International Education Forum

Editor-in-Chief

Sarab Abu-Rabia-Queder

Ben-Gurion University, Israel

BIO-BYWORD SCIENTIFIC PUBLISHING PTY LTD
(619 649 400)
Level 10
50 Clarence Street
SYDNEY NSW 2000
Copyright © 2026. Bio-Byword Scientific Publishing Pty Ltd.
Complimentary Copy

International Education Forum

Focus and Scope

International Education Forum (IEF) is an international, peer reviewed and open access journal that aims to promote the development of education around the world, promote new educational concepts and methods, and demonstrate new achievements in the field of education and teaching. Manuscripts are encouraged to be submitted as original article, review, case report, short communication and letters. The covered topics include, but are not limited to: educational internationalization, educational diversification, vocational education, basic education development, curriculum development, educational psychology, educational technology, learning and educational model reform, educational assessment, special education, etc.

About Publisher

Bio-Byword Scientific Publishing is a fast-growing, peer-reviewed and open access journal publisher, which is located in Sydney, Australia. As a dependable and credible corporation, it promotes and serves a broad range of subject areas for the benefit of humanity. By informing and educating a global community of scholars, practitioners, researchers and students, it endeavors to be the world's leading independent academic and professional publisher. To realize it, it keeps creative and innovative to meet the range of the authors' needs and publish the best of their work.

By cooperating with University of Sydney, University of New South Wales and other world-famous universities, Bio-Byword Scientific Publishing has established a huge publishing system based on hundreds of academic programs, and with a variety of journals in the subjects of medicine, construction, education and electronics.

Publisher Headquarter

BIO-BYWORD SCIENTIFIC PUBLISHING PTY LTD
Level 10
50 Clarence Street
Sydney NSW 2000
Website: www.bbwpublisher.com
Email: info@bbwpublisher.com

2026, Volume 4, Issue 8

Table of Contents

1 **Research on the Cultivation of Independent Learning and Innovative Abilities of Accounting Majors under the Background of Artificial Intelligence**
Limin Lu

9 **A Preliminary Study on the Progressive-Driven Metalworking Practice Teaching Mode Combining Virtual and Real Training—Taking CNC Lathe Training as an Example**
Yebei Wu

15 **Research on the Construction and Application of a Public Health Experimental Practice Teaching System Based on the Integration of Practice—Innovation—Internationalization**
Yujie Ning, Chaowei Wang, Hui Wang, Yirong Qin, Pengyan Jiao, Zhouyun Chen, Yang Liu, Lian Liu, Lulu Bai, Liangyu Cui, Qi Jing, Yuyang Ma, Xi Wang

23 **Exploration of Ideological and Political Education in English Major Courses in the New Liberal Arts Context: A Case Study of the Course "An Introduction to English-Speaking Countries"**
Jiaojiao Meng

29 **A Study on the Practice of Aesthetic Education in Universities Carried by the Visual and Associative Beauty of Traditional Chinese Calligraphy**
Xiaoyang Zhao, Jian Xie

38 **AI-Empowered "Job-Course-Competition-Certificate" Integrated "Four-Dimensional Integration and Five-Stage Progression" Teaching Model Research for Higher Vocational Engineering Courses**
Qianxiu Zou

46 **Undergraduate Learning Ability and Career Cognition in Emerging Engineering Fields: A Systematic Review**
Bowen Cheng, Qiumiao Liang

53 **Research on the Path and Practice of Higher Vocational English Teaching Reform Empowered by Artificial Intelligence**
Hao Wang

59 **Reforming the Model for Training Financial Professionals in the Era of Artificial Intelligence**
Zhenguo Xu, Zhonghuan Yang

66 **Analysis and Reflection on Classroom Assessment Research in Chinese Primary and Secondary Schools**
Zhuoqing Li, Shunyu Li

73 **Research on Strategies for Cultivating Students' Critical Thinking Skills in English Reading Teaching**
Bingzhi Li

82 **Perceived Usefulness and Higher-Order Thinking: A PLS-SEM Investigation of the Chaoxing AI Learning Companion Platform among Vocational College Students**
Yiting Qiu, Wen Liu, Wenjie Zhang, Yue Ying, Bo Song, Asokan Vasudevan, Deshinta Arrova Dewi, Munir Hayet Khan

96 **Effects of a Child-Mediated Family-Based Stroke Education Intervention on Public First Aid Knowledge and Attitudes**
Jie Wang, Jinping Sai, Zhenzhen Rao, Dongmei Zhao, Yanli Tao, Haoying Yang, Jianying Peng

107 **Research on the Development and Cultivation Path of Children's Aesthetic Ability from the Perspective of Family and School Co-education**
Mohan Liu

114 **Research on the Path of Integrating Intangible Cultural Heritage Craftsmanship into the Aesthetic Education of the Interior Furnishings Design Course in Higher Vocational Colleges**
Xiao Han

121 **Demand Preferences and Cognitive Barriers in Adolescent Health Science Communication: A Medical Student Survey**
Penghui Yu, Liqin Wu, Xiuyu Wu, Shichang Cai, Yu Liu

132 **Development and Practice of a Quality Evaluation System for Professional Graduate Education in Engineering**
Yuexia Lv, Yanbin Shi, Hui Zhang, Wei Zhao, Jin Du

139 Study on the Application Effect of CBL Combined with Standardized Patient (SP) Teaching Model in Clinical Teaching of Residents in Respiratory Medicine
Jing Niu, Jie Du

146 Research on Cross-Cultural Emergency Education Based on an Editable VR Platform
Zhongyi Huang

152 Research on China-Malaysia New Engineering Talent Cultivation Paths from the Perspective of Industry-Education Integration: A Case Study of Xiamen University of Technology
Xiahui Fan

162 Economics Education into Medical Professional Education — A Literature-Based Normative Curriculum Design Study
Yongfeng Zhang, Xia Li

International Education Forum, 2026, Volume 4, Issue 8
http://ojs.bbwpublisher.com/index.php/IEF
Online ISSN: 2981-8605
Print ISSN: 3083-4902

Research on the Cultivation of Independent Learning and Innovative Abilities of Accounting Majors under the Background of Artificial Intelligence

Limin Lu*

Harbin University of Commerce, Harbin 150028, Heilongjiang, China

***Corresponding author:** Limin Lu, 102774@hrbcu.edu.cn

Copyright: © 2026 Author(s). This is an open-access article distributed under the terms of the Creative Commons Attribution License (CC BY 4.0), permitting distribution and reproduction in any medium, provided the original work is cited.

Abstract: In the artificial intelligence era, traditional accounting tasks are gradually being replaced by intelligent tools, and complex demands such as management decision-making, analysis, and the integration of business and finance have become the development direction of the accounting industry. Self-directed learning ability and innovation ability are key competencies for accounting students to adapt to industry development. This study systematically elaborates on the significance of cultivating self-directed learning and innovation abilities in accounting students, explores the internal relationship connection between the two capacities, sorts out the existing problems in the current cultivation, and proposes targeted and feasible cultivation paths. The research aims to provide a theoretical foundation and practical references for the teaching reform of the accounting major.

Keywords: Artificial intelligence; Accounting students; Self-directed learning; Innovation ability

Online publication: August 31, 2026

1. Significance of cultivating independent learning ability and innovative capacity for undergraduates majoring in accounting

1.1. An inevitable requirement to adapt to the intelligent development of the accounting industry

With the widespread adoption of artificial intelligence technologies, the extensive use of financial robots, intelligent audit systems, and automated accounting platforms is rapidly replacing repetitive and standardized basic accounting tasks, such as bookkeeping, expense reimbursement, and voucher verification [1–2]. The talent demand structure of the accounting industry has undergone fundamental changes, transitioning from traditional skill-oriented personnel to modern strategic value-creating professionals. Contemporary

accounting practitioners are now required to engage in high-value-added and complex tasks, including risk management, integrated industry-finance analysis, and group financial control [3–4]. Without a strong awareness of independent learning and innovative thinking, accounting undergraduates may struggle to adapt to dynamic post-adjustment and career transitions, thereby failing to meet the industry's development demands in the era of intelligent finance.

1.2. The key path to break through the limitations of traditional accounting education

In the context of the rapid development of intelligent finance, accounting education is facing new challenges. Due to the limitation of classroom hours, the teaching content is not closely connected with the development of industry practice and intelligent finance. The practical teaching system still needs to be improved. The traditional training mode that emphasizes theoretical teaching still continues, and the talent training mode is temporarily difficult to fully adapt to the development needs of compound accounting talents in the new era [5–6]. The cultivation of independent learning and innovation ability is the core of breaking through the limitations of traditional education. Autonomous learning ability can effectively make up for the deficiency of classroom teaching, break the limitation of time and space, and make students become the main body of learning. The cultivation of innovative ability feeds back the transformation and upgrading of teaching mode. Through scene teaching methods such as sand table simulation, school-enterprise cooperation projects, scientific research and innovation training, colleges and universities enable students to exercise innovative thinking in practice, thus promoting colleges and universities to change traditional teaching methods.

1.3. Core support for shaping students' competitiveness and career development

Self-directed learning and innovative capabilities constitute the core competitiveness for accounting majors to thrive in the workplace and achieve long-term career growth, as well as vital drivers of career potential. As the foundation of lifelong learning, self-directed learning enables students to quickly adapt to job requirements at the early career stage, master practical operations of financial software proficiently, and independently supplement knowledge and upgrade competencies in response to career development needs, facilitating smooth transitions from entry-level accounting roles to mid-to-senior positions such as management accountants, financial analysts, and finance supervisors. Innovative capabilities, by contrast, directly determine whether graduates can stand out as elite accounting professionals amid homogeneous workplace competition. The integration of self-directed learning and innovative skills effectively strengthens students' critical thinking, logical analysis, and interdisciplinary integration capabilities. Equipped with core accounting expertise alongside interdisciplinary literacy covering information technology, corporate management, and strategic planning, students gain an edge in the job market and lay a solid foundation for career advancement.

1.4. The internal driving force for the self-development of accounting discipline

As a highly applied discipline, accounting witnesses constant mutual nourishment and promotion between its theoretical advancement and social practical innovation. The intelligent transformation of the accounting industry expands the connotation and denotation of the accounting discipline continuously. The cultivation of accounting majors' autonomous learning and innovative capacity serves as the internal driving force for the self-development of the accounting discipline. Cultivating students' innovative capacity enables them

to conduct forward-looking and exploratory academic thinking, which provides brand-new ideas for the theoretical research of the accounting discipline. Against the backdrop of artificial intelligence, accounting majors integrate cutting-edge technologies with the accounting discipline on the basis of their professional knowledge to carry out innovative research and practice. This enriches the research content of the accounting discipline, promotes its evolution from the traditional role of "value reflection" to the modern role of "value creation," facilitates the interdisciplinary integration of accounting with information technology, big data, enterprise management, and other disciplines, and strengthens the competitiveness of the discipline.

2. Internal correlation between independent learning ability and innovative capacity of accounting majors

2.1. Autonomous learning is the cornerstone of innovation ability

Innovation is not generated out of thin air, but based on the deep understanding of professional knowledge and the flexible use of cross-domain knowledge. Self-learning enables students to break through the limitations of the classroom and build a dynamic knowledge system to lay the foundation for presenting a novel method. At the same time, the cultivation of critical thinking in the process of autonomous learning is the key to the discovery of the starting point of origination. The research points out that interdisciplinary autonomous learning can guide students to analyze problems from multiple perspectives, construct a knowledge system independently, and improve problem-solving ability and practical innovation ability [7–8].

2.2. Innovation practice reversely drives the deepening of autonomous learning

When students try to solve practical problems, they will expose the blind areas of their knowledge, so as to stimulate their targeted autonomous learning. For example, in ERP sand table simulation, students will actively learn more advanced cost management concepts and tools if they find that traditional cost allocation methods cannot explain differences in resource consumption. This "practice-demand-learning" closed-loop makes autonomous learning change from passive acceptance of knowledge to active construction, which significantly improves learning efficiency and innovative practical ability.

2.3. Innovative practice is the core driving force of autonomous learning

Students tend to engage in innovative practice when participating in discipline-specific competitions, scientific research projects, or internship training programs. Such problem-oriented "learning needs" generated in practice can effectively stimulate autonomous learning and drive students to search for literature, learn new software, and consult experts in a targeted manner. The outcomes of innovative attempts offer the most direct feedback on students' in-depth understanding of existing knowledge and their application capabilities. This represents a role transformation from "knowledge recipients" to "problem-solvers," upgrading learning from passive knowledge reception to active construction. Such role transformation brings about a fundamental change in learning motivation, shifting the cultivation of high-order abilities from external indoctrination to internal generation [9–10].

2.4. The artificial intelligence environment as the core link for the coordinated development of the two types of capabilities

Artificial intelligence provides an important carrier for the coordinated cultivation of autonomous learning

and innovative capacity. Relying on the digital accounting training platform, universities allow students to conduct simulated financial statement analysis of listed companies. In this process, students need to independently study industrial data and propose innovative risk-identification models, so as to realize the in-depth integration and coordinated improvement of autonomous learning and innovative capacity in the artificial intelligence environment.

3. Existing challenges in fostering independent learning and innovative capabilities among accounting majors

3.1. Limited integration of advanced technologies into the curriculum and weak guidance for independent learning

Accounting programs at many universities still focus on traditional core subjects such as financial accounting, auditing, and tax law. Some universities have added courses such as Accounting Information Systems and Financial Big Data Analysis. Even so, artificial intelligence is not fully included in the course content. Most intelligent accounting courses mainly teach financial software and basic digital tools. Technologies such as natural language processing and knowledge graphs receive much less attention, especially in intelligent auditing and risk control, financial risk early warning, financial fraud detection, and intelligent financial statement analysis. This means that what students learn in class does not always match actual accounting work. Students may therefore have only a general understanding of how digital and intelligent transformation is changing the accounting profession. They may also be unclear about the new abilities expected of accounting professionals. Without enough motivation, it is hard for them to keep learning on their own and develop a lasting habit.

3.2. Traditional teaching methods and limited opportunities for innovative practice

Classroom teaching still relies mainly on the traditional model in which teachers deliver lectures and students complete exercises passively. Modern inquiry-based and immersive teaching methods are not widely used. Teaching cases are mostly based on traditional accounting scenarios and lack comprehensive, open-ended, and inquiry-based cases that deeply integrate artificial intelligence with accounting operations. Experimental teaching mostly uses standardized simulation software for basic accounting procedures and provides little practical training in financial data mining, intelligent financial analysis, and digital financial decision-making based on real corporate data. At the same time, too few interdisciplinary innovation projects in areas such as “accounting + big data” and “accounting + artificial intelligence” are available to students. Students have limited opportunities to participate in interdisciplinary innovative practice, making it difficult for them to develop innovative thinking and apply what they have learned in practice. In addition, current academic assessment systems focus mainly on knowledge memorization and basic abilities such as standardized accounting procedures. They have not yet fully established a diverse assessment framework covering innovative solution design, the application of interdisciplinary thinking, and complex financial problem solving. This narrow assessment focus reduces, to some extent, students’ willingness to explore new methods and broaden their perspectives. It does not support the long-term development of their innovative abilities.

3.3. Students have a limited understanding of the industry and their independent inquiry lacks depth

Some students do not have a comprehensive understanding of the integrated development of artificial intelligence and the accounting industry. They simply understand the intelligent transformation of accounting as the mechanized replacement of basic accounting work by financial software. They have an insufficient understanding of deeper industry changes, such as human-machine collaboration, the digital restructuring of financial processes, and the upgrading of enterprise value management. Their understanding of the new requirements for professional qualities and comprehensive abilities in the accounting industry under artificial intelligence remains limited. Under the influence of academic assessment and employment orientation, students pay more attention to preparing for professional qualification examinations such as the Certified Public Accountant examination and improving their short-term employability. Their learning shows some exam-focused and fragmented features, and they lack systematic learning plans and deeper exploration of advanced fields such as intelligent finance and big data accounting. At the same time, in an online learning environment with diverse information resources, students still need to improve their abilities in information screening, knowledge integration, and independent knowledge construction. Their learning content mostly remains at a basic level, making it difficult to form a systematic and interdisciplinary professional knowledge system. Therefore, the quality of independent learning still needs to be improved, and it remains difficult to meet the requirements for the sustainable development of accounting professionals under digital transformation.

3.4. Insufficient support from high-quality educational resources and a need to improve the environment for innovation

Colleges and universities have built basic teaching laboratories and financial data resource systems, but there is still room for improvement in the development of professional teaching platforms for training intelligent accounting professionals. High-quality teaching resources such as training platforms for financial big data analysis, intelligent audit simulation systems, real business data from enterprises, and practical cases from the latest developments in the industry are relatively limited. This makes it difficult to meet the practical training needs of accounting professionals with interdisciplinary skills in an intelligent environment. In the development of academic competitions, the range of innovative competition projects that integrate accounting with artificial intelligence and big data remains limited. Some teachers are still gaining experience in interdisciplinary teaching and guidance on innovative practice, and their support for students' interdisciplinary innovation projects needs to be strengthened. Current academic exchanges and teaching activities at universities mainly focus on basic theories and the introduction of concepts. A regular system that supports independent inquiry, collaborative innovation, and practical learning has not yet been established. The environment for innovation-focused education in intelligent accounting still needs to be strengthened, and comprehensive support for students' independent learning, exploration, and innovative practice needs further improvement.

4. Paths for improving accounting majors' independent learning and innovative abilities in the context of artificial intelligence

4.1. Restructuring the intelligent accounting curriculum and adding independent learning modules

Universities should offer compulsory courses such as Fundamentals of Intelligent Accounting and Financial Robotics Applications and Development. Artificial intelligence cases should also be included in traditional core courses, including financial accounting and auditing. Students can then learn how modern technology is used together with traditional accounting knowledge. Open elective courses on recent professional technologies are also needed. Students may choose areas such as blockchain auditing and big data risk control according to their own needs and future plans. This allows them to spend more time studying a field that interests them. A micro-credential system could be introduced by universities. Students may complete independent learning tasks through online platforms, such as Python Applications in Finance. Course credits or professional skills certificates can be awarded after they pass the assessment. In this way, students have more reasons to continue learning outside the classroom.

4.2. Building an innovative teaching model through projects and interdisciplinary collaboration

Real business situations and actual company projects should be brought into classroom teaching. Projects can become the main form of learning. Working in groups, students should complete the main steps by themselves, including defining problems, designing solutions, carrying out their plans, and reviewing the results. Accounting students can also work with students from computer science, statistics, and other majors. Different ideas and skills may help them become more innovative and improve their ability to deal with complex problems. The assessment method needs to change at the same time. Project results, technical analysis reports, how innovative the proposed solution is, and its practical value should all be considered. More weight should be given to practical ability. Industry experts can take part in course design, project guidance, and result evaluation. Their involvement can help promote the accurate docking of teaching content, practice scenarios, and real needs of enterprises.

4.3. Building a three-dimensional collaborative support system with platforms, mentors and learning communities

Constant optimization has been made to the school's intelligent accounting training platform. De-identified real corporate data and classic industrial case resources are opened to students, which facilitates their hands-on practices including data modeling and data visualization, and further strengthens students' practical technological application capabilities. An interdisciplinary dual-mentor cultivation mechanism has also been adopted on campus. Students participating in innovation projects can receive joint guidance from teachers with diverse professional expertise, so that core difficulties encountered in their study and practical work can be resolved in a timely manner. A community focused on accounting technological innovation has been set up for all students. Regular case study seminars and experience exchange activities are organized within the community. Latest industrial updates and professional technical guides are continuously released via official social media platforms and online knowledge resource libraries. These efforts help build a stable and immersive learning atmosphere, where students are able to carry out independent study and innovative exploration consistently.

4.4. Strengthening university-enterprise collaborative education to enrich diversified innovative practice opportunities

Stable internship and training bases have been built through close cooperation between universities, accounting firms, and tech companies. Intelligent finance studios and practical training camps are co-developed by these cooperating parties, which enable students to get fully involved in corporate practical projects. These projects cover RPA process design, intelligent report compilation, big data audit, and other practical fields, effectively bridging the gap between professional theories and real industrial practice. Students are motivated to take part in various high-standard professional contests. Typical examples include financial big data competitions and intelligent audit case contests, which play a vital role in improving students' comprehensive professional competencies. For outstanding projects that obtain awards in these competitions, corresponding resource access and incubation support will also be offered to students. A special innovation fund has been set up for accounting undergraduates. It aims to back students who take the initiative to apply for interdisciplinary and practical research programs. Under targeted academic guidance, students are able to transform their research findings into practical operational schemes and formal academic papers. A sound talent cultivation system is therefore formed, which features study improvement through competitions and the integration of academic learning with practical application.

4.5. Giving students a more active role and developing lifelong learning habits

Orientation courses and introductory classes are arranged for accounting majors. In these courses, the influence of artificial intelligence on the accounting industry's development is discussed in a systematic manner. Students are guided to develop a professional view based on technology empowerment and human-machine collaboration and to understand the important role of independent learning and innovation ability in career development. Courses focused on artificial intelligence technology have been added to the curriculum. With the guidance of these courses, students can master information retrieval skills, and their critical thinking as well as problem-solving abilities can be improved at the same time. Students are also encouraged to make their own independent learning plans according to the latest industry developments. In this way, they can shift from passive knowledge acceptance to active learning, and gradually form the habit of lifelong learning.

Funding

The Key Project of "14th Five-Year Plan" of Heilongjiang Province Educational Science in 2024(GJB1424243)

Disclosure statement

The author declares no conflict of interest.

References

[1] Song SY, Meng H, Nie ZM, et al., 2026, Evaluation of the Application Effectiveness of Artificial Intelligence in Financial Digitalization. Friends of Accounting, 2026(S1): 13–17.

[2] Du YY, 2023, Changes and Innovations in Financial Decision-making in the Age of Artificial Intelligence.

Accounting Learning, 2023(12): 49–51.

[3] Kuang YT, 2025, Exploration of Teaching Reform of "Industry-Finance-Data Integration" in Accounting Major Based on TPACK Theoretical Framework. Communication of Finance and Accounting, 2025(17): 170–176.

[4] Xie JC, Liu C, Zhou L, 2025, Logic and Path of Cultivating New-Quality Accounting Talents in Application-Oriented Undergraduate Universities under the Background of Digital-Real Integration. Communication of Finance and Accounting, 2025(24): 153–160.

[5] Liang SY, 2026, Exploration of Teaching Reform Path of "Ideological and Political Guidance + AI Empowerment" for Management Accounting Course from the Perspective of Industry-Education Integration. Business Accounting, 2026(1): 131–137.

[6] Cheng Y, 2025, Research on Intelligent Accounting Talent Cultivation under the Perspective of High-Quality Development of Private Economy—Analysis Based on Supply-Demand Fit Perspective. Communication of Finance and Accounting, 2025(18): 172–176.

[7] Ge YJ, 2025, Research on the Impact of Generative Artificial Intelligence on College Students' Interdisciplinary Learning Ability—Taking Shandong University of Finance and Economics as an Example, thesis, Shandong University of Finance and Economics.

[8] Li GS, Zhang XJ, Cui JX, 2026, Logic Framework and Implementation Path of Smart Finance Talent Cultivation Based on "Platformization + Scenarioization". University Education, 2026(1): 82–86.

[9] Wang YC, Qi WX, 2024, Deviation and Return of Autonomous Learning in the Era of Educational Digitalization. Jiangsu Higher Education, 2024(5): 61–66.

[10] Chen Y, Deng JK, 2026, Exploration of the Education Model of "Three Subjects, Three Transformations, One Platform" in the Innovation Practice Class of Programming. Journal of Higher Education, 12(7): 74–78.

Publisher's note

Bio-Byword Scientific Publishing remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

International Education Forum, 2026, Volume 4, Issue 8
http://ojs.bbwpublisher.com/index.php/IEF
Online ISSN: 2981-8605
Print ISSN: 3083-4902

A Preliminary Study on the Progressive-Driven Metalworking Practice Teaching Mode Combining Virtual and Real Training—Taking CNC Lathe Training as an Example

Yebei Wu*

School of Mechanical and Electrical Engineering, Xinjiang Institute of Technology, Aksu 843000, Xinjiang, China

Author to whom correspondence should be addressed.

Copyright: © 2026 Author(s). This is an open-access article distributed under the terms of the Creative Commons Attribution License (CC BY 4.0), permitting distribution and reproduction in any medium, provided the original work is cited.

Abstract: Taking CNC lathe training in metalworking practice as a research object, this paper addresses the prominent problems of high equipment investment, high practical operation risks, and insufficient hierarchical teaching, and explores a progressive-driven practical teaching mode integrating virtual and real training. The progressive framework of "virtual simulation teaching + physical operation + CAXA CAM CNC lathe programming + actual machining" realizes the organic integration of online and offline teaching. The acquisition of CNC lathe proficiency is divided into four progressive levels: overall perception layer, skill practice layer, comprehensive application layer, and capability leap layer. A compound teaching form of self-study + collective lecture + group rotation + individual tutoring is adopted to ensure students fully master all knowledge points of CNC lathe operation. The results show that this mode can significantly improve students' comprehensive CNC lathe operation ability. It can deliver differentiated teaching coverage for students with varied foundations, consolidate their theoretical foundation, and strengthen their professional literacy.

Keywords: Combination of virtual and real training; Metalworking practice; Teaching mode; CNC lathe

Online publication: August 31, 2026

1. Introduction

Metalworking practice is a vital practical link in engineering education, serving as a bridge for students to connect theoretical knowledge with actual production. Its core status has become more prominent under the construction of emerging engineering disciplines [1]. As a typical representative of advanced manufacturing technology, CNC lathes integrate precision transmission, computer control, and precision cutting, featuring high machining accuracy, high efficiency, and stable performance. They have been widely applied in

manufacturing, aerospace, shipbuilding, and other industries. CNC lathe training is a practical platform for students to master modern programming methods and establish digital machining thinking, and its teaching quality directly determines students' cognitive depth and skill level of modern manufacturing technology.

Nevertheless, current CNC lathe training in universities faces multiple challenges. Firstly, CNC lathe equipment requires huge investment and high maintenance costs, resulting in a severe shortage of machine tools per student. Secondly, new learners are exposed to safety hazards during operation; improper manipulation may lead to tool collision and workpiece scrapping, which wastes training time and limits students' exploration space. Moreover, traditional training adopts a single teaching flow of "lecture – demonstration – imitation," lacking hierarchical design. Students receive knowledge passively, which hardly stimulates their innovation and problem-solving thinking. With the continuous improvement of virtual simulation technology, its introduction into practical teaching can bring multiple advantages. On the one hand, students can get familiar with equipment, programming codes, and tool setting, and conduct simulation verification without equipment loss or safety risks. On the other hand, the simulation process intuitively displays the dynamic visual effect of each code, as well as tool paths and workpiece cutting processes. In addition, students can lower trial-and-error costs, cultivate interest through the cycle of "trial and error – learning – optimization," and transform from passive participants to active simulators, laying a solid foundation for subsequent physical operation [2].

Based on the above considerations, this paper takes CNC lathe training as the entry point to explore a progressive-driven practical teaching mode combining virtual and real training. The integration of virtual simulation, theoretical lectures, and physical operation can improve the teaching effect of metalworking practice and provide valuable references for practical teaching reform.

2. Curriculum and student analysis

2.1. Curriculum overview

This course is designed for engineering students in the second semester of their freshman year or the first semester of their sophomore year. At this stage, students have finished studying Mechanical Drawing and Advanced Mathematics, laying a solid knowledge foundation for subsequent mechanical drawing interpretation, CNC programming, and machining operations. Referencing the competition standards for the CNC Turning event of vocational skills competitions and incorporating research findings on talent demands from equipment manufacturing enterprises, the course defines its core competency objective: enabling students to independently complete drawing creation, process analysis, CNC programming, simulation verification, and physical machining of moderately complex rotary parts, as well as equipping them with the awareness and capability for quality inspection and process optimization. For pre-class simulated practice, students use the open virtual simulation experiment teaching management platform accessible via the one-stop service hall on the university's official website. On-site practical training is carried out on existing CK6150 CNC lathes, covering component recognition, tool setting, familiarization with control panel functions, and machining with self-written simple programs. Students generate machining programs for finished drawings through CAXA CAM Turning installed on computers, transfer the exported CNC programs to the CNC lathes, and machine parts on actual equipment. Qualified inspected parts constitute complete practical training deliverables [3].

2.2. Student analysis

Students taking this course have mastered the reading of part drawings, selection of tolerance fits, and use of basic measuring tools. Due to their engineering majors, they hold clear learning objectives and strong learning initiative. Growing up in the digital era, they naturally adapt to various online learning platforms and mobile software. However, most students are accustomed to individual learning and lack team cooperation awareness during practical operation; some students passively accept knowledge and have weak active learning ability. Besides, students have insufficient safety awareness, lacking intuitive perception of injuries caused by high-speed rotating spindles, which requires repeated emphasis during teaching.

3. Teaching design

3.1. Ladder-step progressive internship content

Traditional metalworking practice courses adopt a one-size-fits-all teaching model. Aligned with students' cognitive rules, this course divides the learning process of CNC turning technology into four progressive stages. The first stage is the holistic perception stage: students get familiar with the basic structure, operation panel, and safety regulations of CNC lathes via a virtual simulation platform, and finish simple manual programming and simulated cutting tasks. The second stage is the skill practice stage: students manually learn modules including tool setting, assembly, external cylindrical cutting, and end face cutting to cultivate operational proficiency, integrating theories, simulation exercises, and hands-on practice. The third stage is the comprehensive application stage: students can independently complete the full workflow of process planning, programming, and practical machining for rotary parts with multiple combined features. The fourth stage is the capability leap stage: after learning CAXA CAM for CNC turning, students are guided to implement software-based programming, complete drawing sketching, tool path planning, cutting parameter configuration, and simulated cutting independently, generate program codes, and proceed with actual machining.

3.2. Toolbox-style internship resource allocation

Drawing on the toolbox concept, the course matches diversified internship resources to meet the demands of students with varied learning foundations. Abundant learning resources are provided, including the online simulation module of the open virtual simulation experimental teaching management platform, CAXA CAM CNC lathe programming software, physical CNC lathes, micro-lesson videos, programming handbooks, and process parameter lookup tables.

Diversified organizational forms are adopted: self-study + collective lecture + group rotation + individual tutoring. Before class, students use the simulation module to strengthen cognitive reserve. In class, teachers deliver collective lectures on common knowledge, then guide students to conduct physical tool setting and simple cutting in groups of 3 to 4 to finish assigned programming tasks with CAXA CAM. In spare time, students can machine self-interested workpieces under teachers' guidance according to their own learning progress.

3.3. Clock-style integration of curriculum ideology and politics

Ideological and political theories incorporated into practical training teaching must never be applied in a forced and rigid manner; instead, the integration should be as precise and well-timed as a clock, natural and

appropriate. First, before the skill practice phase, this course plays videos of typical cases covering equipment damage and personal injuries caused by operational errors, while explaining standard safety operation rules to guide students in building safety awareness and internalizing standardized operation as conscious personal conduct. Second, prior to the comprehensive application phase, inspiring stories of national master craftsmen who devote themselves to researching NC machining technology and pursuing ultimate precision of mechanical parts are introduced, alongside physical displays of previous works to foster students' emotional recognition of the pursuit of excellence and the craftsman spirit. Before the competency advancement phase, students are encouraged to form groups freely and collaborate to complete the full machining workflow of parts from blueprint design to finished products. They are required to hold thorough discussions for every step of the workflow, assist one another during practical operations, and conduct error analyses in an open and candid manner [4–5].

4. Teaching implementation

4.1. Pre-class stage

Students log into the one-stop service hall on the school's official website and access the virtual simulation teaching and resource management platform to enter the CNC lathe simulation module. The platform contains dozens of virtual simulation experiments, especially a simulated CNC lathe operating environment. Students can master basic knowledge including operation panel introduction, power-on and power-off procedures, emergency stop buttons, and simple codes via virtual operation. A concluding test and safety operation examination are set on the platform to consolidate students' basic knowledge and safety awareness.

4.2. In-class stage

First, intensive theoretical lectures are delivered in the CNC lathe training area of the engineering training center. Teachers systematically explain CNC lathe composition, working principles, coordinate systems, tool setting procedures, code definitions, code formats, and programming for simple parts. Then teachers demonstrate physical operations including tool setting, program input and dry running, as well as the machining of stepped shafts. After demonstration, students independently finish practical tasks under guidance. Every student must master tool setting, as well as programming and operation for outer circle turning, end face turning, grooving, and thread cutting. Each student is required to practice repeatedly to grasp basic operational skills.

After students master manual programming, CAXA CAM CNC lathe teaching is launched. Teachers demonstrate the full workflow from part modeling, blank definition, machining scheme selection, tool and cutting parameter setting, to tool path generation and post-processing. Students are assigned part machining tasks and required to independently complete 3D modeling, machining parameter configuration, and tool path simulation. After successful simulation, CNC codes are generated and imported into lathes for dry running and physical machining under teachers' confirmation. After machining, students measure workpiece sizes with vernier calipers and micrometers, and analyze errors against engineering drawings.

4.3. Post-class stage

Teaching evaluation and summary reflection are the core work after class. Students score and comment on course content, teaching arrangement, organizational forms, teacher tutoring, and simulation platform

experience via the school's teaching evaluation system to provide improvement references. Teachers conduct comprehensive grading based on attendance, classroom performance, practical operation effects, workpiece quality, and training report completeness. Before the next round of teaching, teachers summarize experience, sort out teaching deficiencies, and continuously optimize teaching schemes.

5. Teaching effects

5.1. The ladder-step mode improves students' skill mastery

The ladder-step progressive teaching mode significantly lifts students' comprehensive CNC lathe proficiency. Students can independently machine medium-complexity workpieces within a specified time. Some students are able to identify error causes, optimize processes, and adjust cutting parameters rapidly to improve precision and shorten machining cycles. The pre-class virtual simulation link greatly reduces machining accidents, tool collisions, and workpiece scrapping. Students stay calm and operate standardly when facing real CNC lathe equipment.

5.2. Diversified learning demands of students are satisfied

The toolbox-style resource allocation meets the learning needs of students with different foundations. Students with weak foundations can repeatedly study via the open virtual simulation platform and micro-lessons, and finish training tasks after theoretical lectures and physical practice. Advanced students adopt CAXA CAM for automatic programming and process optimization; some of them take part in the "Zhe-A Vocational Skills Competition" CNC lathe event under teachers' guidance.

5.3. Cultivation of students' professional literacy

The clock-style accurate integration of curriculum ideology and politics remarkably improves students' professional literacy. During training, students take initiative to check tools and three-jaw chucks and wear protective equipment before tool setting. No safety or equipment damage accidents occurred throughout the training period. Group training spontaneously forms a clear division of labor: programming – tool setting – operation – inspection, cultivating students' teamwork awareness.

6. Conclusion

This teaching mode lowers students' cognitive threshold via virtual simulation. The ladder-step content system conforms to the law of skill formation, and the toolbox-style resource allocation meets differentiated learning demands. It stimulates students' active exploration through the cycle of "trial and error – learning – optimization." On the other hand, CNC lathe training equips students with machining skills and digital manufacturing thinking. The combination of virtual and real training eases the school's pressure in equipment, teaching, and safety management. In the future, this concept can be extended to more practical courses to provide transferable reform paradigms for engineering training teaching.

Disclosure statement

The author declares no conflict of interest.

References

[1] Tian CL, 2025, A Preliminary Study on Teaching Reform of Metalworking Practice in Application-Oriented Universities from the Perspective of Engineering Technology Management. Henan Private Education Association. Proceedings of Teaching Reform Sub-forum, 2025 Higher Education Development Forum (Volume II), 2025: 48–49.

[2] Fu Q, Xu GX, Liu Z, et al., 2025, Integrated Theory-Practice Teaching Reform of Metalworking Practice Under the Background of Emerging Engineering Disciplines. Journal of Liaoning University of Science and Technology, 27(3): 68–72.

[3] Zhang XS, 2020, Application of CAXA CNC Lathe in Secondary Vocational CNC Major Teaching. Modern Vocational Education, 2020(29): 110–111.

[4] Ouyang Y, 2018, Psychological Dimensions and Educational Paths of Craftsman Spirit Among Higher Vocational Students. Journal of Shunde Polytechnic, 16(4): 62–66 + 73.

[5] Shen H, 2024, Research on Integrated Virtual-Real Hybrid Teaching Reform of Metalworking Practice Course. Die & Mould Manufacture, 24(7): 108–110.

Publisher's note

Bio-Byword Scientific Publishing remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

International Education Forum, 2026, Volume 4, Issue 8
http://ojs.bbwpublisher.com/index.php/IEF
Online ISSN: 2981-8605
Print ISSN: 3083-4902

Research on the Construction and Application of a Public Health Experimental Practice Teaching System Based on the Integration of Practice—Innovation—Internationalization

Yujie Ning[1], Chaowei Wang[1], Hui Wang[1], Yirong Qin[1], Pengyan Jiao[1], Zhouyun Chen[1], Yang Liu[2], Lian Liu[2], Lulu Bai[2], Liangyu Cui[2], Qi Jing[2], Yuyang Ma[2], Xi Wang[2]*

[1]Institute of Endemic Diseases, School of Public Health, Xi'an Jiaotong University Health Science Center, Xi'an 710061, Shaanxi, China
[2]Department of Occupational and Environmental Health, School of Public Health, Xi'an Jiaotong University Health Science Center, Xi'an 710061, Shaanxi, China

Author to whom correspondence should be addressed.

Copyright: © 2026 Author(s). This is an open-access article distributed under the terms of the Creative Commons Attribution License (CC BY 4.0), permitting distribution and reproduction in any medium, provided the original work is cited.

Abstract: In order to address the problems of the disconnect between theory and practice, insufficient cultivation of innovation ability, and weak integration of international teaching resources in current public health experimental practice teaching, this study is based on the disciplinary characteristics of public health and preventive medicine, combined with the actual teaching of undergraduate and international students, and based on policies such as the "Guiding Opinions of the General Office of the State Council on Further Supporting College Students' Innovation and Entrepreneurship," to construct a "practice—innovation—internationalization" integrated public health experimental practice teaching system. The research results indicate that this system can effectively promote the reform of practical teaching, strengthen students' innovation and entrepreneurship abilities, and enhance the level of international teaching, thereby providing theoretical reference and practical guidance for the reform of public health experimental practical teaching in similar universities.

Keywords: Practical innovation; Internationalization; Public health experimental practice teaching system

Online publication: August 31, 2026

1. Introduction

The continuous promotion of the Healthy China strategy has led to an increasing demand for comprehensive talents in the public health industry. While emphasizing comprehensive literacy, it also requires talents to possess solid theoretical and effective practical abilities as well as innovative thinking. Based on this, they

should be able to broaden their horizons internationally and combine with international development forms to achieve the implementation of the strategy [1]. Public health and preventive medicine, as an applied discipline closely linked to social needs, have experimental and practical teaching as the core link of talent cultivation, and their quality directly determines the effectiveness of talent cultivation [2]; Furthermore, the "Guiding Opinions of the General Office of the State Council on Further Supporting College Students' Innovation and Entrepreneurship" clearly proposes to promote the deep integration of innovation and entrepreneurship education with professional education, and strengthen practical teaching links; The construction of the new medical system also emphasizes the need to reconstruct the medical education system and enhance the practicality and internationalization level of talent cultivation [3]. In this context, this article aims to construct a deeply integrated teaching system of "practice—innovation—internationalization," in order to solve the problems in public health experimental practice teaching and further promote the improvement of the quality of public health talent cultivation.

2. Construction of an integrated teaching system that combines practice, innovation, and internationalization

2.1. Principles of system construction

Firstly, adhering to the principle of practice orientation, based on the actual needs of public health positions, practical teaching modules that are suitable for real work scenarios are designed by integrating experimental links from multiple courses such as public health, epidemiology, and health inspection technology, such as public health emergency response, infectious disease prevention and control, occupational environment risk assessment, etc., in order to strengthen the practical application of teaching theoretical knowledge and achieve the effect of enhancing students' job competence [4]. Secondly, following the principle of innovation-driven, relying on cutting-edge scientific research achievements in the current discipline, the course content of epidemiology methods of environmental gene interactions for graduate students will be extended to undergraduate teaching courses, thereby designing micro research topics and gradually guiding students to conduct research-based experiments based on real data. At the same time, a mechanism for connecting college students' innovation and entrepreneurship projects can be established to increase students' research guidance content and learning support resources, providing them with innovative inspiration and foundation [5]. Finally, implementing the principle of international collaboration, in accordance with the current needs of international student teaching and bilingual teaching, referring to advanced international teaching concepts and standards, developing bilingual practice resources and cross-cultural cases, and cultivating students' international perspectives and cross-cultural collaboration abilities; Such as building an international collaborative platform, conducting joint practice between Chinese and foreign students, international academic exchanges, and other activities.

2.2. Four in one teaching system framework

Based on the core of "practice—innovation—internationalization," a four in one teaching system is constructed, which includes course experiments, scientific research training, social practice, and international collaboration [6–8]. Each module is interrelated and mutually supportive, thus forming a closed-loop talent cultivation model.

(1) Course experiment: By integrating existing experimental projects on campus, a three-level curriculum

system consisting of basic experiments, comprehensive experiments, and design experiments is constructed; The basic experiments focus on training core skills such as sample detection and data statistics; Comprehensive experiments integrate multidisciplinary knowledge, such as the "Public Health Emergency Simulation" experiment, which covers the entire process of case investigation, risk assessment, and prevention and control plan formulation; Designing experiments involves students independently selecting topics, designing plans, and conducting innovative experimental research; And develop standardized experimental teaching manuals, establish a shared experimental platform, and provide basic guarantees for teaching quality.

(2) Scientific research training: Combining learning at different educational stages and degree levels, conducting hierarchical scientific research training, with undergraduate academic programs focusing on teaching scientific research methods, using micro courses, and training under the guidance of teachers; Graduate education focuses on project-based teaching, allowing students to participate in the execution process of specific research projects; International students and exchange students with international characteristics adopt group teaching, focusing on cross-cultural themes and conducting research on public social issues.

(3) Social practice: Before starting the practice, establish contact with local disease control centers, hospitals, community health service centers, and other organizations, and establish scientific research cooperation relationships in advance; Afterwards, students will be organized to carry out social practice activities in conjunction with scientific research projects, such as conducting surveys on residents' health conditions and providing guidance on infectious disease prevention and control; At the same time, establish standardized practice management mechanisms to constrain and ensure the effectiveness of students' practical activities.

(4) International Collaboration: Developing a bilingual practical research resource library in Chinese and English, integrating typical cases of infectious disease prevention and control in different countries, and providing international data support for students' learning, in accordance with international academic research requirements; At the same time, educators cooperate with foreign universities and international health organizations to carry out bilingual curriculum teaching activities, providing opportunities for cultural exchange and academic exploration for students from different countries both domestically and internationally.

In addition, by establishing a comprehensive evaluation system with a dual orientation of "process+ability" and using a multi-agent mutual evaluation method, all participating subjects are required to conduct comprehensive evaluations of themselves and other subjects, and use them as the basis for evaluating students' integrated teaching-learning effectiveness and comprehensive literacy.

3. Practical application of two teaching systems

3.1. Practical application scenarios and objects

Select one university's School of Public Health as the practice base, which involves 50 undergraduate students and 100 graduate students majoring in Public Health and Preventive Medicine, as well as 50 international students from four countries. The practical period is set for 2026-2028, mainly including four core courses: epidemiology, environmental health, public health, etc.

3.2. Typical practice case analysis

3.2.1. Case 1: Interdisciplinary practice of public health emergency simulation

Taking the outbreak of a new infectious disease as an example, organize students to complete the entire process of case reporting, on-site investigation, data analysis, risk assessment, and prevention and control plan formulation in a team form; Then invite emergency experts from local disease control centers to provide on-site guidance, and use virtual simulation technology to digitally restore the emergency response scene. The practical results show that more than 90% of students believe that their ability to handle complex public health issues has improved. At the same time, the average score of the comprehensive experimental assessment has increased by 12% compared to previous practical activities, fully demonstrating the high practical teaching effectiveness of the comprehensive practical module.

3.2.2. Case 2: Microscience research project on the interaction between environment and genes and the prevention and control of chronic diseases

Based on the research direction of the disciplinary research team, design corresponding research projects that undergraduate students can participate in, and then guide students to carry out data analysis and mechanism exploration activities for the project by collecting information such as air quality data, resident chronic disease incidence data, and genetic testing data of a certain city. In this activity, it was found through the evaluation of students' research reports that more than 10 research reports reached a high level of quality. Not only was the data analysis more in-depth, but the scope also extended to environmental protection, urban construction, and public health security. Some project reports also have the qualifications to participate in provincial-level university student innovation and entrepreneurship projects, and even excellent reports were directly recognized and affirmed by core journals, greatly stimulating students' enthusiasm for participating in scientific research projects.

3.2.3. Case 3: Comparative study on cross-cultural public health literacy between Chinese and foreign students

By organizing a joint research project team consisting of Chinese and international students, community residents from countries such as China, Thailand, and Pakistan were selected as research subjects. Subsequently, a public health literacy questionnaire survey and comparative analysis were conducted. In the practical process of this project, due to the involvement of many countries and the theme of joint teaching, as well as the survey content of public health literacy, it received strong support from the International Society of Public Health. The research results have also been used as the latest public health data from multiple countries for exchange at international academic conferences. Through this project, the cross-cultural communication skills and international academic expression abilities of domestic students have been significantly enhanced, while also expanding the international influence of the discipline.

3.3. Teaching team building

In order to ensure the effective operation of the public health experimental practice teaching system based on the integration of "practice—innovation—internationalization," and to build an interdisciplinary, international, and industry-university research-combined teaching team. The construction of teaching teams is strictly carried out in accordance with four strategies. Firstly, regular training on innovative teaching methods and bilingual teaching skills is conducted to enhance teachers' comprehensive literacy; Secondly,

support teachers to participate in international academic exchanges and collaborative research, and expand their international perspectives; Thirdly, establish an integrated mechanism of teaching and research, encouraging teachers to transform research achievements into teaching content; The fourth is to hire industry experts as part-time teachers to strengthen the pertinence of practical teaching.

4. Evaluation of the effectiveness of the 3 teaching systems

4.1. Evaluation indicator system

The evaluation object is the practical application scenarios and objects mentioned in section 2.1 above, and the content scope includes the implementation process and output results of the four modules of course experiments, scientific research training, social practice, and international collaboration, as well as the implementation effect of the evaluation reform module. Therefore, the evaluation index system follows the principles of scientificity, comprehensiveness, and operability, and is constructed using the Delphi method; Furthermore, the weights of each indicator are determined through the Analytic Hierarchy Process, and the evaluation criteria refer to relevant national education quality standards and industry norms, as shown in **Table 1**.

Table 1. Evaluation indicator system

First level indicators (weights)	Second level indicators (weights)	Third level indicators (weights)
Student Competence Enhancement (0.45)	Practical Operational Ability (0.18)	Basic experiment pass rate, comprehensive experiment completion quality, emergency response simulation score, excellent rate of practical reports;
	Innovation Literacy (0.15)	Innovation project application approval rate, number of research papers published, number of patent applications, awards for innovative proposals
	International Perspective (0.12)	Bilingual course grades, international project participation, selfrated crosscultural communication score, international academic presentation ability
Teaching Operation Quality (0.30)	Resource Development (0.10)	Number of integrated courses, case bank update frequency, bilingual resource coverage rate, experimental platform sharing rate
	Process Implementation (0.12)	Experiment participation rate, research training duration, international collaboration frequency, student course satisfaction
	Team Capacity (0.08)	Bilingual teaching ability attainment rate, number of teachingresearch projects approved, number of international cooperation achievements, industry guidance ability score
Social and Industry Recognition (0.15)	Employer Evaluation (0.08)	Graduate job competency score, practical performance satisfaction, continuity of cooperation willingness
	Social Feedback (0.07)	Graduate employment competitiveness, industry reputation, evaluation by international partner institutions, feasibility of outcome promotion
Evaluation Reform Effectiveness (0.10)	System Adaptability (0.10)	Rationality of evaluation indicators, fairness of evaluation process, guiding value of evaluation results

In addition, the evaluation implementation is divided into three stages: pre-evaluation, formal evaluation, and data verification and calibration, in order to ensure the comprehensiveness and feasibility of the evaluation content, as well as the authenticity of the evaluation data.

4.2. Evaluation results and analysis

Present the evaluation results and analysis from the perspectives of students, teaching, and society, as shown in **Table 2**.

Table 2. Evaluation results

Evaluation Content	Main Evaluation Indicators	Before Reform	After Reform
Student Competence Enhancement	Practical operational ability (score)	72	88
	Number of innovation project applications (case)	2	7
	Project participation rate (%)	5	38
Social and Industry Recognition	Number of institutions willing to cooperate	3	8
	Promotion status	No promotion	Adopted by 2 institutions

According to **Table 2**, the public health experimental practice teaching system based on the integration of "practice—innovation—internationalization" has shown significant improvement in various core dimensions after implementation, indicating a positive cycle between students' comprehensive abilities and teaching operation quality. Furthermore, the significant increase in key indicators such as practical operation and innovation literacy indicates that the "practice—innovation—internationalization" integration model has high feasibility. The integration of resources and the improvement of teaching staff capabilities further provide talent and resource support for the implementation of the system, with high industry satisfaction and feasibility of promotion, intuitively demonstrating its practical value for the cultivation of public health talents, which can lay a solid foundation for subsequent optimization and promotion.

4.3. Problems and improvements

Based on feedback from multiple stakeholders and data, it can be concluded that there are four prominent issues in the practical application of the public health experimental teaching system based on the integration of "practice—innovation—internationalization," which require targeted improvement.

(1) There are limitations to resource integration and sharing: relying on the provincial public health teaching guidance committee, educators will build an online and offline resource-sharing platform, integrate high-quality courses, cases, equipment, and other resources, and provide an international resource-sharing platform for local universities and industry units.

(2) There are obstacles to collaboration between Chinese and foreign students: special courses such as bilingual communication in public health and international academic norms should be offered, cross-cultural and academic norms training should be strengthened, and a mutual aid group for Chinese and foreign students should be established, equipped with cross-cultural guidance teachers, to resolve potential collaboration barriers in advance and achieve the goal of improving collaboration efficiency [9].

(3) The evaluation of innovation capability is not sound enough: by refining the evaluation criteria for the basic, advanced, and excellent levels of innovation capability, increasing the weight of qualitative indicators, and introducing a third-party expert evaluation mechanism, students' innovation achievements can be objectively evaluated to ensure the objectivity and accuracy of the evaluation [10].

(4) The closed-loop application of evaluation results has not been formed: by constructing a closed-loop mechanism of evaluation → analysis → improvement → feedback, clarifying the main body and time nodes of improvement responsibility, and then incorporating the improvement results into the evaluation

indicators of the teaching team, periodic effect teaching and research can be achieved to ensure the improvement of teaching quality in practice and application of evaluation results.

5. Conclusion

In summary, based on the integration of "practice—innovation—internationalization" in the public health experimental practice teaching system, in the construction process, the common characteristics of curriculum experiments, scientific research training, social practice, and international collaboration should be comprehensively considered, so as to construct a "four in one" practical teaching framework system, effectively solve the problems of limited resource integration and sharing, obstacles to collaboration between Chinese and foreign students, inadequate evaluation of innovation ability, and the lack of a closed loop for the application of evaluation results in current public health experimental practice teaching, and further improve the education level of medical colleges and universities. In addition, although the sample size of this study is limited, the effectiveness evaluation is mainly based on short-term data, and the cooperation of the internationalization module is mainly concentrated in universities in developing countries. Therefore, in future research, researchers can strengthen the depth and comprehensiveness of research by tapping into the scope of practice, conducting long-term tracking research for more than 5 years, deepening international cooperation, and introducing digital technology, in order to promote research with stronger theoretical guidance value and practical reference significance.

Disclosure statement

The authors declare no conflict of interest.

References

[1] Wang XL, Zhang X, Song L, et al., 2024, Construction and Practice of Experimental Teaching System Based on Ability and Literacy Development. Continuing Medical Education, 38(1): 37–40.

[2] Zou LJ, Gao YF, Hu GH, 2024, Construction of Evaluation Index System for Public Health Master's Degree Practice Base in Local Medical Colleges. Journal of Gannan Medical College, 44(7): 754–760.

[3] Liu QL, Li XY, Song AQ, et al., 2024, Reconstruction and Practical Exploration of Basic Medical Experimental Teaching System under the Background of New Medicine. China Health Industry, 21(6): 253–256.

[4] Yang Y, Chen R, Xu J, et al., 2025, Research on Public Health Practice Science Popularization Education and Effect Evaluation. Journal of Higher Education, 11(5): 89–92.

[5] Zheng WQ, Li SP, Zhao GY, et al., 2025, Exploration and Research on the Standardization Construction of Practical Teaching in Media Biology. Chinese Journal of Health Insecticidal Devices, 31(5): 617–623.

[6] Hu J, Zhuo WW, Li YJ, et al., 2024, Exploration and Practice of Cultivating Innovative Abilities of Pharmaceutical Vocational College Students under the Concept of "Integration of Science and Education" — Taking the Course of "Biochemistry" as an Example. Science and Technology Wind, 2024(21): 102–104.

[7] Fang XY, Fan YG, Ye DQ, 2024, Based on the Construction of Interdisciplinary Curriculum Teaching System, Improve the Quality of High-level Public Health Talent Training. Chinese Journal of Disease Control and Prevention, 28(12): 1365–1372.

[8] Liu Y, Zhou L, Zhang Z, et al., 2023, Reform and Practice of Practical Teaching System for College Food Chemistry Based on the Cultivation of Applied Talents. Chemical Management, 2023(18): 37–40.

[9] Yu DJ, Fan RH, Feng X, et al., 2024, Research on the Construction of Health Inspection and Quarantine Experimental Teaching System Based on Job Competence. China Modern Education Equipment, 2024(11): 162–165.

[10] Du BY, Guo Y, Yuan PP, et al., 2025, Exploration of Reconstructing the Immunology Curriculum System to Improve the Teaching Quality of Preventive Medicine Undergraduate Students. Chinese Journal of Immunology, 41(5): 1220–1222.

Publisher's note

Bio-Byword Scientific Publishing remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

International Education Forum, 2026, Volume 4, Issue 8
http://ojs.bbwpublisher.com/index.php/IEF
Online ISSN: 2981-8605
Print ISSN: 3083-4902

Exploration of Ideological and Political Education in English Major Courses in the New Liberal Arts Context: A Case Study of the Course "An Introduction to English-Speaking Countries"

Jiaojiao Meng*

Shanghai University of International Business and Economics, Shanghai, China

Author to whom correspondence should be addressed.

Copyright: © 2026 Author(s). This is an open-access article distributed under the terms of the Creative Commons Attribution License (CC BY 4.0), permitting distribution and reproduction in any medium, provided the original work is cited.

Abstract: The New Liberal Arts Initiative advocates for the integration and innovation of liberal arts disciplines, as well as the transformation of talent cultivation, setting forth new requirements for fostering moral and value-driven English majors in the new era. "An Introduction to English-Speaking Countries" serves as a core course in English studies and is a key medium for implementing ideological and political education in English programs and advancing the New Liberal Arts reform. A three-dimensional pathway of knowledge transmission, skill cultivation, and values shaping can be adopted in the implementation of ideological and political education in this course, which helps students develop correct intercultural perspectives, strengthen their national identity, as well as enhance their intercultural competence. In addition, the teaching method of this course should be innovated to create an immersive ideological and political teaching environment. Finally, the course evaluation system should be improved to enhance the effect of talent cultivation.

Keywords: New Liberal Arts; English courses; Ideological and political education; Intercultural awareness; Intercultural competence; Cultural identity

Online publication: August 31, 2026

1. Introduction

The New Liberal Arts Initiative is an important direction for the development of higher education disciplines in China in the new era, aiming to promote the innovative development of liberal arts education and cultivate compound talents with interdisciplinary knowledge, innovation ability, and social responsibility [1]. As an important component of the humanities field, the cultivation of English majors faces an urgent need to transform and upgrade its talent training mode in the context of the New Liberal Arts.

As a key measure to fulfill the fundamental task of fostering virtue through education, curriculum-

based ideological and political education integrates ideological and political elements into the entire teaching process of specialized courses, achieving an integration of imparting knowledge and shaping values [2]. "An Introduction to English-Speaking Countries," as one of the core courses for English majors, encompasses rich cultural, historical, and humanistic knowledge, which provides platforms for the development of curriculum-based ideological and political education. In-depth research on talent cultivation and curriculum-based ideological and political education within this course under the New Liberal Arts context is of great significance for enhancing the comprehensive qualities of English majors and cultivating outstanding foreign language talents with a sense of national identity and international perspective.

2. New requirements for English Major talent cultivation in the New Liberal Arts context

"The Teaching Guide for English Majors in Regular Undergraduate Institutions" states that undergraduate English major education aims to cultivate English professionals and interdisciplinary talents with strong comprehensive qualities, solid language skills in English, and robust intercultural communication abilities, who can proficiently use English to serve the nation and society. In the New Liberal Arts context, both the educational philosophy and training mechanisms for English majors are undergoing a series of transformations, which impose higher demands on the objectives of English talent cultivation [3].

Firstly, the New Liberal Arts paradigm emphasizes breaking down disciplinary barriers and promoting interdisciplinary integration between liberal arts and other disciplines [4]. Comprehensively cultivating students' academic and interdisciplinary abilities is an important goal of English talent cultivation, which requires English majors not only to have solid English language skills, but also to master broad interdisciplinary knowledge such as economics, management, law, etc., in order to meet the needs of diversified social development.

Secondly, in the context of New Liberal Arts, cultivating the comprehensive abilities of English talents is an important task, including critical thinking ability, intercultural communication ability, innovation ability, information technology application ability, etc., so as to increase the core competitiveness of English talents.

Thirdly, in the context of New Liberal Arts, cultivation of English talents should attach great importance to shaping their values [5]. English talents should not only have a broad international perspective, but also possess profound national sentiments, firm cultural confidence, and a deep understanding of the connotation of Chinese culture. They should tell the story of China well and promote the dissemination of Chinese civilization.

3. The necessity of ideological and political construction in the course "An Introduction to English-Speaking Countries" in the context of New Liberal Arts

3.1. Implement the fundamental task of cultivating virtue and talent

In the process of imparting knowledge of English-Speaking countries, the course "An Introduction to English-Speaking Countries" incorporates elements of ideological and political education, which can guide students to establish correct worldviews, outlooks on life, and values [6]. It can also cultivate students' patriotism, sense of social responsibility, and professional ethics, and enable them to improve their ideological and moral literacy while mastering professional knowledge, effectively implementing the

fundamental task of cultivating morality and nurturing people.

3.2. Enrich teaching content

The construction of ideological and political education in the curriculum injects new vitality into the course "An Introduction to English-Speaking Countries" and enriches the teaching content of the course. Integrating ideological and political elements with course contents, such as guiding students to analyze the political, economic, and cultural factors behind historical events in English-Speaking countries from different perspectives, can cultivate students' critical thinking abilities. At the same time, by introducing cases of cultural exchange and economic cooperation between China and English-Speaking countries, students' horizons are expanded, and the practicality of the curriculum is enhanced.

3.3. Enhance students' comprehensive quality

Through the construction of ideological and political education in the curriculum, the course "An Introduction to English-Speaking Countries" can cultivate students' comprehensive literacy. In the process of learning professional knowledge, students not only improve their language expression ability and intercultural communication competence, but also enhance their ideological and political literacy and moral standards. The improvement of this comprehensive quality helps students better adapt to the needs of future social development and become high-quality talents with all-round development.

4. Implementation path of ideological and political construction in the course of "An Introduction to English-Speaking Countries"

4.1. Constructing three-dimensional educational goals

Based on the requirements of the New Liberal Arts education, educators should completely break from the single goal of teaching knowledge and construct a three-dimensional and hierarchical education goal system that integrates knowledge imparting, ability cultivation, and values shaping to implement ideological and political education effectively.

Knowledge imparting: Educators should enrich students' understanding of the society and culture of English-Speaking countries, and promote the improvement of students' humanistic literacy. This course introduces the social and cultural backgrounds of major English-Speaking countries, aiming to help students systematically understand the basic knowledge of their culture and society, such as geography, history, politics, economy, education, law, etc., in order to help students understand the cultural traditions and social customs of major English-Speaking countries, promote their understanding of language and culture, and enrich their humanistic knowledge [7].

Ability cultivation: In this course, great importance should be attached to students' understanding of the values behind culture, which can strengthen their comprehension of intercultural differences and enhance their ability to think critically across cultures. This course is not simply about imparting professional knowledge, but focuses more on comparing various aspects of society and culture between China and other English-Speaking countries. It aims to help students deepen their understanding and grasp of the cultural values behind social phenomena, enhance their intercultural awareness, strengthen their understanding of intercultural differences, enhance their intercultural competence, and cultivate their inclusive mindset while recognizing cultural differences [8].

Values shaping: When introducing the basic social status quo of English-Speaking countries, educators should shape students' objective and correct evaluation of the social status quo of different countries. This course not only broadens students' international perspectives but also guides them to establish correct values. While enhancing students' intercultural communication, it deepens students' understanding of Chinese culture and civilization, enhances their cultural confidence, promotes their cultural identity, cultivates their national pride and patriotism, as well as encourages them to take on social responsibilities.

4.2. Innovative teaching method

Relying on the concept of interdisciplinary integration in the New Liberal Arts Initiative, educators should change traditional teaching modes, adopting diversified, interactive, and immersive teaching methods to achieve the silent and deep integration of ideological and political education through professional teaching [9].

Case studies: Select representative cases and integrate course knowledge with ideological and political elements. For example, when explaining the foreign policies of English-Speaking countries, taking the China-US trade friction as an example, students are guided to analyze the political, economic, and cultural factors behind it, which cultivates their international perspective and analytical skills. At the same time, by discussing China's response strategies in trade frictions, educators aim to enhance students' sense of national identity.

Group discussion: Organize students to participate in group discussions and encourage them to actively express their opinions and viewpoints. During the discussion process, educators should guide students to apply correct values and methodologies to analyze problems, cultivate students' critical thinking and teamwork spirit. For example, when studying social issues in English-Speaking countries, educators can organize student groups to discuss how to draw on the experience of English-Speaking countries to solve similar social problems faced by China, so as to cultivate the students' critical thinking and enhance their sense of social responsibility during the discussion.

Practical teaching method: Educators can carry out practical activities related to the course content, such as organizing students to conduct cultural research on English-Speaking countries, model United Nations conferences, etc. Through practical activities, students are encouraged to use their knowledge in real-life situations, enhancing their practical skills and intercultural communication competence. At the same time, educators should integrate ideological and political education into practical activities to cultivate students' patriotism and international cooperation spirit [10]. For example, in doing cultural research activities of English-Speaking countries, students are encouraged to actively participate in the external dissemination of Chinese culture in some cultural exhibitions.

4.3. Improve the course evaluation system

Based on the New Liberal Arts education Initiative, educators should break the single assessment mode that relies on scores and knowledge, and construct a comprehensive assessment system to achieve quantifiable, testable, and optimizable ideological and political education.

Knowledge and ability evaluation: Educators should not only test students' knowledge of the society and culture of English-Speaking countries, but also focus on testing students' ability to apply knowledge to solve practical problems [11]. Through diverse assessment methods such as classroom performance, assignments, exams, project reports, etc., educators should comprehensively evaluate students' learning outcomes.

Evaluation of ideological and political literacy: Educators should incorporate students' ideological and political literacy into the curriculum evaluation system, and evaluate the improvement of students' values, intercultural awareness, social responsibility, and other aspects of ideological and political literacy through observing their performance in classroom discussions and practical activities, as well as their course papers and reflections. Besides, educators should establish scientific and reasonable evaluation indicators of ideological and political literacy to ensure the objectivity and accuracy of the evaluation results.

5. Conclusion

In the context of the New Liberal Arts, the cultivation of English majors is closely linked to the construction of ideological and political education in the curriculum [12]. As an important course for English majors, the course "An Introduction to English-Speaking Countries" has achieved an organic unity of knowledge transmission and value guidance through in-depth exploration of ideological and political elements in the curriculum, innovative teaching methods, and curriculum evaluation improvement. It has laid a solid foundation for cultivating high-quality English professionals with cultural confidence, international vision, and innovative abilities. In future teaching practice, it is necessary to continuously explore and improve the construction of ideological and political education in various courses, so as to better serve the cultivation of English professionals and make greater contributions to promoting the construction of New Liberal Arts and social development.

Disclosure statement

The author declares no conflict of interest.

References

[1] Deng S, 2023, Interdisciplinary Integration and Construction of the Foreign Language Discipline Knowledge System from the Perspective of the New Liberal Arts: A Cross-case Study. Foreign Language World, 2023(4): 34–41.

[2] Wang L, Ren Q, 2025, A Study on the Teaching Practice System of Ideological and Political Theories Teaching for College English Based on the Cultivation of National Consciousness. Journal of Chongqing Electric Power College, 2025(10): 25–29.

[3] Sun Y, Yang L, 2025, Focusing on the Goal of Building a Strong Education Nation and Advancing the New Liberal Arts Development in Foreign Language and Literature. Foreign Language World, 2025(3): 2–6.

[4] Wang L, 2025, Research on the Pathway for Compound Talent Cultivation in Business English Based on the New Liberal Arts Construction. Overseas English, 2025(2): 100–102.

[5] An F, Wang M, 2024, Constructing Core Competencies in Foreign Language Studies in the New Era: Value Implications, Connotative Dimensions, and Implementation Pathways. Foreign Languages Research, 2024(3): 57–63.

[6] Xu M, 2023, On the Implementation of the Teaching Approach of "Ideological and Political Education" in English Major Courses—Taking "Society and Culture of English-Speaking Countries" as an Example. Journal of Hanshan Normal University, 2023(1): 94–101.

[7] Hou X, Liu H, 2022, Curricula-based Ideological and Political Education Practice Research for English Majors: A Case Study of "A Guide to English-Speaking Countries". Journal of Xiangnan University, 2022(6): 99–102.

[8] Li L, 2023, Practice of Ideological and Political Education Reform in English Major Courses from the Perspective of National Consciousness: Taking "the Overview of English-Speaking Countries" Course as an Example. Journal of Nanchang Normal University, 2023(12): 132–136.

[9] Zhang L, 2025, Research on the Teaching Reform of English and American Culture Curriculum under the Guidance of Cultural Confidence——Taking "the Modern Society and Culture Curriculum in the UK and the US" as an Example, Overseas English, 2025(18), 202-204.

[10] Wang X, 2024, Practical Research on the Integration of Course Ideology and Politics with Core Courses of English Majors in Colleges and Universities. Overseas English, 2024(7): 93–96.

[11] Fan M, 2025, Exploration and Practice of Blended Teaching in the Course of "Society and Culture of English-Speaking Countries" Based on Curriculum Ideological and Political Reform. Heilongjiang Education (Theory & Practice), 2025(5): 53–56.

[12] Sun Y, Zhang L, Chen F, 2024, The Construction of Ideological and Political Education in Foreign Language and Literature Majors: Objectives, Principles, and Paths. Foreign Language World, 2024(2): 2–6.

Publisher's note

Bio-Byword Scientific Publishing remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

International Education Forum, 2026, Volume 4, Issue 8
http://ojs.bbwpublisher.com/index.php/IEF
Online ISSN: 2981-8605
Print ISSN: 3083-4902

A Study on the Practice of Aesthetic Education in Universities Carried by the Visual and Associative Beauty of Traditional Chinese Calligraphy

Xiaoyang Zhao*, Jian Xie

Digital Business College, Guangxi Economic and Trade Vocational Institute, Nanning 530021, Guangxi, China

***Corresponding author:** Xiaoyang Zhao, 515170693@qq.com

Copyright: © 2026 Author(s). This is an open-access article distributed under the terms of the Creative Commons Attribution License (CC BY 4.0), permitting distribution and reproduction in any medium, provided the original work is cited.

Abstract: As the core carrier of the fine traditional Chinese culture, calligraphy art boasts a dual aesthetic system with multi-layered and profound connotations, namely visual beauty and associative beauty. Visual beauty presents intuitive formal aesthetic perception through the strokes, character structures, and composition of Chinese characters, serving as the foundation of calligraphic aesthetic education. Associative beauty generates spiritual aesthetics based on textual implications, phonological rhythms, humanistic connotations of texts, and the moral cultivation of calligraphers, acting as the core sublimation of calligraphic aesthetic education. At present, university aesthetic education classrooms generally suffer from teaching deficiencies: overemphasis on technical skills while neglecting aesthetic cultivation, and overfocus on brushwork techniques while ignoring humanistic literacy. From the perspective of this dual aesthetic system of calligraphy, this paper systematically interprets the aesthetic connotations, internal relations, and practical contradictions between calligraphic visual beauty and associative beauty, explores implementation approaches to integrate the dual aesthetic paradigm into university aesthetic education classrooms, and constructs a calligraphic aesthetic education teaching model of "laying foundations through techniques, improving quality via aesthetics, and shaping souls with humanities." It provides references for the reform of aesthetic education featuring the fine traditional Chinese culture and practical education in universities in the new era.

Keywords: Traditional Chinese calligraphy; Visual beauty; Associative beauty; University aesthetic education; Classroom practice

Online publication: August 31, 2026

1. Introduction

University aesthetic education in the new era is a crucial measure to fulfill the fundamental task of fostering virtue through education and enhance college students' aesthetic literacy and cultural confidence. As a unique

Chinese visual plastic art integrating formal aesthetics and humanistic spirit, calligraphy stands out as one of the most compatible curriculum carriers for university aesthetic education with profound deposits of fine traditional Chinese culture. Compared with other aesthetic education forms such as painting, music and dance, calligraphic appreciation combines visible formal beauty and profound spiritual beauty, forming a complete educational closed loop covering visual perception, aesthetic judgment, humanistic edification and value shaping.

The aesthetic feelings brought by calligraphy to viewers are multi-dimensional. Classified by the aesthetic sources of calligraphic works, they fall into two main levels. The first is the inherent beauty of calligraphy itself, namely visual beauty, which belongs to concrete and visible formal aesthetics. The second is the beauty derived from calligraphic texts, the original authors' thoughts, as well as the morality and personality of calligraphers, namely associative beauty, which belongs to abstract and spiritual value aesthetics. Visual beauty focuses on perceiving character forms with eyes, while associative beauty centers on evaluating textual connotations and the morality of both calligraphers and original writers through mental reflection. Complementary and dialectically unified, the two form the complete aesthetic system of Chinese calligraphy and provide a clear, scientific teaching logic for university calligraphic aesthetic education classrooms. Reconstructing university calligraphic aesthetic education classrooms from the dual aesthetic perspective can effectively address the prominent problems of superficial, skill-oriented, and homogenized aesthetic teaching, and realize the profound transformation of aesthetic education from "handwriting skill training" to "aesthetic literacy cultivation and inheritance of the fine traditional Chinese culture."

2. Connotation analysis of the dual aesthetic system of traditional Chinese calligraphy

2.1. Visual beauty of calligraphy: The intuitive perception foundation of university aesthetic education

Among the five senses of sight, hearing, smell, taste, and touch, sight serves as the most important medium for humans to perceive the external world. The visual beauty of calligraphy is generated through vision, referring to the visual charm embodied in the shapes of Chinese characters. Therefore, observation is the fundamental method to appreciate the aesthetic appeal of calligraphy.

Different from music, which relies on hearing, and films that combine sight and sound, the aesthetic foundation of calligraphy lies in the visual delight brought by the linear structures of Chinese characters. Such delight stems from the unique artistic style of Chinese characters, making it the most fundamental and primary teaching content of university calligraphic aesthetic education.

As is well known, Chinese characters originated from pictographs. Pictographs denote objects by depicting concrete images, which are direct visual creations of ancient Chinese people. Later, Chinese characters evolved continuously under the six writing principles: pictography, self-explanatory characters, associative compounds, pictophonetic characters, mutually explanatory characters, and phonetic loan characters, eventually forming the modern Chinese character system. Regular script took shape and was continuously refined in the Wei and Jin Dynasties, consisting of five basic strokes: horizontal, vertical, left-falling, right-falling, and folded strokes. A dot can be regarded as a shortened form of the right-falling stroke. Separately, these five strokes are merely simple symbols with no independent meanings. However, their organic combinations in varied length, thickness, density, and curve create countless distinct character

structures, laying the core foundation for the visual beauty of calligraphy. It follows that exploring the proper writing and layout of these five strokes to fully express the aesthetic charm of characters is a core research topic in calligraphy studies and the aesthetic experience of calligraphy.

According to the existing history of Chinese writing, oracle bone inscriptions are the earliest Chinese characters and already possess elementary visual aesthetics. The evolution of bronze inscriptions, seal script, clerical script, and regular script not only made reading and writing easier, but also improved people's ability to appreciate the aesthetics of Chinese characters. The evolutionary history of Chinese scripts is also a process of continuous aesthetic optimization for calligraphy. Generally speaking, the aesthetic charm inherent to Chinese calligraphy manifests in three dimensions: first, the beauty of character strokes; second, the structural beauty of individual characters formed by combined strokes; third, the compositional beauty of character groups, namely layout beauty formed by a collection of characters.

Strokes in calligraphy vary widely: thick or thin, long or short, horizontal or vertical, left-falling or right-falling, dot or fold, forceful or delicate, gorgeous or plain. It requires long-term practice to master the most aesthetically satisfying way of writing these strokes. Strokes are ultimately assembled into individual characters, which distinguishes primary and secondary strokes, with their spacing and layout complying with visual harmony. Likewise, individual characters are grouped into an integrated whole. Such character groups are unified entities that require visual beauty for every single character as well as overall harmony after arrangement. As some scholars put it, "Calligraphic beauty is holistic" [1]. The holistic beauty of calligraphy lies in the harmonious coordination of character size ratio, character spacing, character position, and ink density, all of which must satisfy human visual aesthetic demands.

Hence, the formal beauty of calligraphy mainly resides in the linear structure of individual characters and the layout harmony between characters. This inherent visual charm constitutes the basic aesthetic quality of calligraphy; without it, any discussion of the deeper connotative beauty of calligraphy would be groundless.

In university aesthetic classrooms, the visual beauty of calligraphy acts as the entry-level foundation for students' aesthetic cultivation. Through observation, copying, and comparative analysis, students perceive the formal charm of strokes, character structures, and layout, and build basic aesthetic cognition, modeling ability, and artistic perception. This is an indispensable preliminary teaching link of calligraphic aesthetic education. Without the technical foundation of visual beauty, humanistic edification and spiritual cultivation can never be realized, nor can the inheritance of the fine traditional Chinese culture be fully carried out.

2.2. Associative beauty of calligraphy: The humanistic spiritual core of university aesthetic education

The associative beauty of calligraphy is a high-level spiritual aesthetic experience transcending visual brushwork techniques. It generates value resonance based on the form, pronunciation, and meaning of Chinese characters, textual backgrounds, and calligraphers' moral character, serving as the core carrier for universities to realize the mission of fostering virtue through education. It is divided into four dimensions: associative beauty of personality, associative beauty of character meanings, associative beauty of textual artistic conception, and associative beauty of phonology.

2.2.1. The associative beauty of personality refers to the aesthetic association derived from the moral character and conduct of the calligrapher

Chinese calligraphic aesthetics has long adhered to the evaluation criterion that "style mirrors character." A calligrapher's life experience, moral cultivation, and inner temperament directly determine the aesthetic value and spiritual depth of his works. The unrestrained and open-minded spirit of Wang Xizhi and the loyal, upright integrity of Yan Zhenqing bring audiences more than merely the brushwork beauty of their works, such as Preface to the Lanting Collection; they also convey the noble character embodied by the masters and their life stories. Master Qi Gong, a contemporary calligrapher, remained grateful, indifferent to fame and wealth, devoted to academic research, and committed to public welfare all his life. His noble moral cultivation greatly elevated the artistic conception of his calligraphy. On the contrary, calligraphers with vile morality will never win high recognition from the public even if they possess superb writing skills. For example, Cai Jing of the Northern Song Dynasty, Qin Hui of the Southern Song Dynasty, and Zhang Ruitu of the Ming Dynasty boasted exquisite brush techniques and perfect visual forms, yet their works were never regarded as model materials for aesthetic education by later generations due to their flawed moral conduct, receiving mixed critical comments [2]. Fu Shan, a thinker and calligrapher living between the Ming and Qing Dynasties, despised Zhao Mengfu for serving the Yuan royal court, and thus belittled both his personality and calligraphy. This serves as a typical embodiment of the tradition of prioritizing morality in the appreciation of fine traditional Chinese culture. This aesthetic feature of associative beauty of personality enlightens universities that calligraphic aesthetic education should not only teach writing skills, but also carry out moral education through the noble spirits of famous calligraphers, so as to educate people with aesthetics and nourish their souls with morality.

2.2.2. The associative beauty of character meanings

Chinese characters inherently carry Confucian philosophies of self-cultivation and social interaction derived from the fine traditional Chinese culture. Creating calligraphic works with positive characters such as benevolence, righteousness, propriety, wisdom, trust, and tranquility can convey philosophies of self-improvement. The single-character horizontal scroll of Tranquility enables viewers to comprehend the maxim "One cannot clarify his aspirations without indifference to fame and fortune, nor reach distant goals without inner peace" [3]. Yue Fei's handwritten Memorial to the Late Emperor integrates Zhuge Liang's loyalty to the nation with his own patriotic feelings, expanding the connotation of aesthetic education through character meanings and guiding students to cultivate a positive temperament. Calligraphic creation consciously avoids vulgar and negative phrases and pursues elegant, inspirational texts to exert the educational value embedded in characters.

2.2.3. The associative beauty of textual artistic conception refers to the associative aesthetic feeling endowed to calligraphy by its written texts and historical backgrounds

The famous poems and essays copied in calligraphy mostly contain profound life philosophies, patriotic sentiments, and spiritual pursuits, making them high-quality materials for university aesthetic education. For instance, Wang Bo's line "Old yet vigorous, never shift one's lofty aspirations even in old age; poor yet steadfast, never abandon noble ideals" inspires uplifting spiritual beauty; Fan Zhongyan's motto "Be the first to worry about the nation's woes and the last to share its joys" embodies noble moral character rooted in patriotism and concern for the people; Lu Xun's verse "Fierce-browed, I coldly face thousands of pointing

fingers; head bowed, I willingly serve the people like an ox" reveals his devotion to the masses; Zhou Enlai's poem "I meditate ten years to break through barriers; should my aspirations fail, drowning myself for the nation still makes me a hero" expresses lofty ideals. In short, philosophical verses written by the original authors of calligraphic texts always bring diverse enlightenment to readers. At this moment, viewers value not merely the external formal beauty of calligraphy, but also its inner spiritual charm. As one scholar states: "Written texts set the keynote of works and build a bond between creators and their art." [4]. When universities guide students to appreciate and create calligraphic works, students can perceive the spiritual power behind texts across time and space, realizing the in-depth integration of aesthetic experience and value shaping. From my perspective, this is the key to improving the quality and efficiency of university calligraphic aesthetic education for inheriting the fine traditional Chinese culture.

2.2.4. The associative beauty of phonology refers to the auditory associative beauty derived from the phonological rhythm of Chinese characters in calligraphy

The unique monosyllabic feature and tonal cadence of Chinese characters constitute an aesthetic advantage unavailable in Western alphabetic scripts. The phonetic charm brought by Chinese syllables in calligraphy is an additional aesthetic layer generated by character pronunciation, which can be fully reflected in calligraphic copies of Chinese poems and prose. In other words, texts selected for calligraphic works often carry rhythmic phonetic beauty. For instance, poems and couplets used for calligraphy follow Chinese tonal rules of level and oblique tones. The alternation of tones endows Chinese syllables with musicality and further strengthens auditory aesthetic perception, a unique feature that no other writing system around the world possesses. Even when calligraphers compose original texts for their works, they will consciously or unconsciously arrange content according to Chinese tonal patterns. Most contemporary calligraphers take famous poems as major creation materials. In recent years, many teachers have integrated poetry and calligraphy into classroom teaching, which is well received by students and brings forth a new educational insight: "The integrated beauty of poetry and calligraphy manifests as humanistic beauty, human nature beauty and integrated beauty" [5]. The remarkable effectiveness of integrated poetry-calligraphy teaching lies in the full combination of the external visual beauty of calligraphy and the phonetic rhythmic beauty of written texts. In addition, numerous couplets written by master calligraphers are preserved in ancient sites and temples across China. The content of these couplets matches the surrounding scenery and forms an integral part of these scenic spots. Obviously, such calligraphy relies on the tonal rhythm of couplets that conforms to tonal regulations. Visitors can easily perceive the phonetic harmony between upper and lower couplets during appreciation, which explains why couplets are widely displayed in tourist architecture all over China. When universities guide students to recite, appreciate, and copy such calligraphic works, students can perceive both the visual beauty of brush and ink and the phonological beauty of characters. This realizes audio-visual interaction and multi-dimensional edification in aesthetic education, effectively enriching students' ability to perceive the fine traditional Chinese culture from diverse aesthetic perspectives.

In general, the associative beauty of calligraphy is essentially an aesthetic projection of values. The aesthetic appreciation of traditional Chinese calligraphy never merely judges brushwork techniques; instead, it forms a comprehensive aesthetic system integrating morality, fine traditional Chinese culture, philosophy, and personal character, which is highly consistent with the core goal of university aesthetic education — "cultivate people with culture and nurture souls with aesthetics."

3. Existing problems of university aesthetic education classrooms from the dual aesthetic perspective of calligraphy

At present, university calligraphic aesthetic education classrooms generally suffer from separation and imbalance between visual beauty and associative beauty, failing to give full play to the educational value of the dual aesthetic system of calligraphy, which is mainly reflected in the following three aspects.

3.1. Overemphasis on technical training and neglect of humanistic edification leads to superficial aesthetic education

Most university calligraphy courses center on copying, brush control, and character structure training. They excessively pursue neat character shapes and standard brush strokes, one-sidedly focus on training students in the visual beauty of calligraphy, and ignore teaching on humanistic connotations, moral cultivation, and cultural philosophy contained in associative beauty. Students only master handwriting skills without understanding the cultural spirit behind calligraphy, resulting in an educational defect of "being able to write yet unable to appreciate art or grasp the fine traditional Chinese culture." Consequently, the educational value of aesthetic education can hardly be realized.

3.2. Insufficient innovation in aesthetic teaching results in rigid and monotonous classroom forms

Restricted by traditional teaching mindsets, some teachers hold the view that calligraphy, after thousands of years of development, has reached its peak with little room for innovation and breakthrough. Consequently, they stick to conventional teaching patterns and lack modernoriented, liferelated, and youthfriendly teaching innovations. Meanwhile, the calligraphy circle is plagued by problematic trends such as "ugly calligraphy," "bizarre calligraphy," and "unregulated folkstyle calligraphy." These works onesidedly pursue sensational visual effects to seek attention, deviate from orthodox calligraphic aesthetics, mislead students' aesthetic cognition, and undermine the unity between the visual beauty and humanistic beauty of calligraphy.

3.3. Utilitarian tendencies among some educational practitioners weaken the value-guiding role of aesthetic education

A small number of calligraphy educators are eager for quick success, prioritizing fame and fortune over self-cultivation. They one-sidedly pursue commercialized and performative creation while neglecting personal moral cultivation and cultural accumulation of the fine traditional Chinese culture. Their calligraphic creations are divorced from the spiritual core, leading to a severe lack of associative beauty in works and the problem of "exquisite handwriting paired with shallow moral character, and disconnection between artistic skill and moral integrity." This is unfavorable for guiding college students to establish correct outlooks on art, aesthetics, and values.

4. Practical paths for university calligraphic aesthetic education classrooms from the integrated dual aesthetic perspective

Based on the aesthetic law of the dialectical unity between the visual beauty and associative beauty of calligraphy, university calligraphic aesthetic education classrooms should break the single skill-oriented teaching mode, build an integrated education system featuring "foundation-building via visual aesthetics,

quality enhancement via associative aesthetics, and integration of morality and art," and achieve the in-depth integration of technical aesthetic training, aesthetic appreciation cultivation and humanistic edification.

4.1. Consolidate the foundation of visual aesthetic education and build a systematic technical training system

Visual beauty forms the foundation of calligraphic aesthetic education. University classrooms should establish a scientific and systematic technical teaching system and carry out tiered teaching across three core dimensions: strokes, character structures, and overall layout. At the elementary stage, brush control training is intensified to guide students to perceive the aesthetic differences in stroke thickness, rigidity, softness, dryness, and moistness. At the intermediate stage, teaching focuses on the structural rules of Chinese characters, enabling students to master the modeling principles of density, primary-secondary hierarchy, and the balance between slanted and upright forms. At the advanced stage, emphasis is placed on compositional layout to cultivate students' holistic aesthetic awareness and layout design ability. Meanwhile, students copy classic orthodox stele calligraphy models to develop a standardized, sound, and elegant aesthetic cognition rooted in traditional calligraphy, resist the misleading vulgar aesthetics of "ugly calligraphy" and "bizarre calligraphy," and consolidate their foundational visual aesthetic competence.

4.2. Delve deep into the connotations of associative aesthetic education and realize humanistic spiritual edification

The four dimensions of calligraphic associative beauty shall be fully integrated into classroom teaching to elevate aesthetic education from formal "form appreciation" to profound "spiritual perception." First, moral stories of master calligraphers are introduced. Combined with the deeds of virtuous and skilled calligraphers such as Wang Xizhi, Yan Zhenqing, and Qi Gong, personality-oriented aesthetic education is carried out to guide students to cultivate noble character. Second, the semantic connotations of Chinese characters are interpreted. Integrated with traditional values of benevolence, righteousness, propriety, and trust, as well as concepts of self-cultivation and self-motivation, students perceive the philosophies of fine traditional Chinese culture through writing practice. Third, the backgrounds of classic poems and essays are appreciated to explore the patriotic sentiments, striving spirit, and broad life vision behind the texts, realizing cultural edification. Fourth, integrated poetry-calligraphy teaching is strengthened. Through reciting verses with tonal cadence, visual and auditory aesthetics are combined to enrich the forms of classroom aesthetic education. Students can achieve aesthetic improvement and value shaping through writing, appreciation, and reflection.

4.3. Innovate classroom teaching modes and promote the modern transformation of traditional aesthetic education

The traditional single copying teaching mode is replaced by a four-in-one teaching model integrating appreciation, copying, creation, and reflection. Before class, students appreciate works by master calligraphers to perceive the charm of dual aesthetics. During class, targeted technical training is carried out to consolidate the foundation of visual aesthetics. After class, students are encouraged to conduct independent creation themed on inspiration, patriotism, and fine traditional Chinese culture, integrating humanistic associative beauty into creative practice. Meanwhile, new media technologies including short videos, digital exhibition halls, and online appreciation platforms are utilized to enrich classroom carriers, enabling traditional calligraphic aesthetic education to adapt to the learning habits and aesthetic demands of

contemporary college students.

4.4. Attach equal importance to morality and art and establish correct evaluation guidance for aesthetic education

A diversified aesthetic education evaluation system integrating technical aesthetics, humanistic literacy, creative thinking, and moral cognition shall be established, replacing the single evaluation mode that only judges the quality of character forms. The evaluation assesses not only students' writing techniques and visual modeling ability, but also their understanding of the humanistic connotations of calligraphy, the spirit of master calligraphers, and cultural philosophies. It guides students to deeply recognize the aesthetic principle that "calligraphy style reflects moral character," consciously abandon utilitarian and vulgar artistic perceptions, and cultivate aesthetic competence featuring both moral and artistic excellence, as well as unity of knowledge and practice.

In conclusion, "The synchronous evolution of the aesthetic thinking of Chinese characters and their writing forms is the driving force for the continuous development of the art of Chinese character writing" [6]. "The status of calligraphy as an art form is inseparable from the moral character and cultural mentality of calligraphers" [7]. The visual beauty of calligraphy serves as the formal foundation of calligraphic proficiency, defining the aesthetic backdrop of the art of calligraphy. By contrast, the associative beauty of calligraphy acts as the spiritual core for elevating calligraphic competence and determines the value height of calligraphy-based education. The two form an organic whole that is mutually reinforcing and inseparable. Given that China has long applied the dual criterion of "integrating moral integrity with competence" to evaluate individuals' merits and demerits, and even to judge the quality of artistic works, the dual dimensions of visual beauty and associative beauty require university aesthetic education classrooms to be rooted in the dual aesthetic system and break the teaching dilemma of disconnection between technical training and humanistic cultivation. On one hand, visual beauty consolidates students' artistic foundation, teaches them to uphold the basic spirit of calligraphic innovation, and guides them to produce innovative works. On the other hand, associative beauty nurtures students' spiritual character, teaches them to value the cultivation of personal morality, enhances their personal charisma, and strives for the realm of both moral and artistic excellence with a pragmatic approach of unity of knowledge and practice. The author holds that by continuously advancing the in-depth integration of traditional Chinese calligraphy culture into university aesthetic education, and adopting scientific classroom practice paths to guide college students to inherit the fine traditional Chinese culture, improve aesthetic literacy and foster patriotic sentiments through hands-on calligraphy practice, educators can truly achieve the fundamental goal of university aesthetic education: educating people with aesthetics, cultivating people with culture, and nourishing hearts with morality.

Disclosure statement

The author declares no conflict of interest.

References

[1] Li G, 2021, Analysis on the Construction of the Overall Aesthetic System of Calligraphy. World of Painting and Calligraphy, 2021(5): 45–47.

[2] Wang ZQ, 2019, Moral Character and Calligraphy Style: Analysis of the Aesthetic Ethical Dimension of Chinese Calligraphy. Calligraphy Appreciation and Review, 2022(3): 12–15.

[3] Zhuge L, 2019, Admonition to My Son. Zhonghua Book Company, Shanghai.

[4] Liu F, 2023, Interpretation of the Aesthetic Education Value of Calligraphy Text Content. Art Education, 2023(2): 78–81.

[5] Chen L, 2022, Innovation of Calligraphy Aesthetic Education Teaching from the Perspective of the Integration of Poetry and Calligraphy. Popular Literature and Art, 2022(12): 190–191.

[6] Ma M, 2022, Research on Chinese Character Aesthetic Thinking and the Evolution of Calligraphy Art. Chinese Character Culture, 2022(18): 56–58.

[7] Lin C, 2023, Analysis on the Relationship Between Calligraphers' Character Accomplishment and the Development of Calligraphy Art. Art Evaluation, 2023(4): 34–36.

Publisher's note

Bio-Byword Scientific Publishing remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

International Education Forum, 2026, Volume 4, Issue 8
http://ojs.bbwpublisher.com/index.php/IEF
Online ISSN: 2981-8605
Print ISSN: 3083-4902

AI-Empowered "Job-Course-Competition-Certificate" Integrated "Four-Dimensional Integration and Five-Stage Progression" Teaching Model Research for Higher Vocational Engineering Courses

Qianxiu Zou*

Chongqing Energy College, Chongqing 402260, China

****Author to whom correspondence should be addressed.***

Copyright: © 2026 Author(s). This is an open-access article distributed under the terms of the Creative Commons Attribution License (CC BY 4.0), permitting distribution and reproduction in any medium, provided the original work is cited.

Abstract: Driven by the dual forces of digital transformation in vocational education and the rapid advancement of artificial intelligence technologies, the integrated "Job-Course-Competition-Certificate" (JCCC) education model has become a central direction for higher vocational education reform. However, current higher vocational engineering courses generally face three practical dilemmas: disconnection between teaching content and job requirements, fragmented application of AI technologies, and a monolithic evaluation system. Grounded in constructivist learning theory and industry-education integration theory, this study takes engineering courses in the Cost Engineering major as its practical context and constructs an AI-empowered teaching model based on the "Four-Dimensional Integration and Five-Stage Progression" framework. The model restructures teaching content through the four-dimensional integration of job requirements, course content, competition standards, and certificate criteria alongside AI technologies, optimizes the teaching process through the five progressive stages of context creation, task-driven learning, application-driven learning, practical drill, and outcome presentation, and leverages AI tools such as DeepSeek to enable whole-process empowerment encompassing learning diagnosis, resource generation, and intelligent evaluation. Practical implementation demonstrates that this model effectively enhances students' learning initiative, improves job competency, and increases certificate pass rates, providing a replicable practical paradigm for the intelligent teaching reform of higher vocational engineering courses.

Keywords: AI empowerment; Job-Course-Competition-Certificate integration; Higher vocational engineering courses; Four-Dimensional Integration and Five-Stage Progression; Teaching model innovation

Online publication: August 31, 2026

1. Problem statement

With the successive introduction of policies such as the Opinions on Deepening the Reform of the Modern Vocational Education System and the Vocational Education Digitalization Action Plan (2024–2026), the integrated "Job-Course-Competition-Certificate" education model has become a core direction for vocational education reform. In 2025, the Chongqing Municipal Education Commission issued the Notice on Accelerating the Advancement of "Artificial Intelligence+" to Enhance the Key Educational Capabilities of Vocational Colleges, requiring all vocational institutions to "introduce domestically developed artificial intelligence software and models into core professional courses and accelerate the formation of an 'artificial intelligence+' curriculum system." Against this policy background, how to deeply integrate artificial intelligence technologies into the JCCC teaching practice has become an urgent issue for higher vocational education.

Current higher vocational engineering courses face three structural contradictions. First, the disconnection of JCCC elements—course content is significantly detached from actual job requirements, skill competition standards, and professional certificate criteria, resulting in a mismatch between talent cultivation and industry needs. Second, fragmented AI application—the use of artificial intelligence in teaching mostly remains at the level of instrumental assistance in isolated segments, failing to achieve deep integration throughout the entire teaching workflow. Third, a monolithic evaluation system—excessive reliance on summative assessment, lacking comprehensive evaluation of students' professional competencies, process performance, and literacy development. For engineering courses in particular, the traditional "teacher demonstration—student imitation" teaching model can no longer meet the new demands of enterprises for composite technical talents in the context of intelligent construction. Therefore, there is an urgent need to construct a systematic teaching model that deeply embeds AI technologies throughout the entire JCCC integration process.

2. Theoretical foundations and literature review

2.1. Theoretical framework

The theoretical foundation of this study rests on two pillars. Constructivist learning theory emphasizes that knowledge is actively constructed through collaboration and reflection in authentic contexts, requiring instructional design to create problem scenarios that approximate real work environments and guide students to complete knowledge construction while solving practical problems. Industry-education integration theory advocates the construction of a "demand—teaching—feedback" dynamic closed loop, achieving precise alignment and synchronous iteration between educational supply and industry demand. The intersection of these two theories lies in: taking real industrial problems as the starting point of learning contexts, using AI technologies as mediators for contextualized transformation and personalized support, and forming a "problem-driven → AI-enhanced transformation → competency feedback to industry" bidirectional empowerment logic.

2.2. Research progress on JCCC integration

Since the JCCC comprehensive education model was proposed at the 2021 National Vocational Education Conference, substantial research has accumulated. Zhang Huiqing et al. [1] systematically analyzed the practical problems and implementation pathways of the integrated JCCC education model. In the field

of civil engineering, researchers have constructed a "four-in-one" talent cultivation model by restructuring curriculum systems, deepening school-enterprise collaboration, strengthening skill competitions, and aligning with professional certificates, using Cost Engineering as a case study [2]. Studies on blueprint reading courses indicate that JCCC integration can effectively enhance teaching effectiveness [3]. In the area of practical training reform for Cost Engineering, scholars have proposed reform pathways such as "restructuring the curriculum based on job positions, using competitions to stimulate teaching innovation, and integrating certificates to enhance value anchoring" [4]. Deng Wei et al. systematically elaborated on the specific implementation methods of the "Four Integrations, Five Progressions, Three Co-Educations" teaching model using relevant courses as examples, including teaching content restructuring, virtual experimental environment setup, and project-based practical task design, providing important methodological references for this study [5–9]. However, existing research predominantly focuses on curriculum content reorganization and teaching method improvement, with few studies incorporating AI technologies as a systematic variable in the design of JCCC-integrated teaching models.

2.3. Research status of AI-empowered teaching

In recent years, research on AI-empowered vocational education has gradually deepened. Lü Mingzhu proposed a "virtual simulation + cloud classroom" JCCC-integrated teaching model, introducing virtual simulation technology to construct training environments and leveraging cloud classrooms to achieve integrated alignment of jobs, courses, competitions, and certificates, while optimizing teaching resources and dynamically adjusting teaching strategies through AI technologies [5]. Gui Fang et al. systematically discussed how digital-intelligent integration can empower JCCC education from three dimensions: theoretical logic, coupling mechanisms, and practical pathways [6]. Zhao Ye constructed an AI-driven JCCC-integrated evaluation system, developing evaluation indicators across four dimensions: job competency, course learning ability, competition innovation capacity, and certificate recognition [7]. Shen Min et al. constructed a "Three Co-Educations, Four Integrations, Five Progressions" industry-education integration teaching model for vocational education based on Outcomes-Based Education (OBE) theory [10]. In the field of engineering courses, Zhang Yutao et al. proposed specific measures for civil engineering testing courses, including reconstructing the curriculum system oriented by job competencies, constructing an integrated teaching model of courses, competitions, and certificates, and deepening the school-enterprise dual education mechanism [11–12]. Xu Jiansu explored the "Three Uses," "Four Integrations," and "Five Progressions" classroom revolution pathway in law courses [11]. Yi Wenjuan validated the feasibility of AI-empowered JCCC-integrated curriculum reform in the Corporate Finance course [13]. However, research on systematically integrating AI technologies with JCCC remains relatively scarce. Existing studies tend to focus either on AI technology applications or on JCCC integration, lacking systematic model construction that deeply integrates both throughout the entire teaching process.

2.4. Gaps in existing research and the entry point of this study

In summary, existing research has three major limitations [1–7, 10–13]: first, research on JCCC integration and AI empowerment has largely progressed along separate tracks, lacking a systematic framework for deep integration; second, relevant studies on engineering courses rarely design AI technologies as an empowering variable throughout the entire teaching process; and third, existing teaching models are mostly at the level of

conceptual advocacy, lacking actionable and replicable practical pathways. This study addresses these gaps by taking courses in the Cost Engineering major as the practical context, exploring a systematic teaching model for AI-empowered JCCC integration.

3. Construction of the "Four-Dimensional Integration and Five-Stage Progression" AI-Empowered teaching model

3.1. Logical starting point of model design

The design of this model follows the basic logic of "industry demand anchoring → AI technology embedding → teaching process reconstruction." First, it starts with the actual job competency requirements of the intelligent construction industry to identify the core competencies that engineering courses should cultivate. Second, it uses domestic AI large language models such as DeepSeek as the technological foundation to achieve intelligent parsing of industry technical documents, precise diagnosis of learning data, and dynamic generation of teaching resources. Finally, it restructures teaching content through the "Four-Dimensional Integration" and optimizes the teaching process through the "Five-Stage Progression," forming a closed-loop system integrating "objectives—content—process—evaluation."

3.2. The "Four-Dimensional Integration": Four-dimensional restructuring of teaching content

The "Four-Dimensional Integration" refers to the organic integration of four dimensions—job requirements, competition standards, certificate criteria, and AI technologies—into the teaching content, achieving its restructuring and upgrading.

First, integration with job requirements. Using the actual workflow of Cost Engineering positions as the organizing thread, real enterprise projects are transformed into course-based teaching cases, allowing students to encounter authentic work tasks in the classroom.

Second, integration with competition standards. The requirements of vocational college skill competitions are transformed into classroom practical training tasks, using competition standards to drive the enhancement of teaching standards.

Third, integration with certificate criteria. The assessment points of vocational skill level certificates are aligned with and embedded into the knowledge modules and skill training sessions of the course.

Fourth, integration with AI technologies. AI tools such as DeepSeek are introduced to achieve empowerment at three levels: at the lesson preparation stage, AI analyzes student learning data to generate personalized teaching needs reports; at the teaching stage, AI parses enterprise technical documents to automatically generate contextualized teaching cases and differentiated exercises; at the evaluation stage, AI integrates multi-source data to generate student learning profiles and competency diagnosis reports.

3.3. The "Five-Stage Progression": Five-stage optimization of the teaching process

The "Five-Stage Progression" refers to the design of the teaching process into five progressive stages: context creation → task-driven learning → application-driven learning → practical drill → outcome presentation, following the cognitive pattern of "action—questioning—thinking—learning—comprehension" of higher vocational students and the professional competency development pattern of "novice—beginner—competent—expert—master."

Stage 1: Context Creation. Teachers use AI-generated or extracted authentic engineering scenarios from the enterprise case library, presented through virtual simulation technology or multimedia means, to stimulate students' learning interest and problem awareness.

Stage 2: Task-Driven Learning. The industrial problems in the context are transformed into specific, actionable learning tasks, with task difficulty following a progressive logic from simple to complex and from singular to comprehensive.

Stage 3: Application-Driven Learning. As students encounter knowledge obstacles during task completion, they learn "on demand"—acquiring knowledge and practicing skills precisely when needed. Teachers monitor students' difficulties in real-time using AI learning analytics tools to provide targeted guidance.

Stage 4: Practical Drill. Students complete comprehensive engineering tasks in groups within CAD or BIM software environments, experiencing the entire process from drawing reading and modeling to quantity calculation. Enterprise mentors can participate in guidance and commentary through online platforms.

Stage 5: Outcome Presentation. Each group presents their task outcomes, receiving multi-party evaluations from teachers, peers, and enterprise mentors. The AI system concurrently generates process-based learning data reports to provide data support for student competency profiling.

3.4. Embedding of AI tools throughout the entire teaching process

In this model, AI embedding is not a scattered "decoration" but a systematic empowerment running through the entire "teaching-learning-evaluation" process. At the instructional design stage, DeepSeek analyzes students' prior course performance and learning behavior data to generate class learning profiles and tiered teaching objectives. At the resource development stage, AI parses enterprise technical documents and engineering drawings, automatically extracting key knowledge points to generate contextualized teaching cases, differentiated exercises, and micro-lecture scripts. At the classroom teaching stage, AI collects students' classroom interaction data, practical operation data, and in-class quiz data in real time, dynamically generating learning heat maps to assist teachers in adjusting teaching strategies. At the after-class tutoring stage, AI pushes personalized learning resources and targeted exercises based on each student's weak knowledge points. At the evaluation feedback stage, AI integrates process-based data (classroom performance, practical training records), outcome-based data (work quality, test scores), and external data (enterprise evaluations, certificate acquisition) to generate multidimensional competency radar charts.

4. Practical pathways and implementation strategies

4.1. Restructuring of course content

Course content is restructured according to the "Four-Dimensional Integration" philosophy. The restructured course content is divided into three modules: the foundational module covers drafting standards and projection principles, aligned with the basic knowledge points of professional certificates; the advanced module uses typical engineering cases as carriers, covering the reading and drafting of construction drawings, aligned with core job competencies and competition requirements; the comprehensive module relies on real engineering projects, covering the entire process from drawing reading to BIM modeling, incorporating cutting-edge AI-assisted design technologies.

4.2. Teaching implementation process

The "Five-Stage Progression" process is strictly followed in teaching implementation. Taking the teaching unit of "reading reinforcement detailing drawings and calculating reinforcement quantities" as an example: at the context creation stage, teachers use AI to generate construction drawings of actual projects and play on-site construction videos to help students establish spatial concepts; at the task-driven stage, teachers assign the learning task of "reading the reinforcement detailing drawings and calculating reinforcement quantities"; at the application-driven learning stage, when students encounter knowledge obstacles such as detailing rules and structural requirements during the reading and calculation process, teachers provide targeted explanations; at the practical drill stage, students complete the construction drawing drafting and reinforcement quantity calculation in software; at the outcome presentation stage, each group presents their outcomes, receiving joint feedback from teachers and enterprise mentors.

4.3. Construction of diversified evaluation

This model constructs a three-dimensional evaluation system encompassing "process-oriented evaluation + outcome-oriented evaluation + value-added evaluation." Process-oriented evaluation relies on the AI platform to record students' classroom participation, practical operation procedures, and group collaboration performance. Outcome-oriented evaluation includes work quality, test scores, and certificate acquisition status. Value-added evaluation focuses on individual students' progress across the dimensions of knowledge, skills, and competencies, embodying the philosophy of "assessing progress rather than absolute performance." Evaluation data from all three dimensions are integrated through the AI system to generate individualized competency development radar charts and personalized learning recommendations.

5. Practical outcomes and reflection

5.1. Preliminary practical outcomes

This model was piloted in the Cost Engineering major at a higher vocational institution in Chongqing. After one semester of teaching practice, the experimental class demonstrated significant improvements in the following areas: learning initiative was notably enhanced, with substantial increases in both pre-class preparation completion rates and classroom interaction participation rates; skill mastery was more solid, with experimental class average scores significantly higher than the control class on the final practical assessment; certificate pass rates improved markedly, with the experimental class's first-attempt pass rate for vocational skill level certificate examinations significantly exceeding that of the control class; and job adaptability was strengthened, with enterprise mentors reporting high satisfaction levels with experimental class students on core competency indicators.

5.2. Problems and reflection

Several issues emerged during the practical implementation. First, varying levels of teacher digital literacy—some teachers were not sufficiently proficient in operating AI tools, limiting the full realization of AI empowerment effects. Second, quality control of AI-generated content—AI-generated teaching cases occasionally lacked precision in professional details, requiring manual review and correction by subject matter experts. Third, barriers to school-enterprise data flow—obtaining and de-identifying enterprise technical documents still presents obstacles, constraining the frequency of updating industry cases.

These issues need to be gradually addressed in subsequent research through enhanced teacher training, establishment of AI content review mechanisms, and deepening of school-enterprise data cooperation.

6. Conclusion and prospects

This study takes courses in the Cost Engineering major as the practical context and constructs a "Four-Dimensional Integration and Five-Stage Progression" teaching model for AI-empowered JCCC integration. The theoretical contributions of this model are twofold: it organically integrates constructivist learning theory and industry-education integration theory, forming a "problem-driven → AI-enhanced transformation → competency feedback to industry" bidirectional empowerment logical framework; and it elevates AI technologies from "teaching aids" to "structural variables of the teaching model," achieving systematic AI embedding throughout the entire teaching process. The practical value of this model lies in: restructuring teaching content through the "Four-Dimensional Integration," optimizing the teaching process through the "Five-Stage Progression," and achieving precise instruction and personalized learning through AI empowerment, providing an actionable and replicable practical paradigm for the intelligent teaching reform of higher vocational engineering courses.

Looking ahead, future research will deepen in the following directions: first, expanding the scope of practice to validate the model's effectiveness across more engineering courses; second, deepening the level of AI application by exploring more advanced applications such as intelligent Q&A, automated item generation, and AI-assisted grading based on large language models; third, refining the evaluation system by further specifying AI-driven competency diagnosis models and personalized learning pathway recommendation algorithms; fourth, establishing school-enterprise data sharing mechanisms to break down data barriers between industry and education, enabling dynamic updates of teaching content and co-evolution of the industry-education ecosystem.

Funding

China Private Education Association Planning Project, "Research on the Integrated Talent Development Model of 'Post–Course–Competition–Certificate' for Engineering Majors in Higher Vocational Education: A Case Study of the Engineering Cost Management Major" (Project No. CANQN250487); Chongqing Energy College of Vocational Studies Educational Science Planning Project, "Research on an Intelligent Teaching System for Engineering Foundation Courses Driven by Industry Problems" (Project No. JYGH202506).

Disclosure statement

The author declares no conflict of interest.

References

[1] Zhang HQ, Wang HY, Liu X, 2021, Practical Problems and Implementation Pathways of the Integrated "Job-Course-Competition-Certificate" Education Model in Higher Vocational Colleges. Education and Vocation, 2021(21): 27–34.

[2] Liao SL, Zhao YF, 2025, Exploration and Practice of the "Job-Course-Competition-Certificate" Integrated Talent Cultivation Model for Civil Engineering Majors. Industrial Innovation Research, 2025(24): 190–192.

[3] Gong YL, Zhang B, 2024, Exploration and Practice of the "Job-Course-Competition-Certificate" Integrated Education Model in Curriculum Reform: A Case Study of Architectural Drawing and CAD Course. Theory and Practice of Innovation and Entrepreneurship, 2024(8): 154–156.

[4] Fu T, 2025, Reform Exploration of Practical Training Courses for Cost Engineering Majors under the "Job-Course-Competition-Certificate" Integration: A Case Study of "Plain Method Drawing Reading and Reinforcement Quantity Calculation". Science and Education Guide, 2025(8): 88–90.

[5] Lü MZ, 2026, "Job-Course-Competition-Certificate" Integrated Teaching: AI Empowering the Tripartite Collaborative Lifelong Learning Ecosystem. Vocational Technology, 25(3): 59–65.

[6] Gui F, Xie F, Fang XY, et al., 2026, Digital-Intelligent Integration Empowering "Job-Course-Competition-Certificate" Integrated Education in Higher Vocational Colleges: Theoretical Logic, Coupling Mechanisms, and Practical Pathways. Higher Education Exploration, 2026(5): 95–100.

[7] Zhao Y, 2026, Design of an AI-Driven "Job-Course-Competition-Certificate" Integrated Evaluation System for Finance and Economics in Higher Vocational Education. Guangdong Vocational and Technical Education and Research, 2026(2): 171–174.

[8] Deng W, Gao JH, Hong XJ, et al., 2025, Exploration and Practice of "Classroom Revolution" in Higher Vocational Computer Education from the Perspective of the "Four Integrations, Five Progressions, Three Co-Educations" Teaching Model: A Case Study of Linux Operating System. Theory and Practice of Innovation and Entrepreneurship, 8(2): 16–18.

[9] Deng W, Gao JH, Hong XJ, et al., 2024, Classroom Teaching Practice in Higher Vocational Education under the "Four Integrations, Five Progressions, Three Co-Educations" Model. Journal of Shandong Electric Power College, 27(5): 47–50.

[10] Shen M, Zhang XH, 2025, Exploration of the "Three Co-Educations, Four Integrations, Five Progressions" Industry-Education Integration Teaching Model in Vocational Education. Equipment Manufacturing Technology, 2025(3): 75–78.

[11] Xu JS, 2023, Exploration and Practice of "Classroom Revolution" in the Civil Law Course of Higher Vocational Law Education: Creating "Useful Classrooms" through "Three Uses," "Four Integrations," and "Five Progressions." Legal Exposition, 2023(13): 160–162.

[12] Zhang YT, Guo ZP, 2025, Exploration of "Job-Course-Competition-Certificate" Integrated Teaching Reform in Civil Engineering Testing Courses. Educational Observation, 14(25): 53–55.

[13] Yi WJ, 2025, AI-Empowered "Job-Course-Competition-Certificate" Integrated Curriculum Reform and Practice from the Perspective of Corporate Finance. Standard Living, 2025(6): 116–118.

Publisher's note

Bio-Byword Scientific Publishing remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

International Education Forum, 2026, Volume 4, Issue 8
http://ojs.bbwpublisher.com/index.php/IEF
Online ISSN: 2981-8605
Print ISSN: 3083-4902

Undergraduate Learning Ability and Career Cognition in Emerging Engineering Fields: A Systematic Review

Bowen Cheng, Qiumiao Liang

Shenzhen Polytechnic University, Shenzhen 518000, Guangdong, China

Copyright: © 2026 Author(s). This is an open-access article distributed under the terms of the Creative Commons Attribution License (CC BY 4.0), permitting distribution and reproduction in any medium, provided the original work is cited.

Abstract: Against the backdrop of new-quality productivity driving rapid iteration in emerging industries, the interdisciplinary integration and swift technological advancement characteristic of new engineering fields have set higher standards for undergraduate students' learning capabilities and career awareness. This paper systematically reviews relevant research findings, focusing on the current status of core learning competencies and career cognition among undergraduate students in new engineering disciplines. The paper conducts an in-depth analysis of structural issues in talent development and clarifies the intrinsic bidirectional relationship between these two aspects. The study reveals that students commonly face rigid learning patterns, deficiencies in higher-order skills, fragmented career understanding, and weak alignment in career planning—factors that mutually constrain each other and result in suboptimal talent development outcomes. To address these challenges, this paper proposes improvement measures from three dimensions: competency cultivation, cognitive development, and industry-education collaboration, offering insights for reforming undergraduate education in new engineering fields and enhancing the alignment between talent development and industrial needs.

Keywords: Emerging engineering fields; Undergraduate students; Learning ability; Career cognition; Talent cultivation

Online publication: August 31, 2026

1. Introduction

With new-quality productivity empowering industrial transformation, emerging engineering industries including artificial intelligence, integrated circuits, low-altitude technology, and new energy have achieved rapid development, which has completely reshaped the job structure, technical standards, and talent requirement system of the engineering community. Different from the standardized and fixed talent demand of traditional engineering disciplines, emerging engineering industries attach greater importance to candidates' cross-boundary learning, dynamic adaptation, innovative practice, and sustainable career development capabilities, which brings disruptive challenges to the cultivation of undergraduate talents in

emerging engineering programs in colleges and universities. As the main component of the reserve talent for emerging industries, undergraduates' learning ability determines the updating and matching speed of knowledge and technology, while their career cognition affects employment choice, the pace of career development, and job retention. At present, there are a growing number of academic studies on the learning ability and career cognition of engineering students, but most of them focus on isolated research on a single major or a single aspect, and no systematic analysis has been conducted on these two fundamental competencies of undergraduates in the emerging engineering field. Based on the relevant academic research outcomes over the past decade, this paper summarizes the development status and existing problems of emerging engineering undergraduates' learning ability and career cognition, as well as the interaction between the two dimensions, accurately aligns with the employment demand of emerging industries, proposes approaches for the synergistic improvement of the two competencies, and promotes the formation of an interactive synergistic development pattern between vocational education and the development of new emerging industries.

2. Current status and shortcomings of core learning competencies of undergraduate students in emerging engineering fields

2.1. Basic learning competencies meet standards while high-order integrative capabilities are weak

At the current stage, most undergraduate students in emerging engineering disciplines possess solid theoretical foundations and are capable of completing basic learning tasks such as in-class knowledge memorization, application of fundamental formulas, and routine experimental operations, which satisfies the basic academic requirements for undergraduate studies. However, from the perspective of industrial adaptability, students have obvious deficiencies in high-level learning capabilities, which are mainly manifested as the lack of systematic mastery of knowledge points and insufficient interdisciplinary comprehensive application capabilities. Most emerging engineering technologies are products of interdisciplinary integration, covering multiple fields including mechanics, electronics, information technology, and materials science. Nevertheless, the majority of students still study in accordance with the traditional siloed teaching and isolated knowledge acquisition mode in science and engineering, leading to severe disciplinary segmentation. As a result, they are unable to integrate basic mathematical and physical knowledge, professional technologies, and practical engineering scenarios [1]. Relevant studies indicate that only approximately 30% of engineering undergraduates can quickly adapt to technological updates in enterprises, while most students apply knowledge in a rigid manner and cannot rely on their acquired knowledge to solve complex and open-ended emerging engineering problems. The main causes of this issue are the lack of critical thinking and systematic knowledge integration capabilities. Furthermore, with the rapid development of new technologies, students have poor capabilities for independent knowledge updating, retain a strong habit of passively accepting knowledge in classrooms, and cannot keep up with the latest industrial technologies and the development requirements of new quality productive forces.

2.2. Formalized practical learning with insufficient innovation and adaptation capabilities

Practical learning constitutes a critical link in the cultivation of core competencies for undergraduate students

majoring in emerging engineering disciplines. However, the current practical teaching system in Chinese universities remains underdeveloped, which leads to unsatisfactory practical learning outcomes for students. Most existing practical courses are dominated by simulated training and fixed-procedure experiments, while the proportion of comprehensive and innovative practical content that is closely aligned with real job scenarios and cutting-edge technology applications in emerging industries is relatively low [2]. The majority of students engage in practical learning merely to fulfill academic requirements, lacking the awareness of active exploration and innovative trial and error; thus, their practical operation capabilities, scheme optimization capabilities, and system integration capabilities are relatively weak. Positions in the emerging engineering industry require talents to possess full-chain practical capabilities from theory to product development, and to be competent for the entire workflow, including demand demonstration, scheme design, debugging, and optimization. Nevertheless, most undergraduate students only master scattered practical skills, fail to form systematic engineering practice thinking, and cannot meet the requirements of interdisciplinary positions in emerging industries. In addition, students' digital learning capabilities and intelligent technology application capabilities are uneven, and their mastery of emerging tools such as artificial intelligence, simulation design, and system control is insufficient, which leads to a mismatch between students' learning capabilities and industrial demands [3].

3. Characteristics and major problems of undergraduates' career cognition development in emerging engineering fields

3.1. Shallow career identity and insufficient industrial sense of belonging

Career identity serves as the fundamental intrinsic motivation for students to engage in the industry and commit to their positions in the long term. However, a prevailing surface-level career identity issue is commonly observed among current emerging engineering undergraduates. On the one hand, as an emerging field, the emerging engineering industry has not yet fully established mature development patterns, post systems, and promotion paths. During their schooling, students lack access to systematic industrial cognition channels, leading to a vague understanding of the job responsibilities, technical value, and industrial prospects of emerging engineering positions, which prevents them from establishing clear professional value recognition. On the other hand, some students hold cognitive biases: they one-sidedly believe that emerging engineering positions are characterized by high work intensity, high technical threshold, and high employment uncertainty, overemphasize superficial factors such as salary and working environment, while neglecting the strategic value and development potential of the industry. Referring to the research findings on undergraduate career identity in majors such as medicine and social work, students in emerging science and engineering majors are more prone to the chain reaction of academic burnout and lack of career identity. Shallow career identity weakens students' learning motivation and makes it difficult for them to form professional beliefs for long-term commitment to the industry [4].

3.2. Static career planning and lack of dynamic adaptability

Dynamic adaptive career planning is a core requirement for talent career development in emerging engineering fields. Nevertheless, most current undergraduates' career planning presents obvious characteristics of staticity and blindness. The majority of students' planning only stays at the low-level stage, such as immediate employment after graduation or postgraduate entrance examinations, and few of

them develop medium- and long-term plans based on their own capabilities, industrial changes, and job demand. Some students choose careers or pursue postgraduate study blindly following peers, without a clear understanding of the prospects of their industry and their own shortcomings, thus failing to make timely adjustments corresponding to technological progress and job requirement changes. Most prominently, students from private undergraduate universities and non-key undergraduate institutions tend to hold utilitarian employment concepts and are prone to the problem of overestimating their own abilities. They are unwilling to take root in grassroots technical positions, while at the same time failing to meet the job requirements of high-end R&D positions [5]. It can be seen that the higher the alignment between an individual's career development path and industrial development and the student's actual situation is, the better the career development outcome will be; otherwise, it will lead to incoordination or conflicts in career planning. Most of the career guidance provided by colleges and universities is general-oriented, rarely involves the cultivation and development of professional knowledge or skills related to emerging industrial fields, which further narrows students' development paths and deprives them of various options they should have had.

3.3. One-sided employment cognition and cognitive bias in supply-demand matching

At the level of employment cognition, emerging engineering undergraduates generally have cognitive biases in supply-demand matching. Most students have insufficient understanding of the employment criteria, capability requirements, and job gaps of the emerging industry. They only focus on the popularity of employment, while neglecting the degree of match between positions and their own capabilities. Some students overestimate their professional capabilities, lack understanding of actual job requirements, and feel pressure from technical updates, which makes it difficult for them to quickly adapt to job requirements after entry. Another group of students underestimates the development potential of the emerging engineering field, worries about the pressure brought by technological innovation, and proactively avoids core technical positions and turns to positions unrelated to their major, resulting in a waste of professional human resources. From the perspective of collaborative education, there is a disconnect between the output standards of talent cultivation in colleges and universities and the employment demand of emerging industries. Students lack first-hand industrial cognition and on-the-job training experience during schooling, which leads to a disconnect between their employment cognition and industrial reality, resulting in insufficient scientificity and accuracy of employment choices.

4. The internal coupling mechanism between learning ability and career cognition

Through systematic collation of relevant studies, it can be found that the learning ability and career cognition of undergraduate students majoring in emerging engineering are not independent of each other. Instead, they constitute an interrelated internal connection characterized by mutual influence and mutual promotion, and together determine the quality of talent cultivation and the effectiveness of employment development. On the one hand, learning ability serves as the core foundation for the deepening of career cognition. The stronger students' capabilities in cross-border integration, innovative practice, and independent iterative learning are, the more accurately they can grasp the technical characteristics, job requirements, and future development direction of the emerging engineering industry, clarify the matching degree between themselves and target positions, thereby form scientific and in-depth career cognition, and improve the accuracy of

career identification and career planning. Conversely, students with weak learning ability cannot correctly understand the professional value and industry development prospects, and are prone to problems such as vague career cognition, low career identification, and confused career planning.

On the other hand, career cognition acts as the intrinsic driving force for the improvement of learning ability. Clear career cognition and definite career development goals can guide students to targetedly compensate for their learning shortcomings, proactively align with job requirements, improve higher-order learning ability as well as practical and innovative ability, and form a positive cycle of "cognition guides learning, learning empowers employment." Students with biased career cognition and vague career goals generally suffer from insufficient learning motivation, confused learning direction, and negative participation in practical activities, which further exacerbates their weakness in learning ability. At present, the core problem in the talent cultivation of emerging engineering undergraduates lies in the coupling imbalance between the two dimensions, which is manifested in the disconnection between learning cultivation and cognitive shaping. As a result, the output of talents cannot meet the requirements for the coordinated development of emerging industries.

5. Collaborative enhancement and optimization strategies for undergraduate competencies in emerging engineering fields

5.1. Focus on industrial demand and reconstruct a high-order learning ability training system

Based on the characteristics of rapid technological updates and a high degree of cross-boundary integration in the emerging engineering industry, higher education institutions should break through the traditional segmented teaching mode and form an interdisciplinary and dynamic learning ability training system. It is necessary to optimize the curriculum system by offering courses in cutting-edge technologies and cross-boundary integration, break down knowledge barriers between basic disciplines and emerging engineering majors, and focus on cultivating students' capabilities in knowledge integration, complex problem decomposition, and systematic thinking. In terms of practical teaching, the mode should be innovated by aligning with real engineering scenarios of enterprises, adding practical contents such as comprehensive innovation training, project-based teaching, and university-enterprise joint research, so as to strengthen students' whole-chain engineering practice ability and innovative adaptability. Meanwhile, students should be guided to change their learning approaches: get rid of the inertia of passive exercise-based and exam-oriented learning, cultivate the awareness of independent iterative learning, take the initiative to track cutting-edge industrial technologies, and adapt to the pace of technological updates under the development of new quality productivity.

5.2. Strengthen targeted empowerment and establish a dynamic professional cognition training system

A normalized dynamic professional cognition cultivation mechanism should be established to address the problems of superficial and static professional cognition among students. According to the characteristics of industries in emerging engineering fields, higher education institutions should carry out professional cognition education. By means of cutting-edge industry lectures, enterprise visits, post-awareness internships, experience exchanges with outstanding practitioners, and other approaches, institutions can help students

fully understand industrial development trends, post-employment standards, and career growth paths, and enhance students' professional identity. Career planning guidance services should abandon the general guidance mode and provide personalized phased guidance based on the needs of new industrial posts and individual characteristics of students, so as to help students form a development-oriented employment concept and eliminate the problems of overestimating one's own abilities and blind employment. Students should be guided to establish correct professional values, unify the interests of short-term employment with long-term career development, focus on improving their own professional competence, and expand their space and sustainability for career development.

5.3. Deepen industry-education integration and build an integrated education platform for competence and cognition

Relying on the collaborative education mechanism between vocational undergraduate education and emerging industries, it is necessary to promote industry-education integration and university-enterprise cooperation, and break down the connection barriers between learning ability cultivation and professional cognition shaping. It is necessary to promote universities and enterprises to jointly develop talent training programs, co-research curriculum systems, and share training platforms, and integrate enterprise post-competence standards and technological iteration requirements into daily teaching, so that students can align with industrial demands synchronously during professional learning, and realize the precise adaptation between learning ability cultivation and post requirements. A two-way exchange platform between universities and enterprises should be established: invite enterprise engineers to campus for teaching and practical guidance, and organize students to take on-the-job internships in enterprises and participate in real engineering projects. In this way, students can deepen their understanding of the industry in practical operations, identify their own competence deficiencies, form a three-dimensional growth path, and comprehensively improve the quality and industrial adaptability of undergraduate students in emerging engineering fields.

6. Conclusion

The learning ability and career cognition of undergraduate students in emerging engineering fields are core competencies that adapt to the development of new quality productivity and support the high-quality development of emerging industries. The coordinated development of the two is the key to improving the quality of talent cultivation and addressing the problem of supply-demand mismatch in employment. At present, undergraduate students in emerging engineering face such problems as insufficient higher-order learning ability, low practical adaptability, one-sided career cognition, and delayed career planning; the unbalanced coupling between learning ability and career cognition also hinders the high-quality development of talents. Colleges and universities should base themselves on the development demands of emerging industries, focus on ability cultivation, take cognition shaping as an approach, and use industry-education collaboration as support to reconstruct the talent cultivation system, so as to achieve the simultaneous improvement of students' learning ability and career cognition. This will enable the continuous delivery of innovation-driven talents that meet industrial demands to emerging engineering sectors, and further promote the formation of a benign mutual development pattern between vocational undergraduate education and emerging industries.

Disclosure statement

The authors declare no conflict of interest.

References

[1] Li Y, 2026, Research on the Collaboration Strategy Between Vocational Undergraduate Education and Emerging Industries Against the Background of New Quality Productivity Development. Learning Weekly, 2026, (16): 71–74.

[2] Li Y, 2026, Construction of Collaborative Education Mechanism for Vocational Undergraduate Education Adapting to the Labor Demand of Emerging Industries. Ability Development, 2026(5): 157–159.

[3] Wang JF, Lai CC, Wang T, et al., 2026, Current Situation and Analysis of Professional Identity of Undergraduate Students Majoring in Stomatology in a University in Henan Province. Henan Medical Research, 35(3): 419–422.

[4] Fu J, Arslan T, Zinura A, et al., 2025, Research on the Current Situation and Countermeasures of Career Planning for Undergraduate Students Majoring in Forensic Medicine. Employment and Security, 2025(9): 85–87.

[5] Liang JJ, 2025, Research on the Dynamic Development of Career Planning and the "overambition" Phenomenon in Employment Concept of Private Undergraduate Students. Public Relations World, 2025(13): 74–76.

Publisher's note

Bio-Byword Scientific Publishing remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

International Education Forum, 2026, Volume 4, Issue 8
http://ojs.bbwpublisher.com/index.php/IEF
Online ISSN: 2981-8605
Print ISSN: 3083-4902

Research on the Path and Practice of Higher Vocational English Teaching Reform Empowered by Artificial Intelligence

Hao Wang*

Hunan Vocational College of Electronic and Technology, Changsha 410000, Hunan, China

Author to whom correspondence should be addressed.

Copyright: © 2026 Author(s). This is an open-access article distributed under the terms of the Creative Commons Attribution License (CC BY 4.0), permitting distribution and reproduction in any medium, provided the original work is cited.

Abstract: The in-depth application of artificial intelligence technology injects new impetus into higher vocational English teaching to break through practical dilemmas. At present, major problems exist in higher vocational English teaching, including huge disparities in students' foundational proficiency, disconnection between teaching content and career demands, single evaluation methods, and teachers' insufficient digital literacy. Based on an analysis of the above predicaments, this paper comprehensively explores paths for AI-enabled teaching innovation from four dimensions: intelligent adaptive learning, construction of multimodal vocational scenarios, data-driven targeted assessment, and human-machine collaborative teacher development. Properly integrating artificial intelligence into the whole teaching process, this research aims to improve vocational college students' workplace English competency and provide reliable referential models for advancing teaching reform outcomes.

Keywords: Artificial intelligence; Higher vocational English; Teaching reform; Personalized learning; Intelligent evaluation

Online publication: August 31, 2026

1. Introduction

The new generation of artificial intelligence technologies is rapidly restructuring the education ecosystem and bringing great opportunities to resolve long-standing problems in traditional teaching. As a compulsory course for cultivating foreign communication abilities of technical and skilled talents, higher vocational English has long been criticized for being time-consuming yet inefficient. The *Curriculum Standards for General English in Higher Vocational Colleges (2021 Edition)* clearly define "workplace foreign communication" as one of the core literacies of English disciplines and set higher requirements for teaching [1]. However, emerging challenges such as diversified student sources and lack of vocational scenarios, coupled with exam-oriented evaluation, make unified teaching approaches fail to reach intended teaching objectives. Therefore, how to leverage AI's

capabilities in perception, analysis, and generation to transform the ecosystem of higher vocational English teaching has become a critical research topic awaiting solutions.

2. Practical dilemmas facing higher vocational English teaching reform

2.1. Wide disparities in students' foundations make unified teaching incompatible with individual needs

Higher vocational colleges enroll diverse student groups, including regular high school graduates, secondary vocational students recruited through classified admissions, and social expanded enrollment learners, whose English proficiency varies sharply. A survey conducted by a vocational college shows that the average English entrance score of senior high school graduates is 75 out of 150, while that of secondary vocational students stands at merely 43; around 35% of students have a vocabulary of fewer than 1,000 words and cannot construct complete oral sentences [2]. Under the class-based unified teaching model, if lessons are designed according to secondary vocational students' level, it will be difficult to achieve the workplace goals stipulated by curriculum standards; if standard teaching progress is maintained, a large number of underachievers will fall behind. Even when tiered class teaching is adopted, conflicts in class scheduling and shortages of teachers render the measure superficial. Moreover, students within the same tier still exhibit heterogeneous abilities in listening, speaking, reading, and writing, and manual grouping cannot realize precise matching for individual learners.

2.2. Disconnection between teaching content and vocational orientations leads to insufficient cultivation of workplace language competency

Most topics in current higher vocational English textbooks follow the general college English system, covering subjects such as online life and ecological environment, without deep connections to specialized posts in intelligent manufacturing, modern services, medical care, and other vocational fields. An analytical study on textbooks of 12 vocational colleges reveals that 89% of textbook units are general topics, while only 11 involve specific vocational scenarios.

In classroom practice, oral teaching mostly stays at text reading and simple dialogues, lacking authentic or simulated workplace communication tasks. Students can only memorize sentence patterns instead of using language for real communication and expression. The competency objective of completing work tasks in vocational settings as specified in curriculum standards cannot be realized due to insufficient situational support [3]. For instance, a questionnaire survey of 312 interns shows that 76.5% of students state that current English courses lack tasks such as drafting foreign trade emails and reading and analyzing English equipment manuals. Mismatch between teaching supply and students' employment demands turns English courses into perfunctory compulsory credits, greatly undermining students' confidence and competence in cross-border communication during internships.

2.3. Single-dimension evaluation system with absence of process diagnosis and feedback

Current assessment of higher vocational English still mainly adopts the model of usual performance (attendance and homework) plus paper-and-pencil final exam, with summative tests accounting for over 70% of total grades. Exams focus heavily on objective questions testing grammar rules and word discrimination, with very few points allocated to listening and speaking [4]. A sampling survey of 286 higher vocational

colleges conducted by the Ministry of Education indicates that final exam scores make up more than 70% of total grades in 68.4% of surveyed institutions, and only 14.7% of schools include oral tests or project tasks in formal assessments.

Process evaluation mostly relies on teachers' subjective impressions, lacking continuous collection and scientific analysis of learning behavior data, which cannot accurately reflect individual learning trajectories and typical errors. A questionnaire shows that among 462 surveyed higher vocational English teachers, 81% rarely use learning portfolios or diagnostic tests, and only provide grades or total scores in feedback without pinpointing students' specific problems. In addition, when facing large classes, teachers cannot fully grasp the distribution of common student problems, resulting in delayed and vague evaluation feedback, and the diagnostic function of assessment to promote learning almost disappears.

2.4. Teachers lacking digital literacy leading to superficial integration of intelligent technology and teaching

Most higher vocational English teachers only understand AI teaching applications at shallow levels, such as playing audio and video or using APPs for attendance taking. Their willingness to adopt tools such as learning analysis dashboards, adaptive learning engines, and intelligent essay grading is relatively low. Some teachers fear human-machine collaboration will weaken teacher-student emotional communication and worry about being replaced, thus resisting in-depth teaching reforms [5]. A survey of English teachers in the Yangtze River Delta vocational colleges notes that 73.5% apply AI in resource playback or attendance, while only 9% use AI for essay grading. Meanwhile, 58% of surveyed teachers hold resistance to AI applications and suffer from "technology replacement anxiety." Furthermore, teachers' overall intelligent education literacy lags behind demand, which has become a major obstacle to the implementation of AI-enabled teaching reform. A shift from ornamental to integrated innovative application is urgently needed.

3. Paths and practices of higher vocational English teaching reform empowered by artificial intelligence

3.1. Construct personalized learning paths based on intelligent adaptive learning platforms

Supported by knowledge graphs, collaborative filtering, and learning sequence analysis technologies, intelligent adaptive learning platforms can dynamically diagnose students' proficiency in vocabulary, grammar, and listening, generate personal digital portraits, and push corresponding learning tasks and resources in real time to realize targeted supply and individualized cultivation. After logging in, the system assigns micro-lessons, challenge exercises, and AI conversations matching students' test scores, and adjusts question difficulty according to answer accuracy [6]. In this context, teachers shift from uniform lecturers to learning planners and intervenors. Relying on background diagnostic reports, teachers identify common weak points and adjust classroom teaching priorities. The combination of online adaptive learning and targeted offline tutoring effectively addresses the lack of personalized guidance in large-class teaching.

Take the workplace general English course "Intelligent Tutoring and Targeted Remedial Teaching" designed for freshmen in vocational colleges as an example. In the first week of the semester, students take adaptive graded tests in listening comprehension, vocabulary & grammar, and short reading. The system generates individual ability graphs. For example, if a student performs poorly in listening recognition and

business vocabulary, the platform pushes pronunciation imitation and industry root word games, and sets situ dictation every two days [7]. Two weeks later, the system conducts a second test to further collect students' learning outcomes and progress.

3.2. Adopt multimodal AI technology to build immersive vocational language scenarios

With speech synthesis, natural language processing, and virtual reality technologies, vocational colleges can create workplace communication scenarios close to real posts, providing more authentic simulated environments for higher vocational English teaching. Supported by VR simulation, dialogue robots, and virtual avatars, students can interact with AI customers, coworkers, or patients in digital workshops, foreign-related hotels, and live-streaming foreign trade studios. For example, students majoring in electrical automation can communicate with coworkers and robots in a "digital workshop" to practice communication skills [8]; tourism and hotel management students can interact with guests in "foreign-related hotels" to improve their language proficiency. Such technical support converts abstract workplace language tasks into perceptible and interactive training projects, making up for the shortage of physical equipment and real-life scenarios [9]. Students practice repeatedly in immersive, low-anxiety virtual environments, greatly improving the fluency and appropriateness of language output, and aligning language learning with post requirements.

Take the practical training course "Intelligent Front Desk English Reception" for hotel management freshmen as an example. Supported by virtual simulation platforms that create hotel scenarios, teachers assign three tasks: check-in handling, phone food ordering, and guest complaint resolution. Students wear headsets and converse with AI guests displaying emotional expressions on screen. During check-in tasks, AI guests randomly raise questions such as "Does the rate include breakfast?" and "Can I upgrade to a sea view room?", requiring students to respond orally instantly. The system generates scores and improvement suggestions based on pronunciation accuracy, completeness of service expressions, and fluency, e.g., "Using 'I'm afraid' for gentle refusal sounds more appropriate." After class, students can replay conversations for self-reflection. Teachers select typical recordings in subsequent classes to identify frequent pragmatic errors [10].

3.3. Build a data-driven intelligent evaluation system to realize targeted teaching decision-making

Based on AI essay marking, speech assessment engines, and learning behavior mining, teachers can embed evaluation into pre-class previews, in-class interactions, and after-class assignments to collect multi-dimensional data and form digital learning portraits. Intelligent systems instantly mark essays in terms of logical coherence, grammatical accuracy, and vocabulary richness, and track indicators such as pronunciation accuracy, classroom activity, and task completion time, generating class error distribution graphs and individual growth trajectories [11]. Teachers make targeted lesson preparation and intervention based on such data. Meanwhile, multi-subject evaluation, including human-machine joint assessment and peer review, can be introduced to turn evaluation into an in-depth learning session and encourage students to attach importance to practical language ability [12].

Take targeted teaching driven by intelligent marking for business English in cross-border e-commerce majors as an example. Teachers assign writing tasks such as English product introductions for wireless earphones. After students submit drafts, teachers use AI marking software to annotate grammar, spelling, and structural problems with sentence-by-sentence comments. For instance, suggestions like "up to 5 hours of

playtime" are provided to replace inappropriate expressions of battery life [13]. After marking, teachers analyze overall class errors based on system statistics. If nearly half of students confuse "charge" and "charging," and 35% lack persuasive closing statements, teachers issue revision checklists requiring independent editing, group polishing, or reference to AI revisions.

3.4. Promote human-machine collaborative teaching research to improve teachers' intelligent education literacy

Teachers are the key to AI-enabled teaching reform. Human-machine collaboration does not replace teachers, but enhances their professional capabilities. Intelligent live recording systems conduct multimodal analysis of classroom teaching, quantifying data such as teacher-student speaking ratio, question types, and interaction depth to generate reflection reports for precise lesson polishing. Meanwhile, generative AI can assist courseware production, corpus retrieval, and differentiated reading material generation, freeing teachers from repetitive trivial work and allowing them to focus on instructional design and emotional communication [14]. "AI + English teacher communities" and practical workshops integrated with real teaching scenarios can be established.

Take the thematic teaching research workshop "Generative AI Empowers Classroom Lead-In" as an example. The college's English teaching and research office holds special training sessions covering theoretical explanations, software operation, resource creation, intelligent instructional design, and hands-on practice. In the session on creating lead-in video clips, teachers use digital human broadcasting platforms to produce English news short videos about booming domestic new energy vehicles overseas for classroom introduction [15]. After class, the teaching research team analyzes the actual effects and optimization suggestions of scenario creation based on intelligent recording systems to continuously improve teachers' digital teaching ability and enthusiasm.

4. Conclusion

AI-enabled reform of higher vocational English teaching is not a simple superposition of technical tools, but an all-round transformation of teaching structure, procedures, and teacher-student relations. For practical problems including diverse student backgrounds and insufficient vocational scenarios, intelligent adaptive learning enables large-scale personalized instruction; multimodal vocational scenarios resolve the disconnection between language practice and posts; data-driven evaluation systems provide precise guidance for individualized teaching; human-machine collaborative research injects new momentum into teachers' sustainable development. Technology integration must always adhere to the fundamental goal of education, and cold data cannot replace the warmth of language communication; attention should also be paid to algorithm ethics and privacy protection. As large language models mature, higher vocational English teaching will develop toward more adaptive and immersive effective forms. Teachers' active acceptance of intelligent literacy and transformation into smart guides becomes a core factor for deepening teaching reform.

Disclosure statement

The author declares no conflict of interest.

References

[1] Sun YT, Zhang XH, 2025, Value, Dilemmas and Countermeasures of Generative AI Empowering Reading and Writing Teaching of Public English in Higher Vocational Colleges. Journal of Shunde Polytechnic, 23(4): 10–15.

[2] Chen ZW, 2025, Practice of AIGC Empowering Higher Vocational English Curriculum Teaching Reform. Journal of Wuhan Engineering Vocational College, 37(4): 81–86.

[3] Xie DL, 2025, Research on Strategies of AI Technology Empowering Innovation in Higher Vocational English Teaching. Shenzhen Special Zone Science and Technology, 2025(6): 126–128.

[4] Dai XL, 2025, Empirical Research on AI Empowering Higher Vocational English Writing Teaching — Construction of Triple Mechanisms and Reflection on Technical Ethics Based on AIGC. China Strategic Emerging Industries, 2025(32): 26–28.

[5] Zhang JN, 2025, Research on Innovative Teaching Modes of Higher Vocational English Empowered by AI Technology. Overseas English, 2025(16): 238–240.

[6] Ning T, 2025, Path of Generative AI Empowering the Application of Production-Oriented Approach — A Case Study of Higher Vocational English Teaching. Guangxi Education, 2025(18): 142–145.

[7] Yuan J, Zhang Y, 2025, Research on Practical Paths of AI Empowering the Whole Process of Higher Vocational English Teaching. Happy Family, 2025(11): 76–78.

[8] Qin YJ, Huang YJ, Huang J, 2025, Research on Integration Path of Party Building and Ideological and Political Education in Colleges in the New Era. Society and Public Welfare, 2025(8): 21–23.

[9] Shi LH, 2025, Research on Innovative Paths of Higher Vocational English Teaching Modes Empowered by AI Technology. Proceedings of Seminar on Integration Modes and Innovative Practices of Cultural Enterprises Empowering New Education Ecosystem. Vocational Education Committee of China Cultural Enterprise Promotion Association, 2025: 3.

[10] Wang XY, 2025, Innovative Paths of Intelligent Higher Vocational English Teaching Empowered by AI Technology. Journal of Qingdao Ocean Shipping Mariners College, 46(1): 62–65.

[11] Jing JM, 2025, Research on Countermeasures for Innovative Higher Vocational English Teaching Modes Enabled by AI Technology. Modern Vocational Education, 2025(7): 121–124.

[12] Li CP, 2024, Research on Practical Higher Vocational English Teaching Empowered by AI Technology. China New Telecommunications, 26(22): 213–215 + 149.

[13] Li XR, Xiang AM, Liu Y, 2024, Dilemmas and Practical Paths of Interaction Between Party Building and Ideological and Political Education in Colleges in the New Era. Journal of Southwest University of Science and Technology (Philosophy and Social Sciences Edition), 41(4): 101–106.

[14] Fan YN, 2024, Research on Higher Vocational English Teaching Reform Based on Artificial Intelligence. Public Relations World, 2024(8): 148–150.

[15] Yang S, 2024, Exploration on Implementation Paths of AI Empowering Higher Vocational English Teaching. Overseas English, 2024(2): 238–240.

Publisher's note

Bio-Byword Scientific Publishing remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

International Education Forum, 2026, Volume 4, Issue 8
http://ojs.bbwpublisher.com/index.php/IEF
Online ISSN: 2981-8605
Print ISSN: 3083-4902

Reforming the Model for Training Financial Professionals in the Era of Artificial Intelligence

Zhenguo Xu[1], Zhonghuan Yang[2]*

[1]School of Finance, Guangdong University of Foreign Studies, Guangzhou 510006, China
[2]School of Accounting, Guangdong University of Finance, Guangzhou 510521, China

Author to whom correspondence should be addressed.

Copyright: © 2026 Author(s). This is an open-access article distributed under the terms of the Creative Commons Attribution License (CC BY 4.0), permitting distribution and reproduction in any medium, provided the original work is cited.

Abstract: As artificial intelligence reshapes the financial industry, the traditional talent cultivation model in finance education is confronting significant challenges. This paper delineates the current practical predicaments in finance education, encompassing outdated curricula, monolithic pedagogical models, insufficient industry-education integration, and suboptimal faculty knowledge structures, while delving into the core mechanisms of talent cultivation in the era of artificial intelligence. The analysis reveals that reconstructing a curriculum system that integrates cutting-edge AI technologies, innovating intelligent cultivation models, deepening the industry-education collaborative mechanism, and addressing the bottleneck of faculty interdisciplinary competence are pivotal to navigating the ongoing "digital-intelligent" transformation in finance education. These efforts lay the foundation for establishing a new ecosystem for cultivating high-caliber finance talent adapted to the demands of the intelligent era.

Keywords: Artificial intelligence; Finance talent cultivation; Curriculum reconstruction; Pedagogical models; Industry-education integration; Interdisciplinary faculty

Online publication: August 31, 2026

1. Introduction: Artificial intelligence reshaping the financial industry and educational challenges

With the rapid advancement of frontier technologies such as big data and artificial intelligence, the global financial industry is undergoing a digital and intelligent transformation. Traditional financial business models, impacted by algorithm-driven operations, data empowerment, and scenario restructuring, are accelerating their "digital-intelligent" evolution, profoundly altering the operational logic and value-creation mechanisms of the financial sector. This transformation not only reshapes the operational ecosystem of financial institutions but also imposes new demands on practitioners' knowledge structures, skill sets, and modes of thinking, rendering conventionally trained finance professionals inadequate for the complex challenges of the intelligent finance era.

Current academic and industry discourse on finance talent cultivation in the era of artificial intelligence increasingly focuses on precisely identifying the impact of financial industry transformation on talent cultivation models under this macro backdrop. How traditional cultivation models can effectively address the urgent industry demand for "digital-intelligent" talent has become a core issue requiring immediate resolution in finance talent development. Against this backdrop, this paper systematically examines the transformation logic of the financial industry driven by AI, delves into the deep-seated challenges and corresponding strategies for traditional talent cultivation, and subsequently reconstructs the finance talent cultivation system, with the aim of providing theoretical support and practical reference for building a new educational framework adapted to "digital-intelligent" financial development.

2. Problems facing traditional finance talent cultivation in the era of artificial intelligence

2.1. Outdated traditional curriculum content

In current finance education, the pace of curriculum content updates fails to keep pace with the rhythm of industry technological iteration, resulting in a disconnect between curriculum design and the actual operational demands of financial markets. Li Jun pointed out that with the intensifying digitalization trend in the global financial industry, the curriculum configuration of finance programs in higher education institutions has significantly lagged behind industry development [1]. Chen Han et al. argued that the curriculum architecture of finance programs in vocational colleges suffers from specific issues such as disconnection from practical work, misalignment with actual industry needs, and detachment from future development trends, necessitating urgent curriculum reform [2]. Liu Hui and Xu Yu, in discussing fintech talent cultivation, noted that traditional educational models, hampered by curricula and knowledge systems that lag behind technological iteration, result in a misfit between talent cultivation and actual industry demands [3]. The above literature indicates that in the current evolution of big data and AI technologies applied to the financial industry, traditional finance education exhibits significant problems in curriculum timeliness, severely constraining the alignment between talent cultivation and industry needs.

2.2. Insufficient effectiveness of traditional pedagogical models

In the context of artificial intelligence technology reshaping the financial industry, the traditional teaching model centered on teachers and one-way knowledge imparting has insufficient effectiveness in updating financial knowledge and developing individuality. Li Dongrong noted that in the context of the big data era, traditional finance education models struggle to cope with the opportunities and challenges brought by informationalized finance, necessitating an urgent transformation of talent cultivation approaches to match the new financial landscape [4]. Fan Hongjuan and Dai Xu, building upon and innovating existing pedagogical models, combined financial theory knowledge with new teaching methodologies to accelerate the process of pedagogical model reform in higher education [5]. Liu Yong and Cao Tingting argued that traditional finance cultivation models predominantly employ a "teacher-centered, textbook-centered, classroom-centered" instructional approach, supplemented by practical teaching [6]. This model, which overemphasizes theoretical instruction at the expense of practice, fails to meet students' comprehensive learning needs and is detrimental to their personalized development. Song Liping pointed out that traditional finance instruction lacks cultivation of students' information technology capabilities, rendering it inadequate for meeting the skill

development demands of the AI era [7]. Wang Yueru discussed the challenges posed by the AI era to finance program instruction and cultivation, clearly pointing out the need to improve teaching methods and focus on cultivating students' thinking ability, innovation capacity, problem-solving skills for differentiated scenarios, and adaptability [8]. Huang Wenqing, in an in-depth analysis of finance course characteristics, explicitly stated that under traditional models lacking AI support, the teacher-dominated instructional approach has long suffered from practical deficiencies including insufficient effectiveness, lack of personalized support, and constrained student comprehensive capabilities [9]. The above studies generally indicate that the traditional rote-learning finance education model exhibits clear shortcomings in addressing knowledge updates and personalized development needs within the "digital-intelligent" financial landscape, necessitating an urgent reconstruction of pedagogical models through the introduction of artificial intelligence technologies to achieve a transition from "standardized provision" to "personalized support."

2.3. Insufficient depth of industry-education integration

In the current financial education system, there is an overemphasis on theory at the expense of practice, accompanied by weak university–industry collaboration mechanisms and a disconnect between talent training objectives and actual industrial demands. Zhang Guaili proposed the construction of innovative social training platforms for talents, aiming to realize a new model of diversified talent cultivation that combines academic education with social training through industry-education integration [10]. Zhang Pu further proposed building an industry-education integration platform and deepening internship and practice mechanisms to break the path dependence of traditional talent cultivation [11]. Liu Hui and Xu Yu pointed out that the insufficient depth of industry-education integration in traditional financial education models is one of the core root causes of the mismatch between talent supply and industrial needs [3]. In current financial education, although some universities offer practical training courses, these are often dominated by simulated software operations and lack immersion in real business scenarios. Many university–industry collaborations remain at the level of "internship bases in name only" or inviting corporate executives to give guest lectures, lacking systematic mechanisms for joint talent cultivation and regular communication platforms between universities and enterprises. As a result, it is difficult for enterprises to provide timely feedback to universities regarding talent demands and job skill standards.

2.4. Inadequate faculty knowledge structure

Faculty constitute the foundation of financial talent cultivation. Against the backdrop of AI-empowered financial education, the lag and deficiencies of university teaching staff in knowledge structure, technical literacy, and interdisciplinary teaching capabilities make it difficult to effectively support the cultivation of financial talents with digital and intelligent capabilities. Wei Sizheng, in studying the talent cultivation model for fintech majors under AI empowerment, argued that the effectiveness of AI is constrained by the lack of faculty interdisciplinary competence, which is one of the key challenges in cultivating high-quality financial interdisciplinary talents [12]. Most finance faculty, especially senior ones, still have a knowledge system confined to "classical financial theories plus traditional econometric methods," and lack systematic understanding of technologies such as machine learning, natural language processing, and large language models. Teachers harbor "technophobia" or "replacement anxiety" regarding AI, and are unable to effectively use AI tools for assisted teaching. The lack of regular exchange mechanisms with industry experts results in

teachers having very limited knowledge of the latest developments in the fintech industry. Therefore, the lag in teacher knowledge updating and the insufficiency of digital and intelligent interdisciplinary competence have become the core bottleneck hindering the deepening of financial education reform.

3. Core mechanisms for cultivating finance talents in the age of artificial intelligence

3.1. Restructuring the curriculum system through integration with AI technologies

In the era of artificial intelligence, finance education should break down traditional disciplinary barriers by deeply integrating and restructuring the classical theoretical framework of finance with big data processing, AI algorithms, and other cutting-edge technologies, so as to cultivate interdisciplinary talents capable of adapting to industrial transformation. Li Jun explicitly noted that traditional teaching systems are facing severe challenges, and that universities should continuously update their curricula in light of big data and AI to keep pace with the rapid development of the financial industry [1]. Zhang Pu proposed restructuring the curriculum system with a focus on strengthening cross-disciplinary integration and skill orientation. Specifically, core course modules should be reorganized to shift from a "pure finance" model to a "finance + AI" paradigm [11]. In the foundational module, classic financial theories—such as finance, asset pricing, risk management, and corporate finance—are retained but streamlined, and their content is reinterpreted through an AI lens. A new mandatory technology module is introduced, covering Python/R programming (for financial data processing), machine learning and deep learning (for predictive modeling and risk identification), natural language processing (for financial statement crawling), and blockchain (for digital currencies and smart contracts). Interdisciplinary applied integration courses, such as "Quantitative Investment and Algorithmic Trading" and "RoboAdvisory," are also offered to embed technical tools into realworld financial business scenarios.

3.2. Innovating teaching models and achieving intelligent transformation

In terms of teaching models, this section explores how AI technologies are transitioning from auxiliary tools to core elements that reshape finance course instruction, thereby achieving deep integration of technology with teaching content. Huang Wenqing pointed out that with breakthroughs in generative AI and the rise of opensource models, the reshaping of finance course teaching by AI has entered a critical stage of "deep coupling," addressing deficiencies in traditional instruction such as insufficient teacherled effectiveness and lack of personalized support [9]. Specifically, teaching methods should evolve from traditional classroom settings to an "intelligent blended learning" approach. This involves reestablishing a "dualteacher classroom" model, where online virtual digital human instructors deliver basic conceptual explanations and standardized knowledge transfer, while onsite human teachers are responsible for case discussions, project guidance, and addressing complex questions. An intelligent teaching system based on large language models is deployed to automatically push personalized learning pathways, exercises, and video explanations according to students' knowledge mastery. The teaching process is made intelligent by using AI tools to collect behavioral data in real time from classroom interactions, assignment submissions, code execution, and forum discussions, generating a "student competency heatmap" that helps instructors precisely identify common weaknesses across the class and adjust teaching pace accordingly. Teaching evaluation is also intelligentized: AI systems generate "quantified competency" radar charts based on classroom performance and assignment quality,

thereby refining the student ability assessment framework.

3.3. Deepening the industry-education integration mechanism

In the era of artificial intelligence, the cultivation of financial talents must transcend the boundaries of campus education by deepening industry-education integration, thereby achieving an organic connection between academic education and social training to meet the urgent demand of the industry for interdisciplinary talents. Liu Hui and Xu Yu, addressing the imbalance between financial talent supply and demand against the backdrop of rapid advances in AI and big data, proposed and constructed a novel "four-in-one" integrated talent cultivation model for fintech professionals, with industry-education integration serving as the core link to ensure that talent training precisely matches actual industrial needs [3]. Specifically, universities and fintech enterprises jointly establish a "dual-subject" Digital and Intelligent Finance Industry College as an educational entity, with enterprise executives appointed as associate deans to collaboratively formulate training programs, curriculum standards, and assessment systems. They also co-build an AI Finance Joint Laboratory equipped with resources such as transaction flow data, desensitized risk control models, computing power, quantitative trading platforms, and intelligent investment research systems, allowing students to engage in real financial industry projects. A "project-driven" practice-oriented teaching model is implemented, in which students form interdisciplinary teams to participate in real projects, and successfully incubated projects may be prioritized for integration into the enterprise ecosystem. Furthermore, a benefit-sharing collaborative innovation mechanism is deepened, whereby models, algorithms, and patents generated by students within the industry-education integration projects are jointly owned by the university and the enterprise in agreed proportions. Enterprises may pre-identify outstanding students early, forming a targeted cultivation model where "enrollment equates to entry into the industry."

3.4. Building a "dual-competency" faculty team

To address the core issue of the disconnect between current financial faculty capabilities and industrial needs, it is essential to build a "dual-competency" faculty team that is proficient in both classical financial theory and cutting-edge artificial intelligence technologies. In concrete terms, reforms should be undertaken in the systems of professional title evaluation and performance appraisal, establishing "AI+Finance" teaching specialized positions and adding fintech-oriented teaching roles, with assessment indicators centered on the development of digital and intelligent finance courses, guidance of student AI competition awards, and participation in industry-sponsored collaborative research projects, replacing the traditional emphasis on publication counts. An "AI+Finance" empowerment system should be created, offering faculty a series of practical courses on AI financial tools, selecting key faculty to participate in "fintech boot camps," and providing funding for faculty to visit and collaborate with leading fintech institutions and schools, jointly developing courses or publishing co-authored papers. An interdisciplinary and inter-institutional faculty sharing platform should be built, establishing a "Fintech Joint Teaching and Research Group" comprising finance and computing disciplines, and forming a cross-institutional AI Finance Faculty Alliance with both online and offline exchange platforms, so as to enhance the digital and intelligent capabilities of the faculty.

4. Conclusions and prospects

This paper systematically reviews the new challenges that the transformation of the financial industry

landscape in the era of artificial intelligence poses to talent cultivation, provides an in-depth analysis of the practical difficulties confronting traditional financial education models—including outdated course content, monolithic teaching approaches, insufficient industry-education integration, and inappropriate faculty knowledge structures—and proposes core pathways to empower financial talent development through curriculum system restructuring, innovative intelligent teaching models, deepened industry-education integration mechanisms, and resolution of the bottleneck in faculty interdisciplinary competence. The research indicates that the central logic of reforming financial education models lies in shifting from mere transmission of financial knowledge to the construction of composite "finance + AI" capabilities, emphasizing an industry-demand-oriented approach that fosters deep coupling between educational elements and AI technologies. This is intended to achieve precise alignment between talent supply structures and the intelligent transformation of the industry, address the sustained challenges posed by rapid AI iteration to financial talent cultivation, and ultimately foster a sustainable, adaptive new ecosystem for financial talent development.

Disclosure statement

The authors declare no conflict of interest.

References

[1] Li J, 2020, Research on Cultivating Interdisciplinary Financial Talents under the Background of Big Data and Artificial Intelligence. Economic Research Guide, 2020(29): 43–45.

[2] Chen H, Zhan J, Li XH, 2024, Exploring the Construction of Finance Majors in Higher Vocational Colleges in the Era of Artificial Intelligence. Journal of Hainan Open University, 2024(4): 139–145.

[3] Liu H, Xu Y, 2026, Exploration and Practice of the "Four-Integration-One-Body" Fintech Talent Cultivation Model under the AI Background. In Proceedings of the 2026 Sociology Symposium (Vol. 1). https://doi.org/10.26914/c.cnkihy.2026.004248

[4] Li DR, 2013, Financial Talent Cultivation in the Era of Big Data. China Finance, 2013(24): 9–10.

[5] Fan HJ, Dai X, 2019, Reform and Innovation of Financial Higher Education Models in the Era of Artificial Intelligence. Journal of Jilin Provincial Institute of Education, 2019(8): 128–131.

[6] Liu Y, Cao TT, 2020, Development Trends of the Fintech Industry and Talent Cultivation. China University Teaching, 2020(1): 31–36 + 59.

[7] Song LP, 2020, An Analysis of Teaching Reform for Finance Majors in the Era of Artificial Intelligence—Taking the "Corporate Finance" Course as an Example. Monthly Journal of Science and Technology Entrepreneurship, 2020(8): 141–144.

[8] Wang YR, 2022, Challenges and Responses in Teaching and Cultivation of Finance Majors in the Era of Artificial Intelligence. Science & Technology Vision, 2022(4): 104–105.

[9] Huang WQ, 2025, Exploration and Practice of AI-Empowered Finance Course Teaching. Educational Informatization Forum, 2025(10): 16–18.

[10] Zhang GL, 2023, Research on the Reform Path of Financial Talent Cultivation Models under the Background of Artificial Intelligence. China High-Tech, 2023(20): 158–160.

[11] Zhang P, 2026, Innovative Paths for AI-Empowered Cultivation of Finance Majors in Local Universities. Western

Quality Education, 2026(9): 11–15.

[12] Wei SZ, 2025, Research on the Talent Cultivation Model for Fintech Majors under AI Empowerment. Zhongguancun, 2025(12): 143–145.

Publisher's note

Bio-Byword Scientific Publishing remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

International Education Forum, 2026, Volume 4, Issue 8
http://ojs.bbwpublisher.com/index.php/IEF
Online ISSN: 2981-8605
Print ISSN: 3083-4902

Analysis and Reflection on Classroom Assessment Research in Chinese Primary and Secondary Schools

Zhuoqing Li[1], Shunyu Li[2]

[1]Yili Normal University, Yining, Xinjiang Uygur Autonomous Region, China
[2]Xinjiang Normal University, Urumqi, Xinjiang Uygur Autonomous Region, China

Copyright: © 2026 Author(s). This is an open-access article distributed under the terms of the Creative Commons Attribution License (CC BY 4.0), permitting distribution and reproduction in any medium, provided the original work is cited.

Abstract: Classroom assessment serves as a pivotal driver for advancing student learning and holistic development. This study systematically reviews extant literature concerning classroom assessment within Chinese primary and secondary education contexts. Relevant articles were retrieved from the China National Knowledge Infrastructure journal database using five title-based search terms, with the sources restricted to Chinese core journals and CSSCI-indexed journals. After excluding duplicate and irrelevant publications, the selected studies were classified and analyzed in terms of author affiliation, educational stage, subject area, and research method. The results indicate that existing research is dominated by university researchers, whereas participation by primary and secondary school teachers as well as collaboration between academic researchers and practitioners remain limited. Most existing studies adopt generalized discussions across educational stages and school subjects rather than examining specific contexts. Moreover, non-empirical approaches, particularly theoretical analysis and experience-based reflection, occupy a dominant position over empirical methods. Future research should strengthen collaboration between universities and schools, focus on specific educational stages and subject areas, and increase the use of classroom observation, interviews, and case studies.

Keywords: Classroom assessment; Primary and secondary schools; Literature analysis; Empirical research; Research reflection

Online publication: August 31, 2026

1. Research background

In 2001, the State Council issued the Decision of the State Council on the Reform and Development of Basic Education, which advocated vigorous advancement of basic education curriculum reform covering objectives, principles, curriculum standards, curriculum structure, assessment, and management, so as to establish a new basic education curriculum system consistent with the quality-oriented education requirements [1].

Assessment constitutes an indispensable component of curriculum reform and consists primarily of student assessment, teacher assessment, and curriculum evaluation. Given that the ultimate purpose of basic

education reform lies in fostering students' development and change, student assessment should stand at the core of assessment reform. National administrative authorities have continuously introduced various changes and innovations in student assessment. For example, the Implementation Opinions of the State Council on Deepening the Reform of the Examination and Enrollment System, issued by the State Council in 2014, explicitly identified students' comprehensive qualities as a critical indicator for examination and enrollment decisions [2].

Student assessment should therefore cover not only students' academic achievement but also their learning attitudes and the development of appropriate values, so as to promote students' multi-faceted developmental potentials. Meanwhile, methods of student assessment have shifted from reliance on a single paper-and-pencil test towards the use of multiple assessment methods. These changes in student assessment have also placed new demands on teachers' professional competence. Both the Ministry of Education's Professional Standards for Secondary School Teachers (Trial)and Professional Standards for Primary School Teachers (Trial) identify assessment skills as a core component of teachers' professional competence [3–4]. Teachers are expected to deploy assessment tools and multiple assessment methods, assess students' development and change from multiple perspectives and throughout the learning process, guide students in conducting positive self-assessment, and use assessment results to improve educational and instructional practices.

Among all assessment activities involving students, classroom assessment represents the only assessment that is closely related to both student learning and teachers' instructional practices. Therefore, in-class student assessment should be a central concern for teachers and educational researchers. As Stiggins argued, "If we cannot assess effectively in the classroom, then all other levels of assessment are a waste of time and money" [5]. Through classroom assessment, teachers can comprehensively and dynamically observe changes in students' multi-dimensional abilities, which in turn facilitates student learning and teachers' professional development. Accordingly, research on classroom assessment carries substantial theoretical and practical significance.

However, summative assessment has long occupied a predominant position in China's student achievement assessment system, whereas formative classroom assessment has received relatively limited scholarly attention [6]. A review of the existing literature shows that research on classroom assessment in Chinese primary and secondary schools began to emerge only after the implementation of the 2001 new curriculum reform.

Against this background, several questions merit further exploration: How has classroom assessment research developed in China? What progress has been achieved? What problems remain unresolved? To address these questions, this study conducts a statistical and content-based analysis of articles concerning classroom assessment in primary and secondary schools published in Chinese core academic journals.

2. Research methods and results

2.1. Literature collection and screening

Relevant articles were retrieved from the journal database of China National Knowledge Infrastructure (CNKI). To ensure the quality and reliability of the selected literature, the source category was restricted to journals indexed in the Chinese Core Journal Catalogue or the Chinese Social Sciences Citation Index (CSSCI).

To maximize the coverage of the search, articles whose titles contained any of the following terms were retrieved: “classroom assessment,” “classroom evaluation,” “classroom appraisal,” “classroom review,” and “classroom examination.” The retrieved publications were then screened according to two criteria. First, the research had to focus on primary or secondary education. Second, the research had to examine student assessment, specifically the assessment of students conducted by teachers in the classroom. Conference papers, book reviews, brief reports, and other non-research publications were excluded to maintain the academic relevance and accuracy of the sample.

2.2. Analytical framework

The selected articles were analyzed in terms of four dimensions: author affiliation, educational stage, subject area, and research method. The specific categories are presented in **Table 1**.

Table 1. Analytical framework for the selected articles

Dimension	Categories
Author affiliation	1. University researchers, including faculty members, researchers, and students; 2. primary and secondary school teachers or teaching researchers; 3. collaboration between the two groups
Educational stage	1. General educational stage without further specification; 2. primary school; 3. junior secondary school; 4. senior secondary school
Subject area	1. General subject category without further specification; 2. Chinese; 3. English; 4. Mathematics; 5. other subjects
Research method	1. Theoretical analysis; 2. experience-based reflection; 3. questionnaire survey; 4. observation; 5. interview; 6. case study

2.3. Distribution by author affiliation

The analysis indicates that university researchers constitute the principal contributors to classroom assessment research. Most of the selected articles were independently written by university faculty members, researchers, or students. By comparison, substantially fewer studies were independently conducted by primary and secondary school teachers or teaching researchers, and collaborative studies involving both university researchers and school practitioners were particularly scarce.

Such distribution suggests that the academic production of knowledge about classroom assessment is highly concentrated in higher education institutions. Frontline practitioners have limited participation in academic publication as independent researchers, while sustained collaboration mechanisms between academic researchers and school practitioners have not yet been well-established on a meaningful scale.

2.4. Distribution by educational stage

The studies were classified into four categories according to the educational stage examined: general educational stage, primary school, junior secondary school, and senior secondary school. The general category refers to studies that discuss classroom assessment across primary and secondary education or basic education without distinguishing among specific stages.

The results show that general studies account for the largest proportion of the literature, whereas studies focusing specifically on primary, junior secondary, or senior secondary education are relatively scarce. Existing research therefore tends to propose general conclusions applicable to the entire basic education system, with insufficient attention paid to the distinctive characteristics of classroom assessment across

different educational stages.

Students at different stages vary in physical-psychological development, knowledge structures, learning demands, and instructional reception modes. Consequently, broadly applicable principles may not provide sufficiently targeted guidance for teachers working at specific educational stages.

2.5. Distribution by subject area

The subject areas examined in the selected studies include the general subject category, Chinese, mathematics, English, politics, physics, science, and art. The general category refers to studies that do not distinguish among individual school subjects but instead investigate classroom assessment across primary and secondary education as a whole.

The results show that general studies constitute the largest category, while the overall number of studies devoted to specific subjects is limited. Only a small number of specialized studies were identified for some subjects, and no directly relevant articles were found for certain other subjects. This pattern is consistent with the distribution by educational stage: broadly defined categories dominate the literature, whereas research situated in specific educational contexts remains insufficient.

Given divergent knowledge structures and teaching-learning approaches across disciplines, classroom assessment practices cannot be applied uniformly across all subjects. General studies can provide principles relevant to multiple subjects, but subject teachers must make assessment decisions within specific disciplinary contexts. General principles cannot replace practical assessment strategies tailored to individual subjects. The shortage of subject-specific research therefore leaves teachers with few assessment models aligned with disciplinary attributes.

2.6. Distribution by research method

The research methods were classified into six categories: theoretical analysis, experience-based reflection, questionnaire survey, observation, interview, and case study. The classification was based on the research procedures actually reported in each article rather than solely relying on authors' descriptions of their methods.

Theoretical analysis refers to research based primarily on conceptual examination and logical reasoning. Experience-based reflection involves the generalization and interpretation of teaching experience. Questionnaire surveys collect data through structured questionnaires, while observational studies involve systematic observation conducted in classroom settings. Interview studies obtain information through in-depth conversations with teachers or students, and case studies investigate a particular classroom, participant group, or research object over a specified period.

When an article employed multiple methods, it was classified according to its principal research method. If no primary method could be identified, the article was included in all applicable methodological categories. Theoretical analysis and experience-based reflection were grouped as non-empirical research because they did not use systematically collected empirical evidence as their primary knowledge base. Questionnaire surveys, observations, interviews, and case studies were categorized as empirical research whose conclusions were anchored in systematically collected data.

The results indicate that non-empirical studies occupy a substantial proportion of the literature. Theoretical analysis is the most frequently used approach, followed by experience-based reflection.

Empirical studies are comparatively limited, with interview-based and case-study research being particularly uncommon. Existing research therefore relies primarily on textual analysis, conceptual reasoning, and the generalization of personal experience. Only a small proportion of the studies support their conclusions with systematically collected empirical evidence. As a result, the existing literature lacks sufficient observational and interview-based data to explain how classroom assessment actually operates in practice.

2.7. Summary of results

The findings across the four dimensions reveal four prominent structural characteristics of classroom assessment research in Chinese primary and secondary schools.

First, research is dominated by university researchers. Most articles were independently produced by university researchers, whereas substantially fewer were independently written by primary and secondary school teachers or teaching researchers. Collaborative research between the two groups was particularly scarce. This pattern indicates that academic knowledge production in classroom assessment remains concentrated in higher education institutions and that collaboration between researchers and practitioners has not yet developed on a substantial scale.

Second, research tends to address educational stages in general terms. Studies covering basic education or primary and secondary education as a whole outnumber those devoted specifically to primary, junior secondary, or senior secondary education. Existing research consequently emphasizes conclusions intended to apply across basic education while paying insufficient attention to differences across educational stages.

Third, research is predominantly subject-general. Most articles do not distinguish among individual subjects, and the total number of subject-specific studies remains small. Some subjects have received virtually no direct scholarly attention. Existing findings are therefore generally presented as principles applicable across the curriculum, while specialized research adapted to particular subjects remains seriously inadequate.

Fourth, non-empirical methods predominate. Theoretical analysis and experience-based reflection account for a large proportion of the literature, with theoretical analysis being the most common approach. Empirical methods, including questionnaire surveys, classroom observations, interviews, and case studies, are used less frequently; interview and case-study methods are especially rare. Thus, discussions of classroom assessment are primarily grounded in conceptual reasoning and personal experience rather than systematically collected empirical evidence.

These four characteristics describe the distribution of existing classroom assessment research by identifying who conducts the research, what educational contexts and subjects are investigated, and which methods are employed. However, this distribution itself does not directly determine whether the current research structure is appropriate. Further analysis is required to establish whether the concentration of research within universities has resulted in disconnection from classroom practice and whether the lack of stage-specific, subject-specific, and empirical studies has reduced the practical value of existing findings.

3. Analysis and discussion

3.1. Lack of standardization in classroom assessment research

A review of the selected literature reveals that classroom assessment research targeting Chinese primary and secondary schools lacks standardization, manifested in three dimensions.

First, there is inconsistency in the deployment of disciplinary terminology. Researchers frequently

use terms corresponding to “assessment,” “appraisal,” and “evaluation” interchangeably, even though these concepts have similar but distinct meanings. “Assessment” generally focuses on individuals and, in educational contexts, particularly on students. By contrast, “evaluation” is more commonly associated with educational institutions, programs, or other non-person entities. The broader concept of evaluation may nevertheless apply to either individuals or objects [7]. The interchangeable use of these terms gives rise to conceptual ambiguity and blurs the demarcation of research scope.

Second, there exists inconsistency in the definition of the object of classroom assessment. The objects examined in the literature can be divided into three categories: teachers, students, and both teachers and students. Studies in the first category mainly center on the assessment of teachers’ classroom instruction. Those in the second category examine teachers’ assessment of students in classroom settings. Studies in the third category address both teaching and learning.

This inconsistency may partly stem from the translation and interpretation of the English term “classroom assessment.” In the relevant international literature, “assessment” generally denotes the collection and interpretation of evidence pertaining to student learning. Accordingly, “classroom assessment” primarily denotes teacher-implemented assessment of students within classroom contexts. However, Chinese researchers frequently adopt an extended definition that encompasses the evaluation of either teachers or students. This difference between the literal meaning of the translated expression and its intended academic connotation has contributed to ambiguity regarding the object of classroom assessment research. However, these macro-level theories can provide only general value orientations at the conceptual level, rather than developing tailored theoretical frameworks for classroom assessment research [8].

Similar inconsistencies can also be found in English academic usage. For example, although the assessment of student achievement focuses on students and would therefore ordinarily be described using the term “assessment,” some scholars use the established expression “evaluation of student achievement.” Such usage illustrates that terminological boundaries are not always strictly maintained. Nevertheless, researchers should explicitly define their key concepts and apply them consistently throughout a study.

Third, inconsistency persists regarding the definition of classroom-assessment scope. Most researchers agree that classroom assessment concerns students and refers primarily to assessment activities conducted by teachers. However, two distinct approaches to its conceptual scope can be identified.

The first is a narrow definition, whereby classroom assessment is confined exclusively to assessment activities implemented during classroom instruction. This interpretation emphasizes the literal classroom setting and focuses on activities such as questioning, feedback, observation, and the evaluation of student performance.

The second is a broad definition, which includes the full range of activities required for classroom assessment to be successfully designed and implemented. In addition to assessment conducted during lessons, this definition covers teachers’ preparatory work before instruction and their subsequent analysis, interpretation, and feedback after the lesson. The coexistence of these definitions makes it difficult to compare findings across studies and may weaken the cumulative development of research in this field.

3.2. Lack of operational applicability

Research on classroom assessment in China began relatively late and remains at an exploratory stage. Existing studies place considerable emphasis on theoretical discussion but devote substantially less attention to practical investigation. Consequently, numerous findings lack operational applicability and provide limited guidance for classroom practice.

One manifestation of this problem is the shortage of research focusing on specific educational stages. The literature analysis shows that most studies discuss classroom assessment across primary and secondary education as a whole, whereas relatively few investigate primary school, junior secondary school, or senior secondary school separately. Such general studies may identify broad principles, but they cannot fully account for differences in students' developmental characteristics, learning demands, curricular content, and instructional practices across educational stages. As a result, their conclusions may be too general to offer teachers concrete and directly applicable assessment strategies.

4. Conclusion

This study reviewed classroom assessment research in Chinese primary and secondary schools from four dimensions: author affiliation, educational stage, subject area, and research method. The findings show that existing studies are mainly conducted by university researchers and generally focus on broad educational stages and subject areas. Empirical research remains limited, while theoretical analysis and experience-based reflection predominate. In addition, inconsistent terminology and unclear research boundaries have weakened the standardization and practical value of this field.

Disclosure statement

The authors declare no conflict of interest.

References

[1] State Council of the People's Republic of China, 2017, Decision of the State Council on the Reform and Development of Basic Education. http://old.moe.gov.cn//publicfiles/business/htmlfiles/moe/moe_16/200105/132.html

[2] State Council of the People's Republic of China, 2017, Implementation Opinions of the State Council on Deepening the Reform of the Examination and Enrollment System. http://www.gov.cn/zhengce/content/2014-09/04/content_9065.htm

[3] Ministry of Education of the People's Republic of China, 2011, Professional Standards for Secondary School Teachers (Trial). http://old.moe.gov.cn//publicfiles/business/htmlfiles/moe/s6127/201112/127830.html

[4] Yang XD, 2009, The Status and Reconstruction of Classroom Assessment. Global Education, 38(9): 42–46.

[5] Chen YK, 1999, Educational Evaluation. People's Education Press, Beijing, 24–26.

[6] Xing HJ, Tian WX, 2020, The Theory of Classroom Teaching Evaluation: Reflection and Reconstruction. Curriculum, Teaching Material and Method, 40(6): 53–58.

[7] Yan YF, 2021, On Competency-based Curriculum Evaluation. Curriculum, Teaching Material and Method, 41(5): 11–17.

[8] Stiggins RJ, 1991, Relevant Classroom Assessment Training for Teachers. Educational Measurement: Issues and Practice, 10(1): 7–12.

Publisher's note

Bio-Byword Scientific Publishing remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

International Education Forum, 2026, Volume 4, Issue 8
http://ojs.bbwpublisher.com/index.php/IEF
Online ISSN: 2981-8605
Print ISSN: 3083-4902

Research on Strategies for Cultivating Students' Critical Thinking Skills in English Reading Teaching

Bingzhi Li*

College of General Education, Tianjin Foreign Studies University, Tianjin 300204, China

Author to whom correspondence should be addressed.

Copyright: © 2026 Author(s). This is an open-access article distributed under the terms of the Creative Commons Attribution License (CC BY 4.0), permitting distribution and reproduction in any medium, provided the original work is cited.

Abstract: Under the core literacy education orientation of the new curriculum standards, English reading teaching is no longer merely about imparting language knowledge; instead, it has taken the cultivation of critical thinking skills as one of its core teaching goals. Currently, there is a phenomenon in primary and secondary school English reading teaching that emphasizes text interpretation but neglects thinking training. The phenomenon of students reading passively and thinking superficially is quite common, and the development of critical analysis and logical reasoning skills is restricted. Based on the core characteristics of English reading teaching and the laws of students' thinking development, this paper analyzes the problems existing in the cultivation of critical thinking skills in teaching, and proposes corresponding cultivation strategies from four aspects: classroom questioning, text exploration, activity design, and evaluation system, in order to stimulate students' deep reading thinking and promote the comprehensive implementation of students' English core literacy.

Keywords: English reading teaching; Critical thinking skills; Core literacy; Teaching strategies; Deep reading

Online publication: August 31, 2026

1. Introduction

With the continuous deepening of the English curriculum reform in basic education, the core literacy concept has permeated into English teaching in primary and secondary schools. Critical thinking ability is an important component of thinking quality and is the key guarantee for the improvement of students' comprehensive English abilities. English reading is the main way of language input and thinking training, which has the dual functions of consolidating language foundation and cultivating thinking ability. Currently, most English classrooms still rely mainly on exam-oriented teaching, with fixed teaching models and a lack of thinking training, resulting in students' reading remaining at the superficial level of translation and memorization, lacking the abilities of independent judgment, dialectical analysis, and innovative thinking.

Therefore, based on the actual situation of English reading teaching, exploring scientific and feasible strategies for cultivating critical thinking ability has important practical significance for optimizing classroom teaching and promoting students' long-term development.

2. Definition and theoretical basis of related concepts

2.1. Core connotation of critical thinking ability

Critical thinking ability, also known as critical thinking, is the comprehensive thinking ability of an individual when facing information, independently thinking, logically analyzing, dialectically judging, and rationally reflecting, screening, interpreting, evaluating, and reconstructing information. It mainly includes five aspects: analysis, reasoning, judgment, reflection, and innovation. Critical thinking ability in the English subject refers to the ability of students, in the reading process, to break through the surface information of the text, independently sort out the logical structure of the text, distinguish the correctness of viewpoints, explore the deep connotations, question the existing expressions, and form individualized cognition. It is a high-level thinking ability different from shallow mechanical reading. Unlike conventional thinking, critical thinking ability has four characteristics: independence, logic, criticism, and innovation. Independence means that students do not rely on the teacher's standard answers to interpret the text and can independently interpret the text; logic requires that students use the evidence of the text as the basis to infer viewpoints, with a clear and organized thinking; criticism is to dare to question the details of the text and the author's viewpoints, not blindly following the existing understanding; innovation is based on the interpretation of the text to generate new thinking and expression. The cultivation of critical thinking ability in English reading teaching is essentially to guide students to transform from "understanding the text" to "reading through the text, understanding the logic, and understanding the value" [1–2].

2.2. The compatibility of English reading teaching and critical thinking ability

English reading is a process of decoding language symbols, processing information, and constructing thoughts. It inherently contains numerous opportunities for thinking training and is in harmony with the cultivation of critical thinking ability. English texts cover a wide range of topics, including narrative, argumentative, expository, and applied texts, as well as various aspects of culture, society, life, and science, providing students with rich materials for multi-angle and deep-level thinking. The essence of reading is not simply language translation and vocabulary memorization, but a process that involves information extraction, logical organization, content interpretation, and value judgment, which has a natural compatibility with the cultivation of critical thinking ability. At the same time, critical thinking ability is the main support for improving the quality of English reading. Students with strong critical thinking ability can quickly clarify the structure of the text and accurately grasp the author's writing intention, dialectically analyze the differences in text viewpoints, and effectively avoid shallow reading and one-sided interpretation. Conversely, students lacking critical thinking ability only understand words and phrases and cannot explore the deep value of the text or achieve long-term improvement in reading ability. The two promote and assist each other, jointly promoting the improvement of students' core literacy in the English subject [3].

2.3. Theoretical support

This article mainly relies on the constructivist learning theory and the Bloom cognitive goal classification

theory. These two theories provide solid theoretical support for integrating critical thinking ability into English reading teaching. The constructivist learning theory holds that learning is not a passive process of accepting knowledge, but a process in which learners, based on their existing knowledge and cognitive reserves, actively process information, construct knowledge, and generate new cognitive systems. This theory completely overturns the traditional transmission-style teaching logic and values the students' subjectivity. In English reading teaching, teachers cannot adopt a one-way transmission method and reduce the direct output of standard answers. They should guide students to actively explore the text context, sort out logical connections, and independently think and analyze, gradually cultivating independent thinking, bold questioning, and critical thinking in the process of actively constructing knowledge. The Bloom cognitive goal classification theory divides cognitive levels from low to high into memory, understanding, application, analysis, evaluation, and creation, which are clearly structured and in line with the development laws of students' thinking. Among them, analysis, evaluation, and creation belong to high-order cognitive categories and are highly compatible with the core requirements of critical thinking ability, serving as an important theoretical basis for cultivating students' critical, logical, and innovative thinking. Currently, most English reading teaching only focuses on low-order cognitive goals such as memory and understanding, with a focus on word recognition and text translation, neglecting higher-order thinking training, resulting in the lagging development of students' critical thinking ability. Optimizing reading teaching based on this theory can accurately identify the target points for cultivating critical thinking ability and design higher-order reading tasks in a targeted manner, enabling students' cognitive thinking to shift from shallow passive memorization to deep active exploration [4].

3. Current situation and problems of cultivating students' critical thinking ability in English reading teaching

3.1. Fixed teaching concepts and insufficient focus on thinking cultivation

Influenced by the traditional exam-oriented education concept, current English reading teaching in primary and secondary schools still has a tendency to focus on scores and neglect thinking cultivation. Most teachers focus their teaching goals on vocabulary explanations, grammar analysis, sentence translations, and exercise solutions, taking students' ability to understand the text and answer questions as the core teaching standards, neglecting the cultivation of core competencies such as critical thinking and thinking quality. In the teaching process, teachers overly emphasize their own dominance, firmly grasping the direction of text interpretation in their own hands, directly telling students the main ideas, paragraph meanings, core viewpoints, and other standard answers, depriving students of the opportunity to think independently and autonomously. The long-term teaching concept has led students to develop a passive reading mindset, accustomed to being interpreted by teachers, lacking the awareness of active exploration, bold questioning, and dialectical thinking. Students only focus on the surface language information of the text, cannot sort out the logic of the text, cannot distinguish the merits and demerits of viewpoints, cannot explore cultural connotations, ultimately resulting in the problem of "being able to do exercises but not reading, understanding language but lacking thinking," and the development of critical thinking ability has been in a stagnant state for a long time [5].

3.2. Shallow classroom questions and lack of higher-order thinking guidance

Classroom questioning is the main way to stimulate students' thinking and cultivate critical thinking ability.

However, current English reading classroom questioning has the problems of shallowness and singularity. The majority of teachers' classroom questioning is mainly composed of low-order cognitive questions such as "What is the meaning of the word?", "How to translate the sentence?", "What content does the text tell?" The answers are fixed and do not require in-depth thinking, and can only test students' memory and basic understanding ability. However, the proportion of higher-order thinking questions such as text logic, author attitude, rationality of viewpoints, text loopholes, and multiple interpretations is very low. Classroom questioning lacks hierarchy and inspiration. Most teachers adopt the fixed form of "one question, one answer." After asking the question, they do not give students enough time to think, and for students' individualized answers and questioning of viewpoints, there is no targeted guidance and expansion, which cannot enable students to conduct in-depth reasoning and dialectical analysis. The shallow questioning system causes a serious lack of thinking training in the classroom and cannot cultivate students' critical thinking ability well [6].

3.3. One-sided text interpretation and ignoring deep exploration and multilateral dialectics

Text is the main carrier of reading teaching and critical thinking training. However, current English reading teaching's text interpretation has the phenomenon of one-sidedness and superficiality. On the one hand, teachers overly rely on the standard answers provided in textbooks and teaching aids when interpreting texts, resulting in a single perspective and focusing only on the core themes and basic knowledge points of the text. They ignore the deeper aspects such as the logical structure, writing techniques, emotional attitudes, and cultural connotations of the text, thus failing to provide students with materials for critical thinking. On the other hand, there is a lack of guidance for multiple interpretations in teaching, and teachers assume that the text's viewpoints are absolutely correct, not encouraging students to question the details of the text, to dialectically view the author's viewpoints, or to expand their thinking based on real-life situations. Teachers do not guide students to analyze the positive and negative viewpoints in argumentative texts, nor do they encourage them to verify the logical coherence of the arguments in opinion-based texts. The one-sided and rigid interpretation mode of the text limits the breadth and depth of students' thinking and fails to effectively cultivate their ability to think critically and dialectically.

3.4. The teaching mode is monotonous, and critical thinking training activities are lacking

Most English reading classes currently adopt a single and rigid mode of teacher explanation, student memorization, and exercise training. There is a lack of targeted critical thinking training activities. Classroom teaching is mainly a one-way output from the teacher, with students passively accepting knowledge. The proportion of autonomous exploration, cooperative analysis, and in-depth discussion in the classroom is very low. The majority of regular classroom activities are basic forms such as reading aloud, recitation, filling in, and multiple-choice training, lacking high-level thinking activities such as debate, text analysis, questioning of viewpoints, rewriting and creation, and case analysis. The expansion of extracurricular reading is insufficient, and students' reading materials are limited to short texts in the textbook and exam practice texts. Their reading horizons are narrow, and they lack opportunities for comparative reading of diverse texts and in-depth exploration of themes. The monotonous teaching mode and the lack of critical thinking activities have fragmented and formalized students' thinking training, preventing the formation of a systematic critical

thinking system, and making it difficult for students' critical thinking ability to steadily improve [7].

3.5. The evaluation system is incomplete, and the assessment of critical thinking ability is absent

Teaching evaluation is an important means to guide teaching direction and promote ability cultivation. However, the current English reading teaching evaluation system has obvious deficiencies, and the assessment of critical thinking ability is seriously lacking. In terms of evaluation content, the current evaluation mainly focuses on students' mastery of language knowledge, the accuracy of exercise answers, and the accuracy of text translation, without including the core indicators of critical thinking ability such as the logicality of thinking, the uniqueness of viewpoints, the rationality of analysis, and the innovation of questioning in the evaluation system. In terms of evaluation methods, final written tests dominate, and process-based evaluation is lacking. Teachers cannot promptly understand the display of students' thinking during the reading process and cannot provide targeted thinking guidance. At the same time, the evaluation standards are rigid and singular, using standard answers as the sole criterion, negating students' individualized interpretation and innovative thinking, suppressing students' critical thinking enthusiasm, and hindering the long-term cultivation of students' critical thinking ability.

4. Optimization strategies for cultivating students' critical thinking ability in English reading teaching

4.1. Update teaching concepts and establish the goal of cultivating critical thinking

To cultivate students' critical thinking ability, teachers must update their teaching concepts and break away from the mindset of exam-oriented teaching. They should establish a teaching concept that emphasizes both language learning and thinking cultivation. Teachers should deeply study the core requirements of the new curriculum standards and clearly identify the core position of critical thinking ability in English reading teaching. They should abandon the traditional teaching cognition that emphasizes knowledge and neglects thinking, and incorporate the cultivation of critical thinking ability throughout the entire reading teaching process. In the teaching design stage, teachers should determine the differentiated critical thinking teaching goals based on the text theme and students' cognitive levels. For lower-grade students, the focus is on cultivating independent thinking, information analysis, and simple reasoning abilities, while for higher-grade students, it is on cultivating logical analysis, dialectical judgment, and innovative questioning abilities. At the same time, educators should fully respect the students' dominant position in the classroom, reduce one-way knowledge transmission, and leave sufficient space for independent reading, independent thinking, and bold questioning, so that students can break free from the constraints of standard answers and form personalized text cognition, laying a foundation for the cultivation of critical thinking skills [8].

4.2. Optimize classroom questioning and build a higher-order thinking questioning system

Classroom questioning is a means to stimulate critical thinking. Teachers should break away from the shallow questioning mode and establish a hierarchical, suggestive, and critical questioning system. By relying on high-quality questions, students can conduct in-depth thinking. First, design progressive questions based on Bloom's cognitive goal theory, combining basic questions and higher-order questions. Basic

questions focus on the surface information of the text, enabling students to organize the content of the text; higher-order questions target the logic, viewpoints, attitudes, value connotations, and details of the text, prompting students to engage in critical thinking activities such as analysis, evaluation, and reasoning. Secondly, strengthen suggestive questioning and design more open-ended, exploratory, and controversial questions, discarding closed questions with fixed answers. For argumentative texts, questions such as "Is the author's core argument rigorous?" and "Is the evidence sufficient to support the viewpoint?" can be asked. For narrative texts, questions that can be asked include: "Was the protagonist's behavior reasonable? What would be the outcome if it were done in another way?" At the same time, optimize the questioning process, give students sufficient time to think, ask follow-up questions to expand on their answers, guide students to deeply analyze the problems step by step, and gradually cultivate their logical reasoning ability [9].

4.3. Deepen the connotation of the text and conduct multi-dimensional in-depth interpretation teaching

The text is the main carrier for critical thinking training. Teachers should break through the single and standardized interpretation mode of the text, guide students to explore the connotation of the text, and carry out multi-angle, deep-level, and diversified interpretations to comprehensively cultivate critical thinking skills. Firstly, start from the text structure, guide students to independently analyze the logical structure, paragraph relationships, and writing ideas of the text, cultivate students' logical thinking ability, and enable them to understand the argumentation logic and narrative framework through the process of organizing the framework. Secondly, conduct in-depth interpretation of the text, go beyond the superficial interpretation of word translation and main idea summary, guide students to explore the emotional attitude, cultural connotation, and writing intention of the text, compare and analyze the cultural differences between China and the West, and distinguish the values conveyed by the text. At the same time, encourage students to question the text, explore the loopholes in the text's expression, the one-sidedness of viewpoints, and the insufficiency of evidence, and not blindly accept the interpretations of the textbook and authorities. Additionally, carry out multi-text comparison interpretation, select texts with the same theme but different positions and styles for comparative reading, guide students to distinguish differences in viewpoints, evaluate the quality of the content, and improve dialectical critical thinking ability.

4.4. Innovate teaching models and design targeted critical thinking training activities

Rich classroom activities are the main way to implement the cultivation of critical thinking skills. Teachers should innovate teaching models, abandon the single explanation mode, and design diversified and high-level critical thinking training classroom activities, allowing students to exercise critical thinking skills in practice. Firstly, carry out group debate activities, select controversial viewpoints or topics in the text as the debate themes, organize students to form groups for debate, and improve students' logical reasoning, dialectical analysis, and critical expression abilities in the process of collecting evidence, logical expression, and positive and negative debate. Secondly, carry out text analysis and rewriting activities, guide students to independently evaluate the advantages and disadvantages of the text after reading, judge the rationality of the author's viewpoints, and supplement and rewrite the text, reconstruct the viewpoints, and cultivate innovative critical thinking ability. Thirdly, carry out theme exploration activities; based on the core theme of the text, guide students to expand and explore through connections with real-life situations and social phenomena,

independently collect materials, organize viewpoints, form personal cognition, break through the limitations of the text, and broaden the breadth of thinking. At the same time, expand extracurricular reading resources, incorporate current affairs news, English essays, and science popularization articles, etc., and use group reading and in-depth exploration to achieve regular training of critical thinking skills [10].

4.5. Improve the evaluation system and strengthen the process evaluation of critical thinking ability

A scientific and complete evaluation system is an important guarantee for the cultivation of critical thinking skills. It is necessary to restructure the English reading teaching evaluation system, incorporate critical thinking ability into the core evaluation category, and achieve the transformation from "knowledge evaluation" to "thinking evaluation." In terms of evaluation content, add evaluation indicators of critical thinking ability, mainly examining students' depth of text interpretation, logical analysis ability, viewpoint judgment ability, questioning and innovative consciousness, and multi-level thinking ability, taking into account both knowledge mastery and thinking development. In terms of evaluation methods, create a multi-dimensional evaluation system that integrates process evaluation and final evaluation. Process evaluation focuses on the thinking, questioning, discussion, and expression shown by students during the reading process, and records the development and changes of students' thinking in real time; final evaluation adds oral analysis, viewpoint presentation, and text exploration assessment forms on the basis of written tests. At the same time, improve the evaluation standards, abandon the sole criterion of standard answers, respect students' individualized and reasonable interpretations, encourage innovative thinking, and give positive evaluations to students' unique insights, rigorous logic, and reasonable questioning, fully mobilizing students' enthusiasm for critical thinking.

5. Teaching practice notes

In English reading teaching, to cultivate students' critical thinking skills, one should follow the laws of students' cognitive development, grasp the teaching boundaries, avoid teaching pitfalls, and ensure that the critical thinking training is carried out scientifically, efficiently, and on a regular basis. First, adhere to the principle of gradual progress. The cultivation of critical thinking skills is a long-term and progressive process; one should not rush for success or blindly raise the difficulty level of the training. Teachers should precisely align with the cognitive characteristics and thinking development levels of students in different grades of primary, junior high, and senior high schools, and design gradient thinking training tasks that progress from simple to complex and layer by layer. Starting from basic text information analysis and paragraph logical organization, gradually transitioning to viewpoint dialectical evaluation, questioning text loopholes, and innovative thinking reconstruction, which fully conforms to the rhythm of students' thinking growth and avoids exceeding their cognitive load. Secondly, balance the relationship between language teaching and thinking cultivation. One should not emphasize critical thinking training alone while neglecting the accumulation of language knowledge, nor should one adhere to traditional language teaching and weaken the cultivation of thinking. Instead, it should be based on language learning and aim at cultivating critical thinking as the core goal, achieving the two-way improvement of language application ability and critical thinking literacy. Finally, adhere to individualized teaching and respect students' individual thinking

differences. Implement teaching training at different levels. For students with weak thinking abilities, focus on basic thinking training to lay a solid foundation for critical thinking; for students with strong thinking abilities, design advanced exploration, viewpoint innovation, and other expansion tasks, so that students at different levels can all obtain suitable growth space and steadily improve their critical thinking abilities. Secondly, balance the relationship between language teaching and thinking cultivation. One should not overly emphasize critical thinking training while neglecting the accumulation of language knowledge; instead, it should be based on language learning and aim at promoting the common development of language ability and critical thinking ability. Finally, adhere to individualized teaching and respect students' thinking differences. For students with weak thinking abilities, focus on basic critical thinking training; for students with strong thinking abilities, design advanced exploration tasks. This allows students at different levels to improve their critical thinking abilities on the basis of their original levels.

6. Conclusion

Critical thinking ability is an important component of students' core English literacy and a key thinking skill for their lifelong development. Cultivating critical thinking ability in English reading teaching is an inevitable requirement for deepening English teaching reform and implementing the educational goal of fostering moral character. This article analyzes the existing problems in the cultivation of critical thinking in current English reading teaching, combines relevant theoretical foundations, and proposes optimization strategies from five aspects: teaching philosophy, classroom questioning, text interpretation, activity design, and teaching evaluation. In future teaching, educators will continue to base it on classroom teaching practice, continuously improve the training mode of critical thinking, refine teaching strategies, and make the cultivation of critical thinking regular and systematic, promoting the dual improvement of students' language ability and thinking quality.

Disclosure statement

The author declares no conflict of interest.

References

[1] Han ZM, 2026, Basic Forms and Advanced Strategies of AI Empowering Junior High School English Reading Teaching. Teaching and Management, 2026(10): 60–63. https://doi.org/10.26993/j.cnki.jxygl.2026.10.011

[2] Zhang J, 2026, Research on the Cultivation Strategies of Primary School English Reading Critical Thinking Ability under the Perspective of Deep Learning. Primary School Learning Guidance, 2026(3): 100–102.

[3] Liao QH, Tang HJ, 2025, Research on the Practice of English Reading Teaching for Developing Critical Thinking Ability in Junior High School. Overseas English, 2025(24): 177–179.

[4] Jiang Y, Yang JC, 2025, English Reading Teaching with the Empowerment of Large Language Models and the Cultivation of Critical Thinking Ability. Theory and Practice of Foreign Language Teaching, 2025(6): 62–70 + 79.

[5] Sun YJ, 2025, Practical Research on Cultivating Scientific Spirit in High School English Reading Teaching. Primary and Secondary School English Teaching and Research, 2025(12): 47–51 + 57.

[6] Lin JZ, 2025, Cultivation of Students' Critical Thinking Ability in High School English Reading Teaching. College

Entrance Examination, 2025(27): 75–77.

[7] Zhang GD, 2024, A Brief Analysis of the Application of Generative Artificial Intelligence in High School English Reading Teaching. English Learning, 2024(S2): 78–81.

[8] Chen H, 2024, Innovation and Practice Exploration of English Reading Teaching Strategies in Junior High School. Achievements, 2024(S1): 62–63.

[9] Zhang T, 2024, Analysis of the Path to Improving English Reading Ability of Primary School Students. Achievements, 2024(S1): 103–105.

[10] Lai WC, 2023, Cultivation of Students' Critical Thinking Ability in High School English Reading Teaching. Chinese Journal of Education Studies, 2023(5): 103.

Publisher's note

Bio-Byword Scientific Publishing remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

International Education Forum, 2026, Volume 4, Issue 8
http://ojs.bbwpublisher.com/index.php/IEF
Online ISSN: 2981-8605
Print ISSN: 3083-4902

Perceived Usefulness and Higher-Order Thinking: A PLS-SEM Investigation of the Chaoxing AI Learning Companion Platform among Vocational College Students

Yiting Qiu[1,2], Wen Liu[1], Wenjie Zhang[3,4], Yue Ying[1], Bo Song[1], Asokan Vasudevan[5]*, Deshinta Arrova Dewi[6], Munir Hayet Khan[2]

[1]Zhejiang Technical Institute of Economics, Hangzhou 310018, Zhejiang, China
[2]Faculty of Engineering and Quantity Surveying, INTI International University, Persiaran Perdana BBN, 71800 Nilai, Negeri Sembilan, Malaysia
[3]Nanchong Vocational College of Culture and Tourism, Nanchong 637400, Sichuan, China
[4]Faculty of Education and Liberal Arts, INTI International University, Persiaran Perdana BBN, 71800 Nilai, Negeri Sembilan, Malaysia
[5]Faculty of Business and Communications, INTI International University, Persiaran Perdana BBN Putra Nilai, 71800 Nilai, Negeri Sembilan, Malaysia
[6]Faculty of Data Science and Information Technology, INTI International University, Nilai 71800, Malaysia

Author to whom correspondence should be addressed.

Copyright: © 2026 Author(s). This is an open-access article distributed under the terms of the Creative Commons Attribution License (CC BY 4.0), permitting distribution and reproduction in any medium, provided the original work is cited.

Abstract: This study focuses on vocational college students' adoption of the "embedded" Chaoxing AI learning companion platform and the influence of AI learning companion adoption on higher-order thinking. Unlike general-purpose AI tools, the Chaoxing AI learning companion platform is embedded in institutional teaching platforms and course-based learning processes. However, existing research has largely examined willingness to use general-purpose generative AI tools, and empirical evidence on how AI learning companion functions embedded in educational platforms affect vocational college students' higher-order thinking remains scarce. Drawing on the Technology Acceptance Model (TAM), this study constructs a research model of "perceived ease of use and perceived usefulness—AI learning companion adoption—higher-order thinking" and conducts PLS-SEM analysis on 75 valid questionnaires using SmartPLS. The results show that the revised measurement model exhibits good reliability and convergent validity. The structural model results indicate that perceived usefulness significantly and positively affects AI learning companion adoption ($\beta = 0.748$, $P < 0.001$), whereas perceived ease of use does not significantly affect AI learning companion adoption ($\beta = 0.092$, $P = 0.517$); AI learning companion adoption significantly and positively affects higher-order thinking ($\beta = 0.540$, $P < 0.001$). The mediation results further show that AI learning companion adoption exerts a significant indirect effect between perceived usefulness and higher-order thinking ($\beta = 0.404$, $P = 0.001$), whereas the indirect effect of perceived ease of use is not significant. The findings suggest that, in the vocational education context, whether students perceive the AI learning companion as "genuinely useful" matters more for their adoption than

whether it is “easy to use,” and this adoption is further associated with the development of higher-order thinking. By applying TAM to platform-based AI learning companion scenarios, this study extends the model’s explanatory scope to embedded educational agents and offers practical implications for vocational colleges to optimize AI-supported learning tools and promote more inclusive and sustainable education (SDG 4).

Keywords: Chaoxing AI learning companion platform; Higher-order thinking; Technology Acceptance Model; Perceived usefulness; PLS-SEM; SDG 4

Online publication: August 31, 2026

1. Introduction

In the past two years, attention to artificial intelligence in education has shifted rapidly from “whether it can be used” to “whether it can genuinely improve learning.” Large language models represented by ChatGPT have triggered a new round of discussion on pedagogical transformation; subsequently, international products such as Gemini and Claude, as well as domestic large models and conversational applications such as ERNIE Bot (Wenxin Yiyan), Qwen, iFlytek Spark, Kimi, and Doubao, have continued to enter students’ daily learning contexts. Meanwhile, educational agents built on large model capabilities have begun to move from general question answering toward course tutoring, homework support, learning analytics, and personalized guidance. In many university teaching scenarios, AI is no longer merely an extracurricular supplementary tool but has begun to enter the course learning process itself. Recent research has likewise shifted from broad discussions to more specific educational contexts, examining how intelligent tools affect learning support, instructional integration, and educational governance [1–3]. Given this shift, leveraging platform-based intelligent learning support tools to promote more inclusive, accessible, and sustainable education is closely related to Sustainable Development Goal 4 (SDG 4).

In this study, the Chaoxing AI learning companion platform is conceptualized as an agentic system—an AI-enabled learning companion that can interpret students’ requests, select appropriate tools and learning resources, and take goal-oriented actions within the course-based learning environment. Depending on the context, this platform is also referred to below as an AI agent, agentic AI, or agent-based learning companion.

Nevertheless, the more diverse the technological forms, the more necessary it is to distinguish the educational functions of different types of tools. Compared with open, general-purpose large models, the Chaoxing AI learning companion platform possesses a stronger education-vertical orientation. It is not a general question-answering system that operates independently of course platforms; rather, it is a platform-based learning support tool embedded in the teaching process together with course resource organization, knowledge graph display, assignment and testing feedback, agent-based question answering, and, in some courses, programming support. For this reason, the value of the Chaoxing AI learning companion platform is more likely to be realized in specific learning activities such as completing assignments, receiving learning feedback, and obtaining problem-solving hints, rather than merely helping students access information more conveniently. This also echoes recent research on generative AI applications in education, which suggests that different technological forms differ in their functional boundaries, usage modes, and pedagogical value [4–5].

This issue is particularly important for vocational education. Vocational learning emphasizes task contexts, application orientation, and problem solving; students need not only to acquire knowledge but

also to analyze, judge, reflect, and innovate in complex or simulated professional scenarios. The value of platform-based learning support tools thus lies not only in helping students obtain information more quickly but also in whether they can further promote the development of higher-order thinking. As discussed in this paper, higher-order thinking comprises four dimensions—problem solving, critical analysis, metacognition, and creativity—mainly involving learners' abilities to analyze problems, judge information, regulate learning processes, and generate new ideas in complex tasks.

Although existing research has accumulated a substantial body of discussion on AI and education, several gaps remain; the following three are particularly relevant. First, many studies focus on willingness to use general-purpose large models, ethical controversies, or overall learning perceptions, paying insufficient attention to education-vertical tools embedded in teaching platforms. Second, even when technology acceptance is addressed, many studies remain at the level of attitudes or intentions, rarely asking a further question: whether learners' acceptance of platform functions can translate into higher-level cognitive outcomes, especially higher-order thinking. Existing reviews also indicate that research in this area is dominated by attitudes, intentions, and ethical issues regarding general-purpose generative AI, with relatively limited attention to platform-embedded learning support tools and their learning outcome variables [1, 6]. For vocational college students, a group with a distinctly practice-oriented profile, direct evidence on this issue is still lacking.

2. Literature review and research hypotheses

2.1. Technology acceptance model and platform-based learning support tools

The Technology Acceptance Model posits that individuals' acceptance of technology is mainly influenced by perceived ease of use and perceived usefulness [7]. The former emphasizes whether a system is easy to learn and operate, whereas the latter emphasizes whether a system helps improve task performance. Subsequent research has further shown that, in educational technology contexts, these two variables have strong explanatory power for learners' acceptance of platforms or systems, although their relative influence varies with technology type, user experience, and usage context [8].

Recent advances in agentic AI have renewed interest in the technology acceptance process. Karran et al. (2025) examined multi-stakeholder acceptability of responsible AI in education and highlighted the role of perceived AI agency in shaping acceptance, while others demonstrated that AI-based pedagogical agents significantly enhance students' self-efficacy, engagement, and learning outcomes in programming education [9]. In adaptive learning environments with motivational pedagogical agents, Su et al. (2025) found that agent-supported learning can support personalized learning and benefit learners with different prior-knowledge levels, and Alshammari et al. (2025) reported that technological, ethical, social, and individual determinants jointly shape GenAI-supported learning beyond simple acceptance [10–11]. These emerging findings jointly suggest that the agentic nature of AI learning companions should be treated as an explicit factor in technology acceptance research alongside perceived ease of use and perceived usefulness.

For platform-based learning support tools, ease of use is certainly important but is not always decisive. For students who have long been exposed to digital platforms, basic usability resembles an entry threshold rather than the core condition determining whether they are willing to continue using a tool. What truly matters is often whether the tool can help them complete tasks, improve learning performance, or enhance

the learning experience. In the context of this agent-based learning companion, students' judgments about the platform's educational value are likely to influence their acceptance more than their judgments about the difficulty of operating it. Accordingly, the following hypotheses are proposed:

H1: Perceived ease of use significantly and positively affects vocational college students' acceptance of the Chaoxing AI learning companion platform.

H2: Perceived usefulness significantly and positively affects vocational college students' acceptance of the Chaoxing AI learning companion platform.

2.2. Higher-order thinking and platform-based learning support

Higher-order thinking is commonly used to describe cognitive activities that go beyond rote memorization and simple reproduction [12–13]. In this study, higher-order thinking comprises four dimensions: problem solving (PS), critical analysis (CT), metacognition (MN), and creativity (CR). Specifically, problem solving emphasizes identifying problems, analyzing conditions, and proposing solutions; critical analysis focuses on verifying information, comparing viewpoints, and forming well-considered judgments; metacognition centers on planning, monitoring, reflection, and self-correction; and creativity involves breaking through existing paths and generating new ideas and solutions. The higher-order thinking scale adopted in this study draws on four dimensions from a previously validated complex thinking instrument—problem solving, critical analysis, metacognition, and creativity [14].

Relevant research suggests that intelligent learning support tools can help learners analyze problems more systematically, revise their understanding, and regulate their learning processes through immediate feedback, hints, and resource integration; such tools are particularly promising in problem-based learning, case analysis, and task-based learning. However, technical capability does not equal learning outcomes. Whether platform functions genuinely contribute to higher-order thinking largely depends on whether learners are willing to accept those functions and integrate them into their own learning processes. Therefore, the study proposes:

H3: Vocational college students' acceptance of the Chaoxing AI learning companion platform significantly and positively affects their higher-order thinking.

2.3. Research gaps and the mediation mechanism

Research on AI applications in education suffers from at least three deficiencies. First, current discussions revolve mainly around general-purpose generative AI, with insufficient attention to learning support tools embedded in educational platforms such as the Chaoxing agent-based companion. Second, vocational education places greater emphasis on task contexts and applied competencies, yet empirical research on vocational college students' use of platform-based learning support tools is relatively limited. Third, existing studies often treat "attitude" or "intention" as the endpoint, rarely examining whether learners' acceptance of a tool extends to higher-level learning outcomes such as problem solving, critical analysis, metacognition, and creativity.

Theoretically, perceived ease of use and perceived usefulness may not directly affect higher-order thinking; rather, they are more likely to operate first on students' acceptance of the platform and then influence cognitive outcomes indirectly through acceptance and subsequent usage processes. In other words, platform acceptance may be a key mechanism linking technology perceptions and higher-order thinking.

Accordingly, the study proposes:

H4: Acceptance of the Chaoxing AI learning companion platform mediates the relationship between perceived ease of use and higher-order thinking.

H5: Acceptance of the Chaoxing AI learning companion platform mediates the relationship between perceived usefulness and higher-order thinking.

Building on this reasoning, this study takes the Technology Acceptance Model as its theoretical foundation, with perceived ease of use and perceived usefulness as antecedent variables, acceptance of the Chaoxing AI learning companion platform as the mediating variable, and higher-order thinking as the outcome variable, and tests the corresponding structural relationships. The study mainly addresses three questions: first, whether perceived ease of use and perceived usefulness affect vocational college students' acceptance of the Chaoxing AI learning companion platform; second, whether platform acceptance affects vocational college students' higher-order thinking; and third, whether platform acceptance mediates the relationships between the antecedent variables and higher-order thinking. The theoretical framework of this study is presented in **Figure 1**.

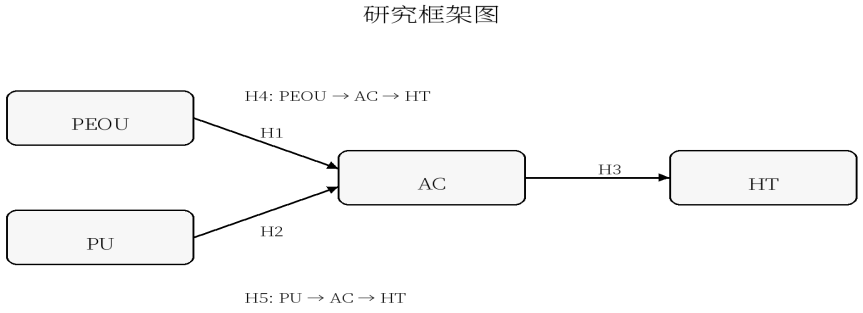


Figure 1. Research framework. Note: PEOU = perceived ease of use; PU = perceived usefulness; AC = adoption of the Chaoxing AI learning companion platform; HT = higher-order thinking. HT is reflected by four dimensions: problem solving, critical analysis, metacognition, and creativity.

3. Method

3.1. Research design and sample

This study employed a cross-sectional questionnaire design. Vocational college students were recruited as the research participants, and their perceptions, acceptance, and higher-order thinking in the context of using the Chaoxing AI learning companion platform were examined. After data collection, questionnaires with obvious careless responding were screened out, and the remaining valid questionnaires were subjected to Partial Least Squares Structural Equation Modeling (PLS-SEM) analysis.

3.2. Pretest and formal survey

No separate formal pilot test was conducted in this study, but a small-scale pretest was administered before the formal questionnaire was distributed. Participants generally considered the questionnaire to be moderate in length, clearly worded, and easy to understand. Based on these responses, the basic comprehensibility of

the questionnaire was preliminarily confirmed, and the formal survey was subsequently administered.

3.3. Variable measurement

The antecedent variables in this study include perceived ease of use (PEOU) and perceived usefulness (PU). PEOU captures whether students see the agentic learning companion as simple to operate, easy to interact with, and quick to learn; PU captures whether they think the platform improves the learning experience, facilitates course learning, and raises task completion efficiency.

The mediating variable is adoption of the Chaoxing AI learning companion platform (AC), measured mainly in terms of overall satisfaction, positive evaluation of the platform's educational potential, and identification with the platform as a supplement to learning tools.

The outcome is higher-order thinking (HT), which in this design comprises four dimensions: problem solving (PS), critical analysis (CT), metacognition (MN), and creativity (CR). This treatment keeps the multidimensional nature of higher-order thinking while letting us examine the relationship between platform acceptance and higher-level cognitive outcomes at the overall level. **Table 1** lists the constructs and their measurement items.

Table 1. Constructs and measurement items

Construct	Description	Sample item content	Source
PEOU	Perceived ease of use	Simple and uncomplicated to operate; easy to learn and become familiar with	Adapted from TAM literature, contextualized to the Chaoxing platform
PU	Perceived usefulness	Improved learning experience; facilitated course learning; improved task completion efficiency	Adapted from TAM literature, contextualized to the Chaoxing platform
AC	Adoption of the Chaoxing AI learning companion platform	Overall satisfaction; positive evaluation of educational potential; accepted as a supplement to learning tools	Adapted from technology acceptance literature, contextualized to the Chaoxing platform
HT	Higher-order thinking	Problem solving, critical analysis, metacognition, creativity	Adapted from higher-order thinking literature, contextualized to the Chaoxing platform

Note: All items were contextually adapted from existing technology acceptance and higher-order thinking research and adjusted to the usage context of the Chaoxing AI learning companion platform

3.4. Data analysis

This study used SmartPLS for partial least squares structural equation modeling (PLS-SEM). Three considerations guided this choice: the sample size is relatively small; the study concerns not only path relationships but also the predictive relevance of the model; and PLS-SEM suits models with multiple reflective constructs and mediating relationships [15]. The analytical procedure consisted of descriptive statistical analysis, measurement model assessment, structural model testing, mediation analysis, and predictive capability assessment.

4. Results

4.1. Descriptive statistics

A total of 109 raw questionnaires were collected in this study. After excluding straight-lining responses and other obviously careless invalid questionnaires, 75 valid responses were retained for subsequent PLS-SEM

analysis. The basic characteristics of the sample are presented in **Table 2**.

Table 2. Sample characteristics

Variable	Category	n	%
Gender	Male	40	53.3
	Female	35	46.7
Grade	Freshman	34	45.3
	Sophomore	40	53.3
	Junior	1	1.3
Major	Business	36	48.0
	STEM	17	22.7
	Other	16	21.3
	Humanities/Arts/Social Sciences	6	8.0
Usage frequency	Weekly	26	34.7
	1–2 times per semester	19	25.3
	Daily	19	25.3
	More than once a month / as needed	11	14.7

Note: N = 75. Because "primary purpose of use" was a multiple-choice question, it is described separately in the text according to endorsement frequencies.

Regarding sample structure, males slightly outnumbered females; in terms of grade level, freshmen and sophomores dominated, with sophomores slightly more numerous. By major, business students accounted for the largest proportion, followed by STEM and other majors. Regarding usage frequency, weekly users were the most numerous, accounting for about one-third; daily users and those who used the platform 1–2 times per semester were equally represented. As for primary purposes, the most common use was completing assignments/practice (69.3%), followed by obtaining supplementary learning materials (60.0%), using the platform because of instructor requirements (60.0%), viewing learning analytics (57.3%), and viewing knowledge graphs (52.0%); the proportion of students who used the platform for direct question-and-answer interaction with AI agents was 28.0%.

4.2. Measurement model assessment

After the initial measurement model assessment, a limited revision was made to a small number of items with poor measurement performance or high redundancy. This revision was based on a joint consideration of indicator performance and item meaning, aiming to improve scale quality while preserving the original measurement content as much as possible. After the revision, all core constructs exhibited good internal consistency and convergent validity. Discriminant validity was assessed using the HTMT and Fornell–Larcker criteria [16]. The reliability and convergent validity results of the measurement model are presented in **Table 3**.

Table 3. Measurement model results

Construct	Cronbach's α	rho_A	CR	AVE	Conclusion
AC	0.942	0.944	0.963	0.896	Satisfactory
HT	0.937	0.948	0.944	0.519	Satisfactory

Construct	Cronbach's α	rho_A	CR	AVE	Conclusion
PEOU	0.906	0.913	0.941	0.843	Satisfactory
PU	0.883	0.893	0.945	0.895	Satisfactory

Note: All constructs have CR above 0.70 and AVE reaching or exceeding 0.50, indicating good internal consistency and convergent validity.

During the revision process, CR3 and CR4 in the creativity dimension were not retained because of low outer loadings (loadings<0.7), and PU2 in perceived usefulness was deleted because of strong redundancy with other indicators of the same construct. The proportion of deleted items was small, representing a cautious scale purification. The two retained PU items still correspond to overall learning gains and task completion efficiency, respectively, preserving the core meaning of the construct. In addition, a small number of items with relatively low outer loadings but content representativeness were retained in the final model. Although the loadings of MN4 (0.466) and PS2 (0.568) were relatively low, the AVE of the relevant constructs still reached acceptable standards; these items were therefore retained on the basis of a balance between statistical results and content completeness.

In this study, discriminant validity was established through both the Fornell–Larcker criterion and the heterotrait–monotrait ratio (HTMT). First, the square root of the average variance extracted (AVE) of each latent variable was greater than its correlations with any other latent variable, satisfying the Fornell–Larcker criterion [16]. In addition, all HTMT values were below the lenient threshold of 0.90, providing further support for discriminant validity [17]. The discriminant validity results are presented in **Tables 4** and **5**.

Table 4. Discriminant validity results: Fornell–Larcker criterion

Construct	AC	HT	PEOU	PU
AC	0.946			
HT	0.540	0.721		
PEOU	0.682	0.372	0.918	
PU	0.820	0.493	0.788	0.946

Note: Diagonal values are the square roots of the AVE of each construct.

Table 5. Discriminant validity results: HTMT matrix

Construct	AC	HT	PEOU	PU
AC	—			
HT	0.551	—		
PEOU	0.738	0.396	—	
PU	0.895	0.527	0.881	—

Note: HTMT values below the threshold of 0.90 indicate acceptable discriminant validity [17].

The collinearity check showed that the inner-model VIF values were PEOU→AC = 2.643, PU→AC = 2.643, and AC→HT = 1.000, indicating no serious structural collinearity problems.

4.3. Structural model results

The structural path results are presented in **Table 6**, and the path coefficients and significance of the structural model are shown in **Figure 2**.

Table 6. Structural path results

Hypothesis	Path	β	t	p	Significance	Result
H1	PEOU → AC	0.092	0.648	0.517	ns	Not supported
H2	PU → AC	0.748	4.970	< 0.001	***	Supported
H3	AC → HT	0.540	4.921	< 0.001	***	Supported

Note: ns = not significant; *** $P < .001$.

The results show that perceived ease of use did not significantly affect platform acceptance; thus, H1 was not supported. Perceived usefulness had a significant positive effect on platform acceptance, supporting H2. Platform acceptance also had a significant positive effect on higher-order thinking, supporting H3.

In terms of explanatory power, the R^2 of AC was 0.676, indicating that perceived ease of use and perceived usefulness strongly explain platform acceptance; the R^2 of HT was 0.292, indicating that platform acceptance explains higher-order thinking to a certain extent. Regarding effect sizes, the f^2 of PEOU→AC was 0.010, indicating a weak effect; the f^2 of PU→AC was 0.654, indicating a strong effect; and the f^2 of AC→HT was 0.412, also reaching a strong level. Supplementary fit indices showed SRMR = 0.097 and NFI = 0.593. Given that PLS-SEM emphasizes prediction and path explanation, these fit indices are reported as supplementary information only.

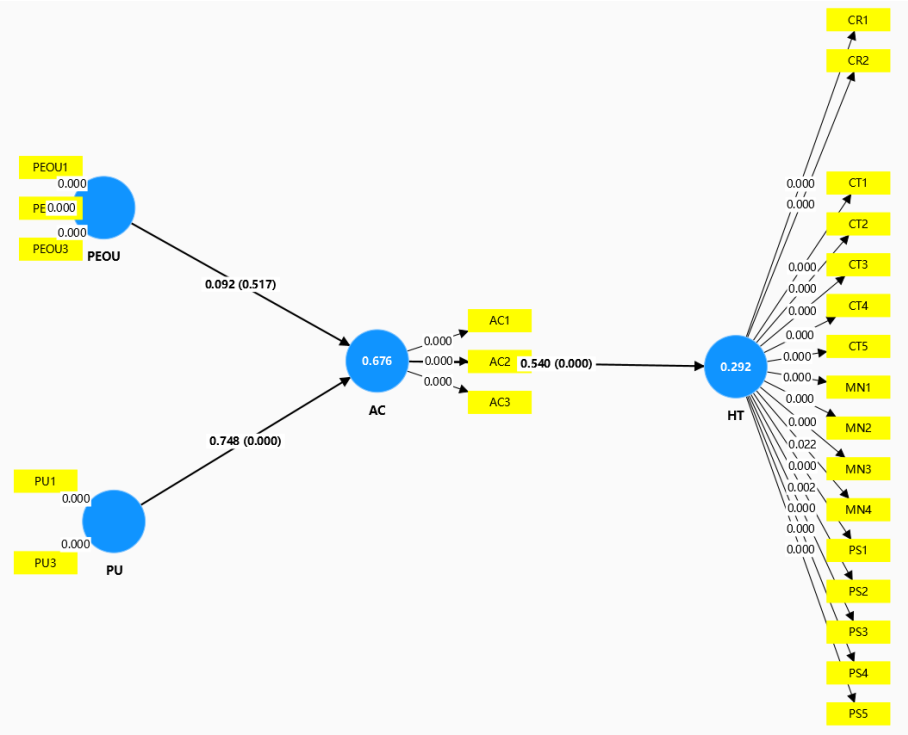


Figure 2. Structural model with path coefficients and significance. Note: Values in circles are the R^2 of endogenous variables; values beside paths are standardized path coefficients, with *P* values in parentheses; values beside observed indicators are the outer model significance results.

4.4. Mediation results

The mediation results are presented in **Table 7**.

Table 7. Mediation results

Hypothesis	Indirect path	β	t	p	Significance	Result
H4	PEOU → AC → HT	0.050	0.618	0.537	ns	Not supported
H5	PU → AC → HT	0.404	3.314	0.001	**	Supported

Note: ns = not significant; ** $P < .01$.

The results show that the indirect effect of perceived ease of use on higher-order thinking through platform acceptance was not significant, so H4 was not supported; the indirect effect of perceived usefulness on higher-order thinking through platform acceptance was significant, supporting H5. In line with the theoretical rationale that perceptions of an AI learning companion affect higher-order thinking only after students accept and engage with the platform, platform acceptance was specified as the sole transmission mechanism in the initial model; therefore, no direct paths from perceived ease of use or perceived usefulness to higher-order thinking (PEOU→HT / PU→HT) were included.

4.5. Predictive capability results

The prediction results show that the Q^2_predict of AC was 0.640 and that of HT was 0.186, both greater than zero, indicating that the model has predictive relevance for both endogenous constructs, with stronger predictive relevance for platform acceptance. Compared with the linear model, the PLS model did not show a clear advantage for AC but showed better predictive performance for HT. The model thus demonstrates limited but acceptable predictive capability, with modest predictive value particularly for the outcome variable of higher-order thinking. The predictive assessment results are presented in **Table 8**.

Table 8. Predictive assessment results

Construct	Q^2_predict	Comparison with LM	Predictive judgment
AC	0.640	Not overall superior to the linear model	Strong predictive relevance, but limited incremental predictive advantage
HT	0.186	Overall superior to the linear model	Some predictive capability

Note: A Q^2_predict greater than zero indicates that the model has predictive relevance.

5. Discussion

The results show that perceived usefulness significantly affects vocational college students' acceptance of the Chaoxing AI learning companion platform, whereas the effect of perceived ease of use does not reach significance; platform acceptance is, in turn, significantly and positively associated with higher-order thinking and exerts a significant indirect effect between perceived usefulness and higher-order thinking.

The prominence of perceived usefulness fits the usage context of the Chaoxing platform. For students, the value of the platform lies not in the technical concept itself but in whether it can satisfy immediate learning needs for on-demand help and quick mastery of course content; the AI learning companion is a support system embedded in course-based learning processes rather than an isolated question-answering

tool. Students who receive direct help with assignments, review, course comprehension, or task advancement usually form a more positive acceptance. In the vocational education context, a platform perceived as useful may therefore connect more strongly with learners' acceptance and, through it, with higher-order thinking gains than one perceived as easy to use.

Second, the relationship between platform acceptance and higher-order thinking is also easy to understand in how students actually use the Chaoxing platform. Knowledge graphs, for instance, help students organize fragmented knowledge into associative networks; this structured presentation fits associative processing in the brain and may support problem solving and creative thinking. The AI agents give 24/7 learning companion support, so students can get timely hints, clarification, or extra explanations when they encounter questions; this immediacy keeps learning continuous and may promote analysis and reflection [18]. Through repeated question–answer–reflection cycles, students may gradually internalize the underlying structure of a problem; these moments of insight are the higher-order cognitive gains this study set out to capture.

Third, an intelligent assignment-grading function may also shape higher-order thinking. Compared with providing a result in one go, timely feedback, error-correction hints, and subsequent optimization suggestions are more likely to prompt students to revisit their reasoning, identify where errors occurred, and adjust their approaches. This cycle resembles the monitoring, reflection, and revision involved in metacognition and may also be helpful for critical analysis. For vocational college students, learning outcomes often depend on whether they can continuously improve their practices in response to feedback.

In addition, code-tutoring functions on the Chaoxing platform may also relate to the logical training behind higher-order thinking. For beginners with weak programming foundations, these functions do not replace thinking; they help students understand steps, organize logic, and lower the entry threshold. That novices can get started easily does not mean that cognitive demands are weakened; on the contrary, with appropriate scaffolding in code generation, error explanation, and problem-solving hints, the platform can help students gradually build clearer logical chains and more flexible problem-solving approaches.

In this study, the low, nonsignificant effect of perceived ease of use has several possible explanations. First, as digital natives, current students already know how to operate platform-based technologies and treat ease of use almost as a taken-for-granted prerequisite rather than a decisive condition for acceptance. Second, the platform has many functions, but its interface hierarchy, menu settings, or functional entry points may be relatively complex, so students may not have formed a strong ease-of-use perception; a clearer, friendlier, lower-cognitive-load interface might help. Sample size also matters: the sample is small and concentrated in one group, so this result may not fully reflect ease-of-use perceptions among a broader student population; larger samples are needed.

The mediation results further indicate that whether the platform is genuinely accepted by students may be a key link connecting technology perceptions and higher-order thinking. Even when students see the platform as helpful, that judgment does not automatically become higher-level learning; benefits for higher-order thinking are more likely to appear when this perception of usefulness turns into sustained use and integration into learning processes. The platform's educational value thus builds gradually through perception, acceptance, use, and reflection, rather than being decided directly by the mere existence of functions.

These results have practical implications as well. Institutions and instructors promoting the platform

should explain concretely how its functions serve course learning (e.g., immediate help, assignment revision, knowledge organization, and code tutoring), rather than emphasizing the number of functions or the novelty of the technology. For platform designers, improving interface friendliness and functional accessibility matters as much as strengthening the learning-support value of functions, so students can find, understand, and keep using relevant functions. If students see the platform as both genuinely helpful and smoother to use, its support for higher-order thinking may become easier to observe.

6. Limitations and future research

First, the sample of 75 valid questionnaires was drawn from a single vocational college, which limits the statistical power of the path tests and the generalizability of the findings. Future research should expand the sample size and recruit participants from multiple vocational colleges across different regions to enhance the robustness and external validity of the model.

Second, the cross-sectional questionnaire design and self-reported measures may introduce common method bias and do not permit causal inferences. Future studies could adopt longitudinal tracking, experimental or quasi-experimental designs, and objective behavioral data to provide stronger evidence for the causal relationships identified here.

Third, although the structural model exhibited acceptable predictive relevance (Q^2_predict > 0), the overall model fit indices were moderate (e.g., SRMR = 0.097 and NFI = 0.593), and the HTMT value between perceived usefulness and acceptance (0.895) approached the threshold of 0.90. Future work may refine the measurement model, introduce additional mediators or moderators, or cross-validate the findings with covariance-based structural equation modeling.

7. Conclusion

Based on the Technology Acceptance Model, this study examined how the Chaoxing AI learning companion platform influences vocational college students' higher-order thinking. The results show that perceived usefulness, rather than perceived ease of use, significantly drives platform acceptance, which in turn is positively associated with higher-order thinking and mediates the usefulness–thinking relationship. Thus, in the vocational education context, whether a platform-based AI learning support tool can function may depend less on how easy it is to operate than on whether students genuinely perceive its help with learning tasks. These findings extend TAM to embedded AI learning companion scenarios and provide a practical reference for vocational colleges to improve platform design and promote quality-oriented, sustainable education (SDG 4).

Funding

Project Title: An Empirical Study on Cultivating Higher-Order Thinking Skills among Vocational College Students through AI-Accompanied Learning Scenarios on the Chaoxing Platform (2025 Higher Education Research Project and "Research on AI-Empowered Teaching and Learning Applications" by the Zhejiang Provincial Higher Education Society) (Project No.: KT2025499).

Disclosure statement

The authors declare no conflict of interest.

References

[1] Crompton H, Burke D, 2023, Artificial Intelligence in Higher Education: The State of the Field. International Journal of Educational Technology in Higher Education, 20(1): 1–22. https://doi.org/10.1186/s41239-023-00392-8

[2] Küchemann S, Avila KE, Dinc Y, et al., 2025, On Opportunities and Challenges of Large Multimodal Foundation Models in Education. npj Science of Learning, 10(1): 1–11. https://doi.org/10.1038/s41539-025-00301-w

[3] Wu X, Zhu P, Zhang J, et al., 2026, ChatGPT's Impact on Student Learning Outcomes: A Meta-analysis of 35 Experimental Studies. Humanities and Social Sciences Communications, 13(1): 684. https://doi.org/10.1057/s41599-026-07019-z

[4] Hemminki-Reijonen U, Hassan NMAM, Huotilainen M, et al., 2025, Design of generative AI-powered Pedagogy for Virtual Reality Environments in Higher Education. npj Science of Learning, 10(1): 31. https://doi.org/10.1038/s41539-025-00326-1

[5] Tlili A, Shehata B, Adarkwah MA, et al., 2023, What if the Devil is my Guardian Angel: ChatGPT as a Case Study of Using Chatbots in Education. Smart Learning Environments, 10(1): 15. https://doi.org/10.1186/s40561-023-00237-x

[6] Létourneau A, Deslandes Martineau M, Charland P, et al., 2025, A Systematic Review of AI-driven Intelligent Tutoring Systems (ITS) in K-12 Education. npj Science of Learning, 10(1): 29. https://doi.org/10.1038/s41539-025-00320-7

[7] Davis FD, 1989, Perceived Usefulness, Perceived Ease of Use, and User Acceptance of Information Technology. MIS Quarterly, 13(3): 319–340. https://doi.org/10.2307/249008

[8] Venkatesh V, Davis FD, 2000, A Theoretical Extension of the Technology Acceptance Model: Four Longitudinal Field Studies. Management Science, 46(2): 186–204. https://doi.org/10.1287/mnsc.46.2.186.11926

[9] Karran AJ, Charland P, Trempe-Martineau J, et al., 2025, Multi-stakeholder Perspective on Responsible Artificial Intelligence and Acceptability in Education. npj Science of Learning, 10(1): 44. https://doi.org/10.1038/s41539-025-00333-2

[10] Su M, Dang B, Nguyen A, et al., 2025, Choice-making in an Adaptive Learning System with Motivational Pedagogical Agents. npj Science of Learning, 10(1): 77. https://doi.org/10.1038/s41539-025-00366-7

[11] Alshammari SH, Alrashidi ME, Alshammari MH, et al., 2025, Determinants of Student Adoption of Artificial Intelligence Applications in Higher Education. Science Reports, 15(1): 35921. https://doi.org/10.1038/s41598-025-19851-5

[12] Yan L, Greiff S, Teuber Z, et al., 2024, Promises and Challenges of Generative Artificial Intelligence for Human Learning. Nature Human Behaviour, 8(10):1839–1850. https://doi.org/10.1038/s41562-024-02004-5

[13] Zhao G, Sheng H, Wang Y, et al., 2025, Generative Artificial Intelligence Amplifies the Role of Critical Thinking Skills and Reduces Reliance on Prior Knowledge while Promoting in-depth learning. Education Sciences, 15(5): 554. https://doi.org/10.3390/educsci15050554.

[14] Tobón S, Luna-Nemecio J, 2021, Complex Thinking and Sustainable Social Development: Validity and Reliability of the COMPLEX-21 Scale. Sustainability, 13(12): 6591. https://doi.org/10.3390/su13126591

[15] Hair JF, Hult GTM, Ringle CM, et al., 2021, Partial Least Squares Structural Equation Modeling (PLS-SEM) Using R: A Workbook, in Classroom Companion: Business. Springer International Publishing, Cham. https://doi.

org/10.1007/978-3-030-80519-7

[16] Fornell C, Larcker DF, 1981, Evaluating Structural Equation Models with Unobservable Variables and Measurement Error. Journal of Marketing Research, 18(1): 39–50. https://doi.org/10.1177/002224378101800104

[17] Henseler J, Ringle CM, Sarstedt M, 2015, A New Criterion for Assessing Discriminant Validity in Variance-based Structural Equation Modeling. Journal of the Academy of Marketing Science, 43(1): 115–135. https://doi.org/10.1007/s11747-014-0403-8

[18] Qiu Y, Lu Y, Xia G, et al., 2025, Leveraging Green AI Technology to Build Sustainable Schools: A Conceptual Model Based on AI Agents. Journal of Electronic Research and Application, 9(2): 150–158. https://doi.org/10.26689/jera.v9i2.9957

Publisher's note

Bio-Byword Scientific Publishing remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

International Education Forum, 2026, Volume 4, Issue 8
http://ojs.bbwpublisher.com/index.php/IEF
Online ISSN: 2981-8605
Print ISSN: 3083-4902

Effects of a Child-Mediated Family-Based Stroke Education Intervention on Public First Aid Knowledge and Attitudes

Jie Wang[1], Jinping Sai[1], Zhenzhen Rao[1], Dongmei Zhao[1], Yanli Tao[1], Haoying Yang[1], Jianying Peng[2]

[1]Department of Neurology, Xiangyang No.1 People's Hospital, Xiangyang, Hubei, China
[2]School of Public Health, Wuhan University of Science and Technology, Wuhan, Hubei, China

Copyright: © 2026 Author(s). This is an open-access article distributed under the terms of the Creative Commons Attribution License (CC BY 4.0), permitting distribution and reproduction in any medium, provided the original work is cited.

Abstract: *Objective:* To investigate the current status of public knowledge and attitudes toward stroke first aid, and to explore the intervention effects of a child-mediated family health education model on stroke prevention. *Methods:* In March 2023, this study enrolled 264 fourth-grade students and their parents from two districts in Xiangyang City. A one-month child-mediated health education intervention was conducted, covering stroke risk factors, warning recognition, and emergency management. Professionally developed training videos were distributed digitally to schools and incorporated into weekly health education sessions (20-minute theoretical instruction + 20-minute practical training), followed by outcome evaluation. *Results:* Students' knowledge scores significantly improved from 29.55±17.80 to 92.48±5.49 (P<0.001). Among parents, post-intervention knowledge and attitude scores were from 43.49±9.92 to 80.27±14.03 and from 60.04±14.26 to 85.98±13.23(P<0.001), respectively. Among parents, post-intervention knowledge was affected by age, education level, occupation, chronic diseases, and child-mediated education participation (P<0.05), while attitudes were associated with education level, occupation, chronic diseases, and child-mediated education participation (P<0.05). *Conclusion:* Public knowledge of stroke first aid requires urgent improvement, with multiple influencing factors identified. The child-mediated family health education model significantly enhances residents' stroke health literacy.

Keywords: Stroke; Public; First-aid knowledge; Children; Family health education

Online publication: August 31, 2026

1. Introduction

Stroke is the leading cause of death and disability among adults in China [1–3]. In recent years, remarkable progress has been made in acute stroke treatment techniques such as intravenous thrombolysis and endovascular thrombectomy. Nevertheless, numerous patients delay medical consultation—some even assume their symptoms will subside—due to insufficient first-aid knowledge of stroke and ignorance of channels for prompt emergency care, which ultimately exacerbates their condition. Studies indicate that

82.52% of patients experience a pre-hospital delay of more than two hours from symptom onset to hospital arrival [4]. After recognizing stroke symptoms, 75.9% of participants choose to call an ambulance [5]; the second most common response (58.8%) is advising the patient to seek hospital care, while only 34.1% opt for immediate consultation with a physician. Conventional stroke health education mainly targets adult populations, yet its intervention effects are limited by obstacles including low willingness to absorb health information and rapid knowledge decay [6–8]. Child-Mediated Health Education (CMHE), an innovative health promotion model, has demonstrated unique strengths in chronic disease prevention and control in recent years. Child-mediated interventions have significantly improved family members' disease awareness and healthy behaviors in the management of hypertension, depression, and vaccination prevention [9–11]. Current research regarding children's role in boosting public capabilities for early stroke recognition and emergency response remains scarce, creating an urgent need to explore its feasibility and effectiveness. Accordingly, this study first investigates the public's awareness of early stroke identification and emergency management knowledge, then implements Child-Mediated Stroke Communication (CMSC), and evaluates the post-intervention outcomes of this health education program, so as to provide scientific evidence for optimizing stroke prevention and control strategies.

2. Subjects and methods

2.1. Study subjects

In March 2023, a total of 264 fourth-grade students and their parents from four classes across two districts of Xiangyang City were selected as research subjects for the survey. This study was approved by the Medical Ethics Committee of the hospital (Approval No. 2022KY012).

Inclusion criteria: (1) Clear consciousness, normal communication ability and basic comprehension capacity; (2) Normal listening, speaking, reading and writing skills, capable of cooperating with medical staff to complete questionnaires; (3) Informed of the research requirements and willing to participate in two rounds of questionnaire surveys.

Exclusion criteria: (1) Non-permanent local residents; (2) Individuals with mental illnesses; (3) Participants who withdraw midway; (4) Other conditions that prevent completion of the research.

2.2. Research methods

2.2.1. Implementation procedures

A random sampling method was adopted in this study. Two fourth-grade classes were selected from each of the two administrative districts of Xiangyang City, covering four classes in total. One day after the spring semester began, investigators launched a one-month stepped intervention. Each training session combined on-site demonstration with verbal Q&A, limited to 40 minutes in total: 20 minutes for theoretical teaching and question answering, and another 20 minutes for hands-on practice by students. Training content covered stroke risk factors, the FAST mnemonic for early warning sign identification, and emergency management procedures. Dedicated staff recorded videos of all training modules and provided electronic copies to students. Students were guided to watch the videos together during weekly health education classes. Any questions raised by students were sent to corresponding investigators via WeChat messages, who delivered consolidated follow-up guidance the next day.

A three-stage evaluation system was applied:

(1) Assessments of stroke first-aid knowledge and attitudes among students (pre- and post-intervention) and parents (post-intervention only), including indicators such as the accuracy of risk factor recognition and standardization of emergency operations;

(2) Standardized score conversion: Standardized score = (actual score / total score) × 100%. A three-tier evaluation standard was set as follows [12]: ≥85 points = good, 60–84 points = moderate, and <60 points = poor.

Pre-intervention data collection was completed within one day after the semester started, while post-intervention data collection was finished within one day upon intervention termination. To guarantee data quality, independent quality control personnel collected and analyzed questionnaires under blind conditions. Meanwhile, investigators' teaching performance was monitored across dimensions including verbal expression and teaching pace to ensure the quality of intervention implementation.

2.2.2. Development of evaluation questionnaires

In accordance with the survey objectives and contents, the self-designed Public Questionnaire on Stroke First-Aid Knowledge (student version and parent version) was developed based on a literature review, after multiple rounds of expert consultation among specialists in emergency medicine, neurology, and nursing [13]. The questionnaire covered three modules: demographic characteristics, health history, and stroke first-aid knowledge and attitudes. A pretest-posttest design was adopted for the student version, with 5 knowledge items in both pretest and posttest (total score = 45). The parent version also included pretest and posttest assessments, consisting of two dimensions: knowledge (5 items, full score = 100) and attitudes (5 items, full score = 60). The knowledge dimension focused on core content, including the FAST identification mnemonic and golden therapeutic time window for stroke. The attitude dimension adopted a five-point Likert scale to measure respondents' willingness and beliefs regarding stroke emergency treatment. A pilot survey verified that the reliability and validity coefficients of all questionnaires were greater than 0.80.

2.2.3. Quality control

Prior to formal data collection, senior nurses with over 5 years of clinical experience in the neurology department of the hospital delivered standardized training to all investigators. The training highlighted research objectives, communication skills, and operational specifications to guarantee standardization and consistency in survey implementation, intervention delivery, and data collection.

2.2.4. Statistical analysis

Statistical analyses were performed using SPSS 26.0 software. Count data were described as frequencies (percentages), and intergroup comparisons were conducted via the Chi-square test. Measurement data conforming to normal distribution were expressed as mean ± standard deviation; the independent samples t-test was adopted for two-group comparisons, and one-way analysis of variance (one-way ANOVA) for multi-group comparisons. Multiple linear regression analysis was applied to analyze associated influencing factors. The significance level was set at $\alpha = 0.05$.

3. Results

3.1. Levels of public knowledge and attitudes regarding early stroke recognition and first aid

The results revealed that the total knowledge score of students was (29.55±17.80) points before intervention and (92.48±5.49) points after intervention, with a statistically significant difference between pre- and post-intervention (t = -54.89, P < 0.001) (**Table 1**). For parents, the pre-intervention total knowledge score was (43.49±9.92) points, and the post-intervention total knowledge score was (80.27±14.03) points. Their pre-intervention total attitude score was (60.04±14.26) points, and the post-intervention total attitude score was (85.98±13.23) points, with all differences statistically significant (all P < 0.001) (**Table 1**).

3.2. Univariate analysis of factors influencing public knowledge and attitudes toward early stroke recognition and first aid

Univariate analysis indicated that students' pre-intervention knowledge level was significantly correlated with age, baseline stroke awareness and recognition of emergency telephone numbers (P < 0.05), while only age remained an independent predictive factor after intervention (P < 0.01) (**Table 2**). Among parents, post-intervention knowledge level was associated with age, educational background, occupation, history of chronic diseases, participation in child-mediated education, and stroke knowledge delivered by children (P < 0.05). Their attitudes were jointly affected by educational background, occupation, being the primary caregiver of children, chronic disease history, participation in child-mediated education, and stroke knowledge transmission from children (P < 0.05) (**Table 3**; items with P > 0.05 were omitted from this table). All significant variables were further verified via multivariate adjustment, which suggested discrepancies in cognitive and behavioral patterns between the two populations.

Table 1. Comparison of knowledge and attitude scores among different groups before and after intervention

Category	Students(n=264)	Parents(n=264)	
	Knowledge Score	Knowledge Score	Attitude Score
Pre-intervention	29.55±17.80	43.49±9.92	60.04±14.26
Post-intervention	92.48±5.49	80.27±14.03	85.98±13.23
t	-54.89	33.961	22.334
P(95%CI)	<0.001(-65.193, -60.680)	<0.001(34.642, 38.906)	<0.001(23.654, 28.228)

Table 2. Univariate analysis of students' knowledge before and after intervention (n=264)

Category (Students)	Number of Participants	Pre-intervention Knowledge Score	*t/F*	*P*-value	95%*CI* Lower Limit	95%*CI* Upper Limit	Post-intervention Knowledge Score	*t/F*	*P*-value	95%*CI* Lower Limit	95%*CI* Upper Limit
Gender			-0.202	0.840	-4.770	3.881		0.847	0.398	-0.759	1.904
Male	136	29.33 ±17.62					92.76 ±5.60				
Female	128	29.77 ±18.07					92.19 ±5.37				
Age	264	10.24 ±0.54	17.735	<0.001	17.160	21.446	92.48 ±5.49	244.576	<0.001	81.578	82.902

Stroke Awareness			-10.161	<0.001	-30.839	-20.742
No	192	22.51 ±9.74				
Yes	72	48.30 ±20.70				
Knowledge of Emergency Call Number			-2.555	0.011	-46.285	-5.992
No	3	3.70 ±6.42				
Yes	261	29.84 ±17.68				

Table 3. Univariate analysis of parents' knowledge and attitudes after intervention (*n*=264)

Category (Parents)	**Number of Participants**	**Post-intervention Knowledge Score**	***t/F***	***P* value**	**95%*CI* Lower Limit**	**95%*CI* Upper Limit**	**Post-intervention Attitude Score**	***t/F***	***P* value**	**95%*CI* Lower Limit**	**95%*CI* Upper Limit**
Age (years)			3.224	0.023				1.546	0.203		
≤30	9	78.33 ±15.41			66.487	90.179	83.33 ±12.50			73.725	92.942
31–40	140	82.50 ±12.69			80.380	84.620	87.56 ±13.58			85.291	89.828
41–50	53	79.62 ±14.03			75.754	83.491	85.06 ±12.48			81.622	88.504
>50	62	76.05 ±15.89			72.012	80.084	83.60 ±12.98			80.307	86.898
Education Level			15.116	<0.001				8.789	<0.001		
Junior high school and below	32	69.69 ±15.81			63.988	75.387	80.73 ±13.46			75.876	85.582
High school/ vocational school	58	75.52 ±14.53			71.697	79.338	81.32 ±14.59			77.487	85.157
College	57	81.05 ±12.31			77.786	84.319	85.09 ±15.49			80.978	89.198
Bachelor's degree and above	117	85.13 ±11.68			82.990	87.267	90.17 ±9.58			88.417	91.925
Occupation			5.732	0.001				3.333	0.020		
Unemployed/ retired	17	76.47 ±14.98			68.771	84.170	81.37 ±15.46			73.424	89.321
Freelancer	63	76.35 ±14.40			72.722	79.976	85.05 ±11.12			82.253	87.852

Worker/ employee of enterprises and institutions	166	81.02 ±13.76			78.916	83.132	85.89 ±13.84			83.772	88.015
Medical professional	18	90.56 ±7.25			86.948	94.163	94.44 ±8.57			90.180	98.709
Student Caregiver			1.710	0.090	-0.569	7.706		2.326	0.021	0.653	7.859
Parents	194	81.21 ±13.38					87.11 ±13.39				
Grandparents (maternal/ paternal)	70	77.64 ±15.50					82.86 ±12.36				
Chronic Disease			-2.264	0.024	-8.509	-0.593		-2.287	0.023	-8.068	-0.603
No	201	79.18 ±13.41					84.95 ±13.25				
Yes	63	83.73 ±15.48					89.29 ±12.74				
Knowledge Level of Stroke Before Receiving Student Education			5.335	0.005				9.513	<0.001		
Not aware at all	94	77.13 ±14.09			74.241	80.015	89.63 ±8.26			87.936	91.320
Slightly aware	154	81.40 ±13.56			79.238	83.555	83.12 ±15.12			80.709	85.525
Very aware	16	87.81 ±14.49			80.093	95.533	92.19 ±10.30			86.696	97.679
Knowledge Level of Stroke After Receiving Student Education			14.874	<0.001				12.463	<0.001		
Decreased	8	81.25 ±9.16			73.591	88.909	89.58 ±3.86			86.358	92.808
No change	7	85.00 ±10.00			75.752	94.249	86.90 ±16.57			71.583	102.227
Increased to some extent	99	73.38 ±15.05			70.383	76.385	79.97 ±15.61			76.853	83.080
Improved Significantly improved	150	84.53 ±11.82			82.626	86.440	89.72 ±9.91			88.123	91.322

3.3. Multivariate regression analysis of factors influencing public knowledge and attitudes toward early stroke recognition and first aid

Multiple linear regression analysis demonstrated that having heard of stroke and awareness of emergency telephone numbers were independent influencing factors for students' pre-intervention knowledge ($P < 0.05$) (table omitted). Age, educational background, occupation, chronic disease history, participation in child-

mediated education, and stroke knowledge conveyed by children were independent influencing factors for parents' post-intervention knowledge ($P < 0.05$) (**Table 4**). Educational background, occupation, chronic disease history, participation in child-mediated education, and stroke knowledge delivered by children served as independent influencing factors for parents' post-intervention attitudes ($P < 0.05$) (**Table 5**).

Table 4. Multiple linear regression analysis of parents' knowledge after intervention (n=264)

Categories	B	B Value (Standard Error)	*t* value	*P* value
(Constant)	64.410	5.100	12.629	<0.001
Age	-1.950	1.110	-1.756	0.080
Education Level	4.119	0.856	4.809	<0.001
History of Chronic Disease	6.062	2.038	2.974	0.003
Knowledge of Stroke Before Receiving Reverse Education	3.170	1.436	2.208	0.028
Knowledge Level of Stroke After Receiving Student-Transmitted Stroke Knowledge	3.964	1.138	3.484	0.001
Occupation (Reference: Unemployed/Retired)				
Freelancer	-3.925	3.678	-1.067	0.287
Worker/Employee of Enterprises and Institutions	-2.800	3.558	-0.787	0.432
Medical Professional	1.012	4.673	0.217	0.829

Table 5. Multiple linear regression analysis of parents' attitudes after intervention (n=264)

Categories	B	B Value (Standard Error)	*t value*	*P value*
(Constant)	73.331	4.161	17.624	<0.001
Education Level	3.663	0.782	4.685	<0.001
History of Chronic Disease	4.837	1.867	2.590	0.010
Knowledge of Stroke Before Receiving Reverse Education	-4.735	1.399	-3.385	0.001
Knowledge Level of Stroke After Receiving Student-Transmitted Stroke Knowledge	2.592	1.105	2.345	0.020
Occupation (Reference: Unemployed/Retired)				
Freelancer	1.370	3.480	0.394	0.694
Worker/Employee of Enterprises and Institutions	0.251	3.388	0.074	0.941
Medical Professional	9.718	4.481	2.169	0.031

4. Discussion

Stroke ranks as the second leading cause of death worldwide and the primary cause of disability in adults, constituting a major public health challenge in China [3, 14]. Statistical data indicate that approximately 3.94 million new stroke cases occur annually in China, the highest figure globally [15]. Stroke survivors suffer from sequelae including limb dysfunction, cognitive impairment, and post-stroke loneliness, imposing a heavy disease burden on families and society [16–19]. The concept that "time is brain" has been widely recognized in stroke emergency care [20]. On average, 10,000 neurons die every minute following stroke onset [21].

Surveys reveal that merely 26.8% of the general public can identify all stroke risk factors [22]. Compared with developed countries, China falls significantly behind in both the scale and quality of stroke prevention and rehabilitation services [23]. Conventional stroke health education relies on one-way communication targeting adults, such as community lectures and promotional leaflets [6, 24–27]. Restricted by low public willingness to absorb health information and rapid knowledge decay, such interventions fail to sustain long-term effects [28–29]. As an emerging intervention strategy, the CMSC model has exhibited unique strengths in chronic disease prevention and control in recent years.

Results presented in **Table 2** and **Table 3** demonstrated that the total scores of public stroke-related first-aid knowledge were significantly elevated ($P < 0.001$). Compared with conventional adult-oriented health education, the CMSC model significantly improved family members' learning engagement and knowledge retention by taking children as an emotional bond. This finding is consistent with the research outcomes of Lwin et al. on hypertension health education [9]. Children's innocent nature reduces adults' psychological defensiveness, and knowledge transmission during parent-child interactions strengthens learning efficacy. As "health change agents" within families, children can effectively facilitate adults' acquisition of health knowledge and behavioral modification [10].

The findings of this study indicated that respondents' mastery of stroke risk factors, stroke symptoms, and emergency coping capabilities varied across groups. Having heard of stroke and awareness of emergency hotlines were independent influencing factors for students' pre-intervention knowledge ($P < 0.05$). Age acted as an independent significant predictor of post-intervention knowledge ($P < 0.01$). For students, older age was correlated with greater stroke awareness, higher knowledge scores, and better emergency response proficiency.

Age, educational background, occupation, history of chronic diseases, participation in child-mediated education, and stroke knowledge delivered by children were independent influencing factors for parents' post-intervention knowledge ($P < 0.05$). Educational background, occupation, chronic disease history, participation in child-mediated education, and stroke knowledge conveyed by children were independent influencing factors for parents' post-intervention attitudes ($P < 0.05$). With advancing age, longer years of schooling and longer tenure in mental work, individuals tend to pay more attention to personal health knowledge, gain broader exposure to early disease identification and first-aid skills, and utilize diverse channels to acquire stroke-related information. They also demonstrate stronger ability to absorb and comprehend disease knowledge, achieve better mastery of relevant content, develop a deeper understanding of disease severity, and attach greater importance to identifying early stroke symptoms [30]. Workers, professional technical staff, and administrative personnel in enterprises and institutions generally possess broader horizons and stronger comprehension and reading capabilities. Moreover, employees of enterprises and institutions have relatively more opportunities to access first-aid knowledge in daily work, which enables them to attach corresponding importance to such information. People with a prior history of chronic diseases tend to improve their medical literacy by reading abundant health materials. Those with a medical background exhibit superior command of stroke knowledge due to the special nature of their professions. Meanwhile, the survey results also revealed that participants who received stroke training achieved better mastery of stroke knowledge and held more positive attitudes compared with untrained participants. This indicates that training on stroke knowledge and skills can expand the public's stroke knowledge reserve and may offer assistance when sudden illnesses or accidental injuries occur. Therefore, targeted training

should be provided for personnel across all occupations, and diversified forms of health education should be organized regularly. These measures can improve the public's mastery of stroke-related health knowledge and emergency response capacity, raise their awareness of first-aid knowledge and skills, and ultimately enhance their overall proficiency in emergency treatment.

5. Conclusion

The CMSC model significantly improves the public's knowledge level and positive attitudes regarding early stroke recognition and emergency management. Health information disseminated via child-mediated communication stimulates family members' sense of responsibility and fosters a shared goal of "protecting family health." This finding expands the theoretical framework of conventional health education. The results of this study provide empirical evidence for the family-centered health promotion model highlighted in the Healthy China 2030 initiative. By leveraging children's unique role within the family, this innovative model overcomes the limitations of traditional health education and offers novel strategies for stroke prevention and control.

Funding

Project funded by Xiangyang Science and Technology Bureau (Grant No. 2022YL35B); Science and Technology Innovation Project of Xiangyang No.1 People's Hospital (Grant No. XYY2023NT05)

Disclosure statement

The authors declare no conflict of interest.

Author Contributions

Jie Wang was responsible for study design, project implementation, quality control, manuscript revision, and submission. Jinping Sai conducted project implementation as well as data collection and sorting. Zhenzhen Rao undertook project design and implementation, data collation, statistical analysis, manuscript drafting, revision, and submission. Dongmei Zhao, Yanli Tao, and Haoying Yang participated in project implementation. Jianying Peng was in charge of project design and manuscript revision.

Reference

[1] Fan J, Li X, Yu X, et al., 2023, Global Burden, Risk Factor Analysis, and Prediction Study of Ischemic Stroke, 1990-2030. Neurology, 101(2): e137–150.

[2] Steinmetz JD, Seeher KM, Schiess N, et al., 2024, Global, Regional, and National Burden of Disorders Affecting the Nervous System, 1990–2021: A Systematic Analysis for the Global Burden of Disease Study 2021. The Lancet Neurology, 23(4): 344–381.

[3] Feigin VL, Abdollahi A, Abreu LG, et al., 2024, Global, Regional, and National Burden of Stroke and its Risk Factors, 1990–2021: A Systematic Analysis for the Global Burden of Disease Study 2021. Lancet Neurology,

23(10): 973–1003.

[4] Jiang Y, Xiong Y, Chi Y, et al., 2024, Healthcare-Seeking Delays in Acute Ischemic Stroke Patients: The Influence of Gender, Immigrant Status, and Educational Background. Risk Management and Healthcare Policy, 2024(17): 191–204.

[5] Luan S, Yang Y, Huang Y, et al., 2021, Public Knowledge of Stroke and Heart Attack Symptoms in China: A Cross-Sectional Survey. BMJ Open, 11(1): e43220.

[6] Yan LL, Gong E, Gu W, et al., 2021, Effectiveness of a Primary Care-based Integrated Mobile Health Intervention for Stroke Management in Rural China (SINEMA): A Cluster-randomized Controlled Trial. PLoS Med, 18(4): e1003582.

[7] Holder C, Krishnamurthi R, Theadom A, 2023, Exploring Facilitators and Barriers to Long-term Behavior Change Following Health–wellness Coaching for Stroke Prevention: A Qualitative Study Conducted in Auckland, New Zealand. Brain and Behavior, 13(1): e2671.

[8] Finch E, Coleman A, Cameron A, et al., 2024, Utilising Interactive Technology for Stroke Patient Education: A Systematic Review. Disability and Rehabilitation: Assistive Technology, 19(4): 1236–1248.

[9] Lwin MO, Malik S, Chua TSJ, et al., 2016, Intergenerational Transfer of Blood Pressure Knowledge and Screening: A School-based Hypertension Awareness Program in Singapore. Global Health Promotion, 23(1): 27–36.

[10] Kageyama M, Matsushita A, Kobayashi A, et al., 2023, Video-based E-learning program for Schoolteachers to Support Children of Parents with Mental Illness: A Cluster Randomized Trial. BMC Public Health, 23(1): 523.

[11] Vaidyanathan R, 2019, Immunization Coverage among under-five Children Living Along a School Student through Child-to-child and Child-to-parent Information, Education and Communication Strategy. Indian Journal of Public Health, 63(4): 334–340.

[12] Ning M, Zheng HH, Jiang DH, et al., 2021, Influencing Factors of First-aid Knowledge and Training Effect among Elderly Residents in Haikou. Chinese Journal of Gerontology, 41(13): 2845–2849.

[13] Feigin VL, Owolabi MO, 2023, Pragmatic Solutions to Reduce the Global Burden of Stroke: A World Stroke Organization-Lancet Neurology Commission. Lancet Neurology, 22(12): 1160–1206.

[14] Zhao Y, Hua X, Ren X, et al., 2023, Increasing Burden of Stroke in China: A Systematic Review and Meta-analysis of Prevalence, Incidence, Mortality, and Case Fatality. International Journal of Stroke, 18(3): 259–267.

[15] Ellepola S, Nadeesha N, Jayawickrama I, et al., 2022, Quality of Life and Physical Activities of Daily Living among Stroke Survivors; Cross-Sectional Study. Nursing Open, 9(3): 1635–1642.

[16] Chowdhury SZ, Baskar PS, Bhaskar S, 2021, Effect of Prehospital Workflow Optimization on Treatment Delays and Clinical Outcomes in Acute Ischemic Stroke: A Systematic Review and Meta-analysis. Academic Emergency Medicine, 28(7): 781–801.

[17] Bjorck A, Materne M, Arvidsson Lindvall M, et al., 2024, Investigating Cognitive Impairment, Biopsychosocial Barriers, and Predictors of Return to Daily Life among Older Stroke Survivors. Frontiers in Neurology, 2024(15): 1403567.

[18] Huang H, Zhang L, Dong W, et al., 2024, Stigma and Loneliness among Young and Middle-aged Stroke Survivors: A Moderated Mediation Model of Interpersonal Sensitivity and Resilience. Journal of Psychiatric and Mental Health Nursing, 31(4): 596–606.

[19] Rajan SS, Decker-Palmer M, Wise J, et al., 2021, Beneficial Effects of the 30-minute Door-To-needle Time Standard for Alteplase Administration. Annals of Clinical and Translational Neurology, 8(8): 1592–1600.

[20] Londhe SR, Gg SK, Keshava SN, et al., 2021, Indian College of Radiology and Imaging (ICRI) Consensus Guidelines for the Early Management of Patients with Acute Ischemic Stroke: Imaging and Intervention. Indian Journal of Radiology and Imaging, 31(2): 400–408.

[21] Al-Obaidi H, Khidhair Z, Jirjees F, et al., 2023, Factors Associated with Knowledge and Awareness of Stroke in the Iraqi Population: A Cross-Sectional Study. Frontiers in Neurology, 2023(14): 1144481.

[22] Chen J, Zhu Q, Yu L, et al., 2022, Stroke Risk Factors of Stroke Patients in China: A Nationwide Community-Based Cross-Sectional Study. International Journal of Environmental Research and Public Health, 19(8): 4807.

[23] Sese LVC, Guillermo MCL, 2023, Strengthening Stroke Prevention and Awareness in the Philippines: a conceptual framework. Frontiers in Neurology, 2023(14): 1258821.

[24] Zhong X, Wang J, He L, et al., 2020, Recognition of Stroke-related Knowledge among Community Residents and the Improvement after Intensive Health Education: A Cross-sectional Study. BMC Neurology, 20(1): 373.

[25] Liang J, Luo C, Ke S, et al., 2023, Stroke Related Knowledge, Prevention Practices and Associated Factors among Stroke Patients in Taizhou, China. Preventive Medicine Reports, 2023(35): 102340.

[26] Abbasian M, Rashidi Birgani H, Khabiri R, et al., 2024, Exploring Education Interventions for Stroke Prevention Among Adults and Older Individuals: A Scoping Review. Health Science Reports, 7(11): e70167.

[27] Saidu A, Lee K, Ismail I, et al., 2023, Effectiveness of Video Self-instruction Training on Cardiopulmonary Resuscitation Retention of Knowledge and Skills among Nurses in North-western Nigeria. Frontiers in Public Health, 2023(11): 1124270.

[28] Dharmakulaseelan L, Ceci Galanos L, Guerrero R, et al., 2025, Knowledge Acquisition and Audience Retention in Stroke Education: Results from a Global Study by the World Stroke Organization. Stroke, 56(2): 521–526.

[29] Xu JF, Jin PY, 2020, Investigation on Early Recognition and First-aid Knowledge among Family Members of Patients with Acute Myocardial Infarction. Chinese Journal of Preventive Medicine, 21(1): 103–106.

[30] Zhang ML, Tang HM, Chen LB, et al., 2023, Exploration of a Full-life-cycle health Management Model with Family-community-hospital Linkage Based on Family Units. Chinese Journal of Health Management, 17(5): 392–394.

Publisher's note

Bio-Byword Scientific Publishing remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

International Education Forum, 2026, Volume 4, Issue 8
http://ojs.bbwpublisher.com/index.php/IEF
Online ISSN: 2981-8605
Print ISSN: 3083-4902

Research on the Development and Cultivation Path of Children's Aesthetic Ability from the Perspective of Family and School Co-education

Mohan Liu*

School of Education, Jilin International Studies University, Changchun 130117, Jilin, China

Author to whom correspondence should be addressed.

Copyright: © 2026 Author(s). This is an open-access article distributed under the terms of the Creative Commons Attribution License (CC BY 4.0), permitting distribution and reproduction in any medium, provided the original work is cited.

Abstract: Home-based co-education is an important means to promote the overall development of children's aesthetic abilities. It plays a crucial role in shaping children's early aesthetic perception, stimulating their imagination and releasing their creativity. This article, from the perspective of home-based co-education, systematically elaborates on the development stages and characteristics of children's aesthetic abilities; deeply analyzes the current cooperation status and prominent problems in aesthetic education between families and kindergartens; and constructs a collaborative cultivation path centered on concept transformation, rich activities, and an optimized environment. However, in the current context of home-based co-education, the cultivation of children's aesthetic abilities still faces practical challenges such as weak cooperation awareness, monotonous educational methods, and insufficient environmental support. Based on this, this article proposes that parents should be transformed from "cooperators" to "co-builders," and teachers should be transformed from "leaders" to "guiding collaborators." Through life-oriented and game-based comprehensive activities and open, supportive material and psychological environments, the aesthetic awareness and creative ability of children should be jointly enhanced.

Keywords: Aesthetic judgment; Home-school collaboration; Preschool education; Development path

Online publication: August 31, 2026

1. Introduction

Aesthetic ability, as an important component of individual cognitive and emotional development, is a special ability formed on the basis of innate genetics through the perception, integration, and creation of aesthetic images in the postnatal period. It encompasses multiple dimensions such as aesthetic perception, imagination, and creativity. The early childhood period is a sensitive and crucial stage for the development of aesthetic ability. The accumulation and expression of aesthetic experience during this period directly affect the healthy formation of early personality, the stimulation of creative potential, and the establishment of lifelong

learning qualities. During this process, family and kindergarten, as the two core environments for children's growth, jointly undertake the important educational responsibility of guiding children to perceive beauty, express beauty, and create beauty. In 2001, the Ministry of Education issued the Guidelines for Kindergarten Education (Trial), stating that through home-kindergarten collaboration, children's emotions should be enriched, and the ability to initially perceive and express beauty should be cultivated. It also emphasizes respecting children's unique aesthetic experiences and expression methods. Therefore, kindergartens and families bear important responsibilities for the improvement and development of children's aesthetic ability, and should focus on the overall development of children's aesthetic ability.

2. The development characteristics and stages of children's aesthetic ability

The aesthetic ability of young children is a dynamic developmental structure that encompasses multiple dimensions such as perception, imagination, and creation. Its development is not a linear process of knowledge accumulation, but rather a gradual deepening and expansion through interaction with the environment in the context of psychological structure maturation [1].

2.1. Deepen children's aesthetic perception ability

Aesthetic perception is the starting point of aesthetic activities, referring to an individual's ability to perceive, identify the external form characteristics of things, and generate initial emotional responses. To deepen children's aesthetic perception, it is necessary to rely on the knowledge and experiences related to beauty accumulated through daily life. Cui Xueqin (2007) proposed that children's aesthetic perception has distinct initiality, intuitiveness, and wholeness. They embrace the world through their senses, not only using their eyes to see and ears to hear, but also touching with their hands and responding with body movements [2]. For example, when children appreciate a painting, they may use their fingers to trace the lines or sway their bodies in rhythm with the music. This integration of perception and action is the core feature of their aesthetic experience. Tu Meiru (1997) believed that children's perception has identity and often regard external things as living companions like themselves, and this animistic thinking can perceive objects more vividly and empathetically [3]. From the perspective of developmental stages, 3–4 years old is a period when children's aesthetic perception develops rapidly. Li Yingyu's (2007) experimental research shows that 4 years old is a sensitive period for children's aesthetic ability development, and their perception acuity and differentiation ability have significantly improved. At this time, children begin to shift from general perception to the initial differentiation of form elements and show personal preferences [4]. Bian Xia (2009) proposed that parents and kindergartens should provide children with rich, diverse, and high-quality aesthetic stimuli to enhance perception acuity and lay the foundation for more complex aesthetic activities [5].

2.2. Stimulate children's aesthetic imagination

Aesthetic imagination is a psychological process that involves processing, reorganizing, and innovating aesthetic images based on perception. The imagination of young children is unrestrained and not bound by reality. Art is children's play and expression, and imagination is the core driving force. The development of imagination requires a rich reserve of internal schemas, which come from a large amount of perceptual experiences. Kong Qiying (2010) emphasized that experience is essential for children's aesthetic development. Only when children fully immerse themselves in the experience of nature and art can their

imagination have vivid materials and emotional warmth [6]. For example, when appreciating picture books, children not only understand the plot of the story, but also can imagine the inner world of the characters through the colors, composition, and details in the pictures, and even construct pictures beyond the story. Parents and teachers should encourage and protect this spontaneous imagination and avoid restricting it with adult standards such as "whether it looks like it or not."

2.3. Release the aesthetic creativity of young children

Aesthetic creativity is the highest manifestation of aesthetic ability, and it is the ability of young children to externalize and express their inner aesthetic feelings and imagination through certain forms. Wang Yiying (2005) believes that children's creativity is not an imitation of adult art, but a free display of the true expression of their inner world [7]. Mr. Chen Hecin has already pointed out that children are born as "artists" and have the potential to express images [8]. The release of children's creativity requires a psychological environment that is safe, free, and encourages exploration. However, there is a prominent problem in current practice. Research has found that adults often emphasize external skill training and neglect the cultivation of internal aesthetic creativity, simplifying art education too early into skill training and suppressing the most genuine creative ideas of children. The task of home-school cooperation is to jointly create an art environment that is prepared for children, provide diverse materials, respect their unique expression methods, and make creation become an enjoyable self-actualization process for children, rather than a burden for pursuing standardized results [9].

3. The current situation and problems of preschool children's aesthetic ability cultivation from the perspective of family and school co-education

3.1. Weak sense of community cooperation

Currently, home-school cooperation largely follows a professionalist paradigm. Li Yan and Gao Fan (2021) found that kindergartens hold an absolutely dominant and controlling position in the co-education activities for cultivating children's aesthetic abilities, while parents are in a passive cooperating and information-receiving role [10]. On the one hand, the communication initiated by kindergartens mostly revolves around notification of matters, and there is less in-depth communication and guidance for the children's aesthetic development; on the other hand, due to their busy work or lack of professional knowledge, parents have low willingness to actively participate and initiate aesthetic education cooperation, and their participation is limited. This one-way transmission, rather than a two-way co-construction model, leads to the dispersion of educational forces and makes it difficult to form a continuous and in-depth co-education relationship.

3.2. The aesthetic education approach is monotonous.

Whether in families or kindergartens, the methods of aesthetic education tend to be monotonous and skill-oriented. Fang Meihong and Wang Renmei (2021) found that in some cases of art activities in kindergartens, the traditional demonstration and imitation teaching methods were still used, with excessive emphasis on the similarity and quality of children's works, thereby restricting their individualized expression [11]. At home, aesthetic education might be simplified to sending children to participate in interest classes, pursuing grade exams and competition awards, while neglecting the aesthetic opportunities in daily life. This monotonous approach strips the connection between art, emotion, and life, making aesthetic education dull and possibly

stifling children's interests.

3.3. Insufficient support for environmental resources

First, there is the physical environment. Some families and kindergartens have weak awareness of creating an aesthetic environment. The family space may lack dedicated corners for children to explore art, and the materials provided are monotonous; the activity areas in kindergartens are not updated in time, and the materials lack inspiration. Second, there is the spiritual environment. The dominance of adult culture often suppresses the expression of children's culture. They tend to evaluate children's works and activities using their own aesthetic standards and utilitarian purposes, failing to create a relaxed psychological atmosphere that allows "trial and error," encourages taking risks, and respects children's innocence.

4. The cultivation path for promoting young children's aesthetic ability through family and kindergarten collaboration

Based on the aforementioned analysis of the issues, in order to effectively enhance the effectiveness of home-school collaboration in cultivating children's aesthetic abilities, a systematic and operational training path needs to be established. This path will be advanced in a coordinated manner from the three core dimensions of concepts, activities, and environment.

4.1. Change your mindset and establish a cooperative relationship for home and school education

Effective home-school collaboration begins with a profound transformation on both sides, especially in the educational mindset of the adult world. The current professionalist paradigm and the passive participation of parents in the cooperation stem from the failure to establish a truly equal and trusting partnership. To this end, both the home and the school must first achieve three ideological transformations.

Firstly, the parent role should shift from a collaborator to a co-builder. Kindergartens need to actively break down the barriers of information and professionalism, and through various channels, explain to parents the unique value and phased characteristics of children's aesthetic development, helping parents understand that aesthetic education is not high-level skill training, but rather permeates daily life's perception, experience, and expression. For example, regular activities can be held to invite experts or teachers to share how to conduct aesthetic enlightenment through low-cost and highly interactive methods such as parent-child reading, natural observation, and music appreciation at home, enabling parents to transform from mere activity collaborators to implementers of the process.

Secondly, the teacher role should shift from a leader to a guide and collaborator. Teachers should abandon an authoritative mindset and recognize the unique advantages of parents in understanding children's personalities, interests, and family culture. In practice, teachers can use tools such as observation record sheets to jointly record the aesthetic behaviors of children at school and at home with parents, and exchange observations and findings during regular communication to jointly analyze the children's aesthetic interests and development needs.

Thirdly, the interaction between home and school should shift from a transactional communicator to a meaning communicator. Home-school communication should go beyond transactional aspects such as activity notifications and work displays, and delve into the educational philosophy and the meaning of children's

development. Kindergartens can set up children's aesthetic growth archives using digital platforms, recording the creative process, children's self-explanations, and teachers' interpretations in graphic and video formats. Parents can supplement relevant observations and interactions at home. This in-depth communication around children's growth stories can prompt both parties to reach a consensus on the meaning of children's aesthetic world, laying a solid ideological foundation for collaborative education.

4.2. Rich activities to enhance children's scientific aesthetic awareness

The limitations of children's aesthetic objects will affect the accumulation of aesthetic images and the richness of imagination. In response to the monotonous current educational methods, the family and the school should collaborate to design and implement a series of life-oriented, game-based, and comprehensive aesthetic activities, guiding children to consciously perceive, compare, imagine, and express, thereby enhancing their scientific aesthetic awareness.

Firstly, the activity content should be rooted in life and nature. Parents and teachers should become the discoverers and guides of beauty, jointly planning the activities. Let children use multiple senses to experience the rhythm of forms, the harmony of colors, and the beauty of materials in real-life situations. This is far more effective in accumulating vivid and profound aesthetic images than copying sample paintings.

Secondly, the activity forms should integrate multiple intelligences and stimulate deep participation. Drawing on the theory of multiple intelligences, design comprehensive artistic activities that require children to participate using different intelligent methods. For example, in the "Our Emotional Concert" activity, children first listen to music with different emotional tones, then express their feelings through body movements, then choose corresponding colors and lines to draw on the collective canvas, and finally tell the story in the painting.

Finally, the activity process should emphasize dialogue rather than indoctrination. When appreciating artworks, adults should avoid direct telling and instead use open-ended questions to build scaffolds, such as "What do you see in this painting?" "What feelings do these lines and colors give you?" "Guess why the artist drew it this way?" Guide children to independently observe, describe, imagine, and speculate. At the same time, encourage discussions among children and the collision of viewpoints, enabling them to learn to appreciate the work from different perspectives in peer evaluations, understand the diversity of aesthetics, and gradually build their own rational aesthetic judgment framework.

4.3. Optimize the environment and encourage children to engage in aesthetic creation

The environment is an invisible curriculum. Montessori believed that children are born with an inherent sensitivity mechanism. During specific sensitive periods, children will use their absorbent mind to actively and efficiently draw information from the environment and develop specific abilities. Therefore, both the family and the kindergarten must jointly strive to optimize the environment, transforming it from a closed, static, and adult-dominated one to an open, dynamic, and child-centered prepared environment.

At the material environment level. In the family, an art exploration corner can be set up, providing low-structured and highly open materials such as natural materials, discarded items, and safe and diverse tools. The art area in the kindergarten should display materials clearly, richly, and beautifully, and be updated regularly according to themes or children's interests. The key is to allow children to freely access and

independently combine these materials, encouraging them to engage in exploratory creative work without preset goals, rather than merely completing the theme tasks set by teachers.

At the psychological environment level, the core is to create a safe, accepting, encouraging, and adventurous emotional atmosphere. The family and kindergarten should jointly practice appreciation and process-oriented attention. Specifically describe the details observed in the work, and pay attention to the children's concentration, attempts, and problem-solving in the creative process. This feedback will divert the children's attention from anxiety about the finished product to the pleasure and sense of achievement in the creative process itself, thereby boldly releasing their inherent creative potential.

Finally, the family and kindergarten should jointly expand the venue of aesthetic education to the social and cultural space. In these real art and nature fields, children can directly experience the solemnity of art, appreciate the depth of cultural heritage, and establish connections between art and life, as well as history. Before and after the visit, the family and kindergarten can jointly conduct topic preparation and extension activities, making the outing no longer an isolated activity but a continuous exploration project, demonstrating the maximum educational value of environmental resources.

5. Conclusion

Early childhood is a critical sensitive period for the development of aesthetic perception, imagination, and creativity, and collaborative education between families and preschools is a vital pathway for fostering children's aesthetic abilities. Currently, aesthetic education for young children faces challenges such as insufficient awareness of home-school collaboration, utilitarian and monotonous teaching methods, and a lack of environmental support. Parents often assume a passive, supportive role, and adult standards can easily stifle children's authentic aesthetic expressions. In response, both families and kindergartens must first update their educational philosophies: parents should transition from mere collaborators to co-creators, while teachers should shift from being dominant figures to guiding collaborators, engaging in in-depth communication centered on children's aesthetic growth. At the same time, they should conduct game-based aesthetic activities rooted in daily life and nature, minimizing the rote teaching of skills; jointly build an open physical environment and an inclusive psychological atmosphere; prioritize the creative process over standardized outcomes; and make effective use of social resources to expand the scope of aesthetic education. Aesthetic education for young children in the home and school setting focuses on nurturing their innate aesthetic sensibilities rather than training them in artistic skills. Only when families and schools reach a consensus on education and integrate aesthetic education into daily life can they effectively cultivate children's abilities to perceive, express, and create beauty, thereby laying the foundation for their character development and lifelong aesthetic growth.

Funding

Jilin Province Primary and Secondary School Teaching Research Association's 2025 Special Project on College Students' Research Topics "Exploration of the Development Logic and Optimization Path of Digital Literacy for Preschool Teachers Driven by Artificial Intelligence" (Project Approval Number: GHKT2025-0060)

Disclosure statement

The author declares no conflict of interest.

References

[1] Li H, Liu ZJ, 2000, The Development of Children's Aesthetic Psychology. Journal of Southwest Normal University (Philosophy and Social Sciences Edition), 2000(2): 53–57.

[2] Cui XQ, 2007, Developing Young Children's Aesthetic Perception. Journal of Hefei University (Social Sciences Edition), 2007(3): 125–128.

[3] Tu MR, 1997, Cultivating Aesthetic Perception, Emotions, and Expressive Abilities in Young Children. Research on Preschool Education, 1997(3): 47–49.

[4] Li YY, 2007, An Experimental Study on the Development and Cultivation of Aesthetic Abilities in 3- to 5-Year-Old Children. Educational Science, 2007(6): 77–81.

[5] Bian X, 2009, Scaffolding Strategies for Promoting the Development of Children's Aesthetic Abilities. Research on Preschool Education, 2009(11): 57–59.

[6] Kong QY, 2010, Experience: A Necessity for Children's Aesthetic Development. Research on Preschool Education, 2010(10): 23–28.

[7] Wang YY, 2005, Art Education and the Development of Children's Creativity. Educational Research, 2005(8): 72–77.

[8] Chen HQ, 1994, Family Education: How to Teach Children. Education Science Press, Beijing, 280.

[9] Sun FL, Lei XM, Zhang GX, et al., 2018, The Practical Significance and Implementation Strategies of Home-School Collaboration. Research on Preschool Education, 2018(7): 70–72.

[10] Li Y, Gao F, 2021, An Analysis of the Current Status of Preschool Teachers' Competence in Home-School Communication. Hunan Education (C Edition), 2021(10): 54–56.

[11] Fang MH, Wang RM, 2021, An Analysis of the Alienation and Paths to Return in Early Childhood Art Education from the Perspective of Children's Culture. Research on Education and Teaching, 35(4): 69–78.

Publisher's note

Bio-Byword Scientific Publishing remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

International Education Forum, 2026, Volume 4, Issue 8
http://ojs.bbwpublisher.com/index.php/IEF
Online ISSN: 2981-8605
Print ISSN: 3083-4902

Research on the Path of Integrating Intangible Cultural Heritage Craftsmanship into the Aesthetic Education of the Interior Furnishings Design Course in Higher Vocational Colleges

Xiao Han*

Chongqing Energy College, Chongqing 402260, China

Author to whom correspondence should be addressed.

Copyright: © 2026 Author(s). This is an open-access article distributed under the terms of the Creative Commons Attribution License (CC BY 4.0), permitting distribution and reproduction in any medium, provided the original work is cited.

Abstract: To enhance the quality of aesthetic education in the interior furnishings design course at higher vocational colleges, this study adopts the perspective of intangible cultural heritage (ICH) craftsmanship empowerment and systematically explores the path of integrating ICH craftsmanship into the aesthetic education of this course. It first interprets the significance of such integration, then analyzes the compatibility between the two, and finally proposes targeted implementation strategies based on the existing problems in the integration, including revitalizing aesthetic education teaching content, improving the educational chain, enriching practical aesthetic education carriers, and refining the aesthetic education evaluation mechanism. The research indicates that integrating ICH craftsmanship into the aesthetic education of the interior furnishings design course in higher vocational colleges can promote the reconstruction of educational forms, broaden the field of practical aesthetic education, and thereby activate the vitality of aesthetic education in the course, ultimately enhancing the educational level and quality of the course.

Keywords: Intangible cultural heritage craftsmanship; Higher vocational colleges; Interior furnishings design; Aesthetic education

Online publication: August 31, 2026

1. Introduction

The integration of ICH craftsmanship into the aesthetic education of the interior furnishings design course in higher vocational colleges represents an innovative measure, as it embodies the aesthetic core and artisan spirit of traditional Chinese culture, serving as a high-quality resource for promoting the aesthetic education reform of this course [1]. In the context of the new era, the core of higher vocational education lies in fostering virtue and nurturing people through aesthetic education. Integrating ICH craftsmanship into the

interior furnishings design course fully aligns with the educational objectives of higher vocational colleges, facilitates the modern transformation of traditional aesthetics, and promotes innovation in the course model of interior furnishings design. Therefore, this study closely focuses on the integration of ICH craftsmanship into the aesthetic education of the interior furnishings design course, analyzing the multi-dimensional paths for achieving deep integration between the two, thereby promoting the quality and efficiency improvement of aesthetic education in this course.

2. The significance of integrating ICH craftsmanship into the aesthetic education of the interior furnishings design course in higher vocational colleges

The traditional Chinese aesthetic foundation, artisan spirit, and cultural connotations embedded in ICH craftsmanship constitute important resources for the aesthetic education of the interior furnishings design course in higher vocational colleges. Integrating ICH craftsmanship into this course helps break traditional fixed course formats, enabling the interior furnishings design course to balance the cultivation of students' professional design skills and cultural literacy, thereby enhancing their aesthetic abilities. Compared with conventional teaching models, the integration of ICH craftsmanship and aesthetic education in this course shows considerable differences. ICH craftsmanship encompasses traditional composition, color matching, and formal aesthetics, which can provide aesthetic edification for higher vocational students, helping them break free from homogenized aesthetic thinking, improve the quality and effectiveness of aesthetic education in the interior furnishings design course, and ultimately cultivate outstanding design talents with solid professional design skills, cultural depth, and aesthetic sensibility [2].

3. The compatibility of integrating ICH craftsmanship into the aesthetic education of the interior furnishings design course in higher vocational colleges

3.1. The aesthetic connotations of ICH craftsmanship align with the educational objectives of interior furnishings design

The aesthetic connotations of ICH craftsmanship align well with the educational objectives of interior furnishings design. ICH craftsmanship emphasizes the integration of natural and minimalist forms, harmonious and elegant colors, and a design philosophy of adapting to local conditions, highlighting both functionality and artistry. These characteristics are deeply compatible with the core educational concept of interior furnishings design, which aims to create design aesthetics, optimize spatial atmosphere, and convey aesthetic culture. In the process of interior furnishings design, not only is it necessary to refine the soft furnishing design plan, but also to highlight the cultural essence of spatial aesthetics, manifesting the aesthetic value of the design scheme [3]. Therefore, integrating ICH craftsmanship into the aesthetic education of the interior furnishings design course in higher vocational colleges becomes an important measure, enabling students to pay attention to the integration of traditional aesthetic elements during the design process, combining ICH craftsmanship with humanistic artistic conceptions to highlight design distinctiveness, thereby producing excellent design works that are both creatively aesthetic and culturally profound, and improving educational quality and effectiveness.

3.2. The demand for living transmission of ICH aligns with the practical teaching attributes of higher vocational education

The compatibility of integrating ICH craftsmanship into the aesthetic education of the interior furnishings design course in higher vocational colleges is also reflected in the alignment between the demand for living transmission of ICH and the practical teaching attributes of higher vocational education. The development of ICH heritage is not merely about cultural preservation; it requires close integration with contemporary development needs to promote the living transmission of ICH culture [4]. In the aesthetic education of the interior furnishings design course in higher vocational colleges, practice is the core element, with emphasis placed on the integration of theory and practice, which is clearly highly compatible with the demand for living transmission of ICH. In promoting the practice of the interior furnishings design course, diversified carriers such as hands-on classrooms and project-based training can provide real-world practice scenarios for the innovative transmission of ICH craftsmanship. Students can also apply the aesthetic thinking embedded in ICH craftsmanship through continuous practical training and design work, thereby promoting the living transmission of ICH and enhancing the level of aesthetic education in the interior furnishings design course [5].

4. Existing problems in integrating ICH craftsmanship into the aesthetic education of the interior furnishings design course in higher vocational colleges

4.1. Insufficient depth of integration of ICH aesthetic education, with prominent superficial teaching phenomena

Insufficient depth of integration and prominent superficial teaching phenomena represent a major problem in the integration of ICH craftsmanship into the aesthetic education of the interior furnishings design course in higher vocational colleges. In the practice of the interior furnishings design course, some teachers merely display ICH pictures, craft styles, and external features, requiring students to conduct basic pattern copying and element application in class, without guiding students to deeply explore the cultural connotations and aesthetic implications of ICH craftsmanship. This results in students' insufficient understanding of the artisan spirit and aesthetic thinking embedded in ICH craftsmanship, weakening the integration effect [6]. In addition, some teachers treat ICH craftsmanship as extended content of the course, without closely integrating it with the spatial creation, soft furnishing matching, and artistic conception shaping of the interior furnishings design course for integrated teaching, causing the integration of ICH craftsmanship to remain at the surface level and making it difficult to improve the quality of aesthetic education in this course.

4.2. Fragmented course teaching content and incomplete aesthetic education curriculum system

The integration of ICH craftsmanship into the aesthetic education of the interior furnishings design course in higher vocational colleges suffers from fragmented course content and an incomplete aesthetic education curriculum system, which reduces the educational effectiveness. In current design courses, the integration of ICH craftsmanship often involves interspersing ICH content within regular design course practice, without setting independent teaching modules or fixed class hours. This leads to a relatively scattered and unsystematic distribution of knowledge points related to ICH craftsmanship. The ICH craftsmanship content integrated into the interior furnishings design course is often determined by teachers based on their own experience, without forming a gradual and systematic knowledge system from basic to advanced levels.

Consequently, students are unable to form a systematic understanding of aesthetic knowledge and craft techniques related to ICH craftsmanship, weakening the overall educational effect [7].

4.3. Insufficient practical aesthetic education carriers and lack of immersive experiential components

The scarcity of practical aesthetic education carriers and the absence of immersive experiential components represent a key issue in integrating intangible cultural heritage (ICH) craftsmanship into the aesthetic education of interior display design courses in higher vocational colleges, which hinders the overall effectiveness of aesthetic education in this curriculum. In current teaching practice for interior display design courses, instructors tend to focus on theoretical lectures interspersed with online multimedia presentations, rather than guiding students into ICH craftsmanship training workshops or aesthetic education practice bases. Moreover, higher vocational colleges maintain insufficient connections with offcampus ICH exhibition venues and master artisan studios, making it difficult to create an immersive educational atmosphere [8]. In addition, the shortage of aesthetic education carriers prevents students from directly participating in the ICH craftsmanship production process, thus impeding their indepth appreciation of the aesthetic nuances and cultural connotations embedded within the crafts.

4.4. Overly narrow evaluation dimensions and insufficient weighting of cultural and aesthetic assessment

The integration of ICH craftsmanship into the aesthetic education of interior display design courses in higher vocational colleges is further hampered by the issue of narrow evaluation dimensions, with cultural and aesthetic assessment receiving insufficient weighting. In the current evaluation system for interior display design courses, assessment emphasis is placed primarily on students' work form, composition, and technical skills, with the focus centered on students' mastery of professional techniques and practical design capabilities. Little attention is given to students' cognition of ICH culture, aesthetic literacy, or culturally innovative thinking. Consequently, the overall assessment suffers from insufficient standardization and weak objectivity, as no specific indicators are established for ICHrelated aesthetic education during evaluation. The weighting of assessment dimensions such as cultural aesthetic appreciation, ICH heritage transmission, and creative transformation remains inadequate, failing to provide timely feedback on the effectiveness of integrating ICH craftsmanship into the aesthetic education of interior display design courses, and thus unable to effectively support the iterative innovation and improvement of aesthetic education in higher vocational interior display design curricula [9].

5. Implementation pathways for integrating intangible cultural heritage crafts into the aesthetic education of higher vocational interior display design courses

5.1. Deepening the core and revitalizing aesthetic education content

In the aesthetic education of higher vocational interior display design courses, the integration of intangible cultural heritage (ICH) crafts should focus on deepening the core and revitalizing the educational content. Therefore, in educational practice, it is essential to closely combine the aesthetic requirements and spatial functional needs of modern interior display design to achieve a modernized transformation of ICH craft content, thereby enabling the revitalized utilization of such heritage. In teaching practice, teachers need to systematically organize ICH crafts, integrating their historical background, color aesthetics, formal principles, and humanistic connotations. During instruction, traditional forms that are insufficiently compatible with

modern interior display design should be removed, while preserving the core aesthetic essence of ICH crafts and extracting ICH aesthetic thinking and the spirit of craftsmanship to drive innovation in the interior display design curriculum. This approach enables students to gradually shift from "formal imitation" to "cultural application" in their design learning, thereby fostering layered connections between ICH crafts and interior display design, and cultivating students' aesthetic thinking. For example, in the practical teaching of interior soft furnishing design, Suzhou embroidery (Suxiu) as an ICH craft can be introduced. During the teaching process, instructors should not merely present images of Suxiu patterns but provide detailed instruction on its elegant color palettes, void-and-solid needle techniques, and floral-and-bird motifs, extracting the auspicious connotations and Jiangnan aesthetic characteristics to promote innovation in the interior display design course. At the same time, during the students' design practice phase, teachers should guide them to closely integrate with design projects such as homestays and neo-Chinese residential furnishing, enabling students to extract the gradient colors and delicate patterns inherent in Suxiu ICH, and subsequently transform them into soft furnishing design elements such as throw pillows, screens, and wall decorations. This helps students learn to apply the aesthetic core of Suxiu ICH in practical design work, thereby enhancing the integration effect of ICH crafts in the aesthetic education of higher vocational interior display design courses.

5.2. Restructuring modules and improving the curriculum education chain

Integrating ICH crafts into the aesthetic education of higher vocational interior display design courses requires promoting the restructuring of teaching modules and improving the curriculum education chain. Therefore, teachers need to consolidate the knowledge points within the interior display design course, establishing a dedicated ICH aesthetic education teaching module centered on ICH craft empowerment. Within this module, ICH aesthetic theory, ICH craft appreciation, ICH innovative design, and ICH furnishing design project training should be incorporated into teaching practice, ensuring precise articulation among foundational courses, core courses, and practical training. This enables students to systematically explore the connections between ICH crafts and interior display design [10]. For example, in teaching practice, a dedicated teaching module for traditional wood carving as an ICH craft can be added, with targeted educational content tailored to students at different year levels. Junior-year students can be offered courses in wood carving aesthetic appreciation, focusing on structural form interpretation, carving techniques, and the analysis of traditional aesthetic connotations; intermediate-year students can be guided through practical training in the creative design of wood carving elements, exploring pattern simplification and modern transformation; senior-year students can engage in project-based training closely linked to commercial and residential furnishing design, incorporating wood carving forms into the design of entryway ornaments and feature wall decorations, thereby establishing a gradient-based education system and forming a complete educational chain.

5.3. Expanding fields and enriching practical aesthetic education carriers

Broadening educational fields and enriching practical aesthetic education carriers constitute a crucial step in promoting the integration of ICH crafts into higher vocational interior display design courses. Higher vocational institutions should strengthen the integration of on-campus and off-campus aesthetic education resources, establishing an immersive ICH aesthetic education practice platform that balances hands-on experience with aesthetic perception. In terms of on-campus resource integration, higher vocational institutions can establish ICH aesthetic education training workshops equipped with basic ICH production facilities and relevant aesthetic education materials, allowing students to directly experience the unique visual

and tactile qualities of ICH workshops. In off-campus resource integration, linkages with ICH museums, ICH inheritor studios, cultural and creative design enterprises, and interior display design companies should be strengthened, with off-campus training bases established through deep university-industry collaboration to provide students with ample practice platforms. For example, higher vocational institutions can collaborate with local paper-cutting ICH inheritors to establish off-campus training classrooms, organizing regular visits for students to immerse themselves in ICH workshops. During such practical training, paper-cutting inheritors demonstrate composition layout, hollow-out techniques, and symmetrical aesthetics on-site, interpreting the staggered visual effects and folk symbolism of paper-cutting art. Students can then closely link these with interior display design requirements, transforming traditional folk paper-cutting patterns through simplified redesign, thereby enhancing their practical innovative capabilities in ICH integration.

5.4. Optimizing benchmarks and improving the aesthetic education evaluation mechanism

In the aesthetic education of higher vocational interior display design courses, the integration of ICH crafts requires optimizing benchmarks and improving the aesthetic education evaluation mechanism. Higher vocational institutions should enrich the aesthetic education dimensions of the interior display design course, coordinating evaluations across student ICH cultural awareness, aesthetic competence, creative innovation, and expression of cultural connotations in works. The weighting of indicators related to cultural aesthetics and ICH innovation capabilities should be increased, thereby forming positive feedback and guiding teachers to strengthen their emphasis on nurturing students' aesthetic competence and ICH innovation abilities. For example, in course assessments, evaluation indicators can be optimized around student ceramic ICH furnishing design projects. Rather than merely evaluating the form and craftsmanship precision of ceramic ornaments, assessment should incorporate aesthetic education criteria such as cultural connotations, expression of traditional aesthetics, and adaptability to modern spaces. This approach enhances the objectivity and precision of evaluation outcomes, comprehensively reflecting the effectiveness of ICH craft integration into the aesthetic education of interior display design courses, and providing a reference basis for iterative curriculum improvement.

6. Conclusion

This study reveals that integrating intangible cultural heritage craftsmanship into the aesthetic education of the interior furnishings design course in higher vocational colleges holds significant importance. It enables the revitalization and utilization of traditional intangible cultural heritage resources, innovates the teaching system of interior furnishings design in higher vocational education, thereby consolidating the educational foundation of aesthetic education in this course and enhancing the comprehensive aesthetic literacy of vocational graduates. The multifaceted approaches proposed in this paper—such as deepening the core content, restructuring teaching modules, expanding practical fields, and optimizing evaluation criteria—are conducive to promoting the deep integration of intangible cultural heritage craftsmanship into the aesthetic education of the interior furnishings design course in higher vocational colleges. These measures not only invigorate the aesthetic education of the course but also cultivate students' artistic competence, ensuring the highquality completion of the aesthetic education objectives of the interior furnishings design course. In the future, the integration of intangible cultural heritage craftsmanship with the aesthetic education of interior furnishings design courses in higher vocational colleges is expected to gradually evolve toward

industryeducation synergy. Subsequent research may seek breakthroughs in the digital transformation of intangible cultural heritage teaching, so as to further promote the highquality development of aesthetic education in these courses.

Funding

Project Title: Practical Research on Integrating Excellent Traditional Chinese Culture into Aesthetic Education in the Interior Furnishing Design Course at Higher Vocational Colleges
Project No.: 2025J03005

Disclosure statement

The author declares no conflict of interest.

References

[1] He L, 2026, Digital Deconstruction and Modern Design Translation of Cloisonné Craft Gene—Based on the Course Practice of "Design and Production of Furnishings". Hebei Pictorial, 2026(6): 112–114.

[2] Xie SY, 2026, Integration and Empowerment: An Exploration of Teaching Practice of Intangible Cultural Heritage in Field Reconstruction—Taking the Teaching Reform of Interior Design Professional Courses as an Example. Art Education Research, 2026(8): 39–41.

[3] Chen Y, 2025, Teaching Strategies for the Inheritance and Innovation of Intangible Cultural Heritage in University Interior Design Teaching. Animation King, 2025(4): 77–79.

[4] Chen R, 2026, Empowering Intangible Cultural Heritage Handicrafts through University Skills Innovation Platforms—Taking the "IndustryUniversityResearchApplication" Model in Interior Design as an Example. Hebei Pictorial, 2026(5): 32–34.

[5] Zhao J, 2025, Teaching Design and Practice of Interior Furnishings Art Course from the Perspective of Aesthetic Education. Art Education Research, 2025(6): 103–105.

[6] Ye RR, Pan T, 2025, Value Logic and Practical Path of Aesthetic Education Construction—Taking Interior Furnishings Design Course as an Example. Journal of Social Science of Jiamusi University, 43(2): 192–195 + 200.

[7] Zeng YZ, 2026, Digital Technology Empowers Mixed Teaching Model Reform—Taking the "Furniture and Furnishings Design" Course as an Example. Science Consultation, 2026(10): 209–213.

[8] Wu Y, 2026, From "Skill Training" to "Intelligent Creation": A Study on the Teaching Transformation of Interior Furnishings Design Courses in the AI Era. Digital Users, 2026(29): 169–171.

[9] Shen YD, 2024, Strategies for Integrating Woodcarving Elements of Folk Houses into Interior Design from the Perspective of Intangible Cultural Heritage. Footwear Craft and Design, 2024(7): 157–159.

[10] Chen Q, Yang LR, 2021, Research and Practice on Integrating Guangxi Ethnic Intangible Cultural Heritage Elements into the Teaching of "Interior Design" Course in Secondary Vocational Schools. Light Textile Industry and Technology, 2021(12): 140–142.

Publisher's note

Bio-Byword Scientific Publishing remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

International Education Forum, 2026, Volume 4, Issue 8
http://ojs.bbwpublisher.com/index.php/IEF
Online ISSN: 2981-8605
Print ISSN: 3083-4902

Demand Preferences and Cognitive Barriers in Adolescent Health Science Communication: A Medical Student Survey

Penghui Yu[1], Liqin Wu[2]*, Xiuyu Wu[1], Shichang Cai[1], Yu Liu[1]

[1]School of Basic Medical Sciences, Hunan University of Medicine, Huaihua, Hunan, China
[2]International Education School, Hunan University of Medicine, Huaihua, Hunan, China

***Corresponding author:** Liqin Wu, Lizziewu@126.com

Copyright: © 2026 Author(s). This is an open-access article distributed under the terms of the Creative Commons Attribution License (CC BY 4.0), permitting distribution and reproduction in any medium, provided the original work is cited.

Abstract: *Objective*: To analyze demand preferences and cognitive barriers in adolescent health science communication using survey data from medical students and to offer empirical evidence for refining delivery strategies. *Methods*: In March 2026, the study conducted a cross-sectional online survey of 390 first-year undergraduates at a Chinese medical college using convenience sampling. The questionnaire captured topic-specific demands, preferred formats and channels, session duration preferences, perceived supply gaps, and underserved populations. Data were analyzed with SPSS 26.0 using descriptive statistics, Pearson correlation, and multiple linear regression. *Results*: (1) The top three demanded topics were nutrition and dietary management (80.51%), mental health (65.90%), and sleep health (60.51%). (2) Short videos (94.36%) were the preferred medium; real-case narratives (62.31%) were rated most memorable, with 77.13% preferring sessions under 10 minutes. (3) Females reported higher coverage than males across most topics, with gaps exceeding 19 percentage points for obesity, sleep, and spinal health. (4) Self-rated health positively predicted active learning frequency (B=0.27, P<0.001), which in turn negatively predicted preferred session duration (B=-0.13, P=0.019). (5) Rural adolescents (79.74%) and left-behind children (75.38%) were identified as the most underserved. *Conclusion*: Adolescent health communication demands now cover both physical and mental health. One cognitive barrier persists, however: poorer self-rated health is linked to weaker learning motivation. Delivery strategies should therefore move from passive dissemination to proactive outreach, using narrative-driven short videos as a core tool, tailoring content to learning behavior, and extending coverage to rural and left-behind adolescents.

Keywords: Health science communication; Demand preferences; Cognitive barriers; Adolescents; Questionnaire survey

Online publication: August 31, 2026

1. Introduction

Adolescence is a key period for physical and psychological development and for establishing health behaviors that often persist into adulthood. Adolescent health therefore matters not only for individuals but

also for the Healthy China initiative. In China, adolescent health problems are becoming more numerous and starting earlier: the myopia rate among children and adolescents has stayed high, and its prevention and control has become a national strategic priority; the detection rate of spinal curvature abnormalities in primary and secondary school students is 4.2% to 6.0%; and more than 30% of adolescents have experienced emotional or psychological distress of varying severity [1–3]. These overlapping burdens call for integrated, accessible health communication strategies aimed at this population.

Health science communication is an upstream intervention that puts the "prevention-first" principle into practice, and it has become a main route for improving adolescent lifestyles and reducing health risks. Existing studies have covered mental health, scoliosis, myopia prevention, and reproductive health during adolescence [1, 3–5]. New media platforms, especially short videos, have become primary communication channels because they are concise and engaging; VR exhibitions, hands-on training, and gamified science content have also been explored [6–7]. Still, a gap remains between what current programs offer and what adolescents actually need. Most programs use uniform lecture-based formats without tiering content to cognitive developmental stage, which lowers adolescents' active participation; adolescents also tend to avoid sensitive health topics, and fragmented pseudo-scientific information on social media worsens cognitive distortions [8–9]. A one-way didactic model cannot deliver the full sequence of knowledge input, behavioral reinforcement, and habit formation, which limits its overall impact [10–11].

A review of the literature points to several research gaps. First, most empirical studies have focused on isolated topics, and little work has integrated the full range of adolescent communication needs. Second, the mechanisms behind cognitive barriers to health engagement are not well understood. Third, proposed solutions often stay at the level of broad policy advocacy and lack empirical grounding in survey-based primary data; in particular, evidence from medical students, who are a potential core workforce for health communication, is scarce [12–13]. Medical students occupy a dual position: they are in middle-to-late adolescence themselves, so they know adolescent audiences from the inside; at the same time, their preclinical training gives them a basic health knowledge base from which to judge whether communication content is appropriate.

Against this background, the present study draws on the medical field to examine preference profiles and cognitive barriers in adolescent health communication through questionnaire surveys and in-depth interviews with medical students. It aims to build a precision delivery model and an analytical framework that covers demand identification, cognitive intervention, and supply adaptation. The ultimate goal is to provide local empirical evidence for a collaborative communication system involving families, schools, communities, and healthcare institutions.

2. Subjects and methods

2.1. Study design

This study used a cross-sectional questionnaire design to analyze demand preferences, content interests, access channels, and cognitive barriers in adolescent health communication among medical students, and to provide empirical evidence for a precision communication delivery model. The study followed the ethical principles of the Declaration of Helsinki, and all participants took part voluntarily.

2.2. Study participants

The survey targeted first-year undergraduate students enrolled in selected majors at a medical college. Participants were recruited via convenience sampling, and questionnaires were administered through an online platform. Inclusion criteria were: (1) current enrollment in a medical college, and (2) voluntary participation with completion of all questionnaire items. Exclusion criteria were an excessively short completion time (<60 seconds) or evidently patterned response behavior. A total of 390 valid questionnaires were retrieved.

2.3. Research instrument

A self-administered questionnaire, the Questionnaire on Adolescent Health Communication Needs, was developed for this study. Its design was informed by a review of the literature and by similar instruments used in China and abroad, with modifications for medical student respondents. The questionnaire consisted of 13 items covering the following domains: demographic characteristics, self-rated health and learning behaviors, needs across 14 health communication topics, preferred formats and access channels, expected session duration and preferred time slots, perceived supply inadequacies, identification of underserved populations, and open-ended suggestions. Item formats included single-choice, multiple-choice, and fill-in-the-blank questions.

2.4. Survey administration

The questionnaire was distributed via the Wenjuanxing platform to class-based group chats and campus social networks. The first page included an informed consent statement that explicitly clarified the anonymous nature of the survey, its academic purpose, and participants' right to withdraw at any time. System-level measures included IP-based restrictions and mandatory-response logic to prevent duplicate submissions and minimize missing data.

2.5. Statistical analysis

Data were analyzed using SPSS version 26.0. Categorical variables were summarized as frequencies and constituent ratios (%). For multiple-response items, both the endorsement rate (number of respondents endorsing a given option / total respondents) and the response rate (frequency of endorsements for a given option / total frequency of endorsements across all options) were reported. Gender differences were expressed as rate differences derived from stratified descriptive comparisons.

Inferential analyses consisted of: (1) Pearson correlation analysis to examine bivariate associations among three core variables—self-rated health, active learning frequency, and expected session duration; and (2) multiple linear regression using the enter method, with Model 1 specifying active learning frequency as the dependent variable and self-rated health and gender as independent variables, and Model 2 specifying expected session duration as the dependent variable and active learning frequency and self-rated health as independent variables. Multicollinearity was assessed using the variance inflation factor (VIF); a two-sided *P*-value of <0.05 was considered statistically significant.

3. Results

3.1. Baseline characteristics of respondents

A total of 390 valid questionnaires were included in the analysis, comprising 133 males (34.1%) and 257

females (65.9%). The majority of participants (*n*=379, 97.18%) were aged >18 years, while 11 (2.82%) were aged 15–17 years. Self-rated health status was distributed as follows: "very good" in 97 (24.87%), "relatively good" in 192 (49.23%), "fair" in 96 (24.62%), and "relatively poor" in 5 (1.28%). Regarding active learning frequency, 195 respondents (50.00%) reported "occasional browsing," 108 (27.69%) reported "1–2 times per month," 75 (19.23%) reported "multiple times per week," and 12 (3.08%) reported "almost no engagement."

3.2. Ranking of health communication topic demands

Among the 14 predefined topics (**Table 1**), nutrition and dietary management (*n*=314, 80.51%) and mental health (*n*=257, 65.90%) ranked first and second, respectively. Sleep health (*n*=236, 60.51%), eye health (*n*=207, 53.08%), and obesity (*n*=205, 52.56%) occupied the third through fifth positions. The three least endorsed topics were basic human organ structure (*n*=115, 29.49%), sports injury prevention (*n*=137, 35.13%), and sex education (*n*=139, 35.64%). The ranking by response rate paralleled that by endorsement rate.

Table 1. Ranking of health communication topic demands (N=390, multiple-response)

Rank	Topic	Endorsement rate (%)
1	Nutrition and dietary management	80.51
2	Mental health	65.90
3	Sleep health	60.51
4	Eye health	53.08
5	Obesity	52.56
6~14	Remaining 9 topics	29.49~43.08

Note: The nine remaining topics comprise growth and height concerns, oral health, infectious disease prevention, pubertal physiological changes, spinal health and postural issues, first aid skills, sex education and self-protection, sports and injury prevention knowledge, and basic structure and function of human organs.

3.3. Preferences for format, channel, and timing

Short videos and animations (*n*=368, 94.36%) were the most preferred format, followed by illustrated comics (*n*=218, 55.90%) and VR-based experiences (*n*=151, 38.72%). Real-life case narratives (*n*=243, 62.31%) were rated as the most memorable format. Social media (*n*=343, 87.95%) and school-based curricula (*n*=275, 70.51%) constituted the primary access channels.

Regarding session duration, 5-10 minutes was most favored (*n*=172, 44.10%), followed by <5 minutes (*n*=121, 31.03%); only 24 respondents (6.15%) indicated acceptance of sessions exceeding 20 minutes. In terms of timing, fragmented time slots (*n*=190, 48.72%) and topic-dependent flexible scheduling (*n*=97, 24.87%) were the dominant preferences.

3.4. Perceived deficiencies and identification of underserved populations

Regarding major deficiencies in current health communication, "conflicting and overly complex information" ranked first by endorsement rate (*n*=233, 59.74%), followed by "content being overly specialized and difficult to comprehend" (*n*=196, 50.26%) and "monotonous and unengