uses technologies such as natural language processing, speech recognition, and machine learning to simulate the symptoms, signs, language expression and emotional response of real patients, and realize real-time interactive inquiry with students. Students can practice inquiry skills and learn how to collect disease information through interaction with AISP, improving doctor-patient communication ability and inquiry skills. For example, the TCM intelligent standardized patient inquiry and differentiation teaching system, through model optimization and integration of speech recognition technology, realizes real-time voice interaction between students and

virtual patients; meanwhile, the AISP system can automatically score and give feedback according to students' inquiry performance, helping students find their own shortcomings and improve their inquiry ability in a targeted manner.
Third, construct an intelligent case analysis system. Using AI big data analysis and machine learning technology to integrate massive TCM clinical cases and construct an intelligent case analysis system. Students can view the case data of different diseases through the system, including four diagnostic information, syndrome differentiation results, diagnosis and treatment schemes, etc., and conduct case analysis and simulated syndrome differentiation. The system can give evaluation and guidance according to students' analysis results, helping students sort out syndrome differentiation ideas and improve syndrome differentiation and treatment ability.

3.3 Empowering Teaching Process

Artificial intelligence technology can accurately grasp students' learning status and learning needs through big data analysis, optimize the teaching process, realize personalized teaching, and improve the pertinence and effectiveness of teaching.
First, construct accurate portraits of students' learning. Using AI technology to collect students' learning data, including learning duration, knowledge point mastery, wrong question distribution, practical operation performance, learning interest, etc., accurately analyze students' learning status through algorithm models, and construct accurate portraits of students' learning. The portraits can clearly present students' knowledge loopholes, learning difficulties, learning progress and learning needs, providing accurate teaching reference for teachers, helping teachers grasp each student's learning situation, and realizing "teaching students in accordance with their aptitude".
Second, push personalized learning resources. Based on the accurate portraits of students' learning, the artificial intelligence system can automatically push personalized learning resources for students, including theoretical explanation videos, knowledge point summaries, case analyses, exercises, etc. Meanwhile, the system can dynamically adjust the difficulty and content of learning resources according to students' learning progress, ensuring that students can improve their learning ability step by step.
Third, realize real-time feedback in the teaching process. The artificial intelligence system can conduct real-time monitoring and analysis of students' learning process, timely discover students' learning problems, and give real-time feedback. When students complete exercises, the system can immediately correct them and explain the reasons for wrong questions in detail, helping students consolidate knowledge in time. Meanwhile, the system can feed back students' learning situation to teachers in real time, and teachers can carry out targeted tutoring teaching and adjust teaching strategies according to the feedback information, improving teaching effect. In addition, AI can also realize intelligent teacher-student interaction, answer students' questions 24 hours a day through intelligent "learning companions", relieve teachers' teaching pressure, and provide timely learning support for students.

3.4 Empowering Assessment and Evaluation

In view of the current problem of single assessment and evaluation in TCM diagnostics teaching, AI can help construct a diversified and whole-process assessment and evaluation system to comprehensively and objectively evaluate students' comprehensive competence.
First, improve the content of assessment and evaluation. Break through the limitations of traditional theoretical examinations, include theoretical knowledge, practical skills, syndrome differentiation thinking ability, communication ability, etc. into the scope of assessment and evaluation, and construct a diversified assessment content system. Meanwhile, students' learning process, participation, innovative thinking, etc. can be included in the scope of assessment, realizing comprehensive evaluation of students' comprehensive competence.
Second, realize the combination of process assessment and summative assessment. Using AI to record and analyze the whole learning process of students, realize process assessment. The system can record students' learning duration, knowledge point mastery, number and performance of practical operations, case analysis results, etc., and score students' learning process according to these data; the summative assessment can adopt the combination of online and offline methods, with online examination of theoretical knowledge and basic practical skills, and offline examination of complex case syndrome differentiation, clinical practical operation and other abilities. The combination of process assessment and summative assessment can fully reflect students' learning process and learning effect.
Third, realize intelligent assessment and evaluation. Using AI to realize the automation and intelligence of assessment and evaluation. Theoretical examinations can automatically generate test papers and correct them through intelligent question banks, improving assessment efficiency; practical assessments can automatically record students' operation process through virtual practice platforms and AISP systems, and automatically score the standardization of operations, accuracy of syndrome differentiation, etc.; case analysis assessments can analyze and evaluate students' syndrome differentiation ideas and diagnosis and treatment schemes through AI algorithms, and give objective scores and feedback. Meanwhile, the artificial intelligence system can conduct big data analysis on assessment data, excavate students' learning problems and weak links in teaching, provide scientific basis for teaching improvement, and form a closed-loop mechanism of "teaching - assessment - feedback - improvement".

4 CONCLUSION AND PROSPECT

The reform of TCM diagnostics teaching is an important measure to improve the quality of TCM talent cultivation and promote the inheritance, innovation and development of TCM cause. At present, TCM diagnostics teaching faces

practical dilemmas such as abstract theory, insufficient practice, rigid teaching mode, and single assessment. With its core advantages in data processing, intelligent simulation and personalized adaptation, AI technology is highly consistent with the needs of TCM diagnostics teaching, providing a brand-new technological path for teaching reform.

At present, the research on AI technology empowering TCM education has entered the stage of "technology scenario implementation + teaching mode innovation", forming a multi-dimensional exploration trend in the field of TCM diagnostics teaching. VR/AR technology has achieved breakthroughs in traditional skill teaching, carrying out pulse diagnosis and tongue diagnosis teaching through VR virtual training systems; AISP has become a core tool for inquiry teaching, and the AISP system realizes real-time interaction through natural language processing and speech recognition technology, improving students' inquiry skills, and solving the problems of high cost and insufficient scene repetition of traditional standardized patients.

With the continuous development and improvement of AI technology, its integration with TCM diagnostics teaching will be more in-depth. On the one hand, AI technology will be continuously optimized, virtual practice scenarios will be more realistic, and intelligent auxiliary systems will be more accurate, which can better meet the needs of TCM diagnostics teaching and promote the further improvement of teaching quality; on the other hand, with the in-depth development of teaching reform, a new teaching mode of "artificial intelligence + TCM diagnostics" will be gradually formed, realizing the in-depth integration of theoretical teaching and practical teaching, full coverage of personalized teaching and precise assessment, and cultivating more high-quality TCM talents who meet the needs of the new era. Meanwhile, AI technology will also facilitate the digital inheritance of TCM diagnostics knowledge, promote the transformation and sharing of famous veteran TCM doctors' experience, and promote the modernization and internationalization of TCM cause[7-8].

COMPETING INTERESTS

The authors have no relevant financial or non-financial interests to disclose.

FUNDING

Jining Medical University Research Project on Artificial Intelligence Empowering Education and Teaching (No.JYJGZX2025054); Jining Medical University Undergraduate Innovation and Entrepreneurship Training Program Project (No.cx2024220z).

REFERENCES

[1] Cong Huiyuan, Xuan Mingshi, Zhu Dandan, et al. Development and Application of a Traditional Chinese Medicine Standardized Patient Inquiry Model Based on Homo Sapiens Artificial Intelligence. Chinese Medicine Education, 2025, 44(4): 131-135.

[2] Zhang Min, Prunus salicina Juan. Artificial Intelligence Empowers the Connotative Development of Traditional Chinese Medicine Education: Logic, Risks, and Pathways. China Educational Technology, 2025(14): 87-92.

[3] Lu Min, Liu Xinhan, Yang Jiazhen, et al. Application of Artificial Intelligence + Knowledge Graph in the Teaching of Traditional Chinese Medicine Diagnostics. Journal of Traditional Chinese Medicine Management, 2025, 33(19):13-15.

[4] Cheng Kai, Li Yongju, Zhang Menglu, et al. Research on the Construction and Application of Knowledge Graph in Traditional Chinese Medicine Courses from the Perspective of "The Second Combination"—Taking "Traditional Chinese Medicine Diagnostics" at Henan University of Chinese Medicine as an Example. China New Telecommunications, 2025, 27(19): 67-69.

[5] Xiao Li, Deng Ying, Yang Yijing, et al. Evolution and Hotspot Analysis of Teaching Research in Traditional Chinese Medicine Diagnostics from the Perspective of Scientific Knowledge Graph. Lishizhen Medicine and Materia Medica Research, 2025, 36(18): 3575-3579.

[6] Yi Kai, Xu Ying, Ma Yunjing, et al. Development of a Remote Bionic Pulse Diagnosis Simulator Based on Traditional Chinese Medicine Image Thinking. Lishizhen Medicine and Materia Medica Research, 2024, 35(03): 747-750.

[7] Zhu Wenjun, Tang Manshi, She Kaijie, et al.The Research Progress and Development Strategies of TraditionalChinese Medicine Diagnosis Empowered by Artificial Intelligenceg. Journal of Traditional Chinese Medicine, 2025, 66(14): 1413-1418.

[8] Xiao Wendi, Zhu Long, Wang Yang, et al. Application and Thinking on Multimodal Fusion Technology of Traditional Chinese Medicine Inspection. Journal of Traditional Chinese Medicine, 2024, 65(17): 1741-1746.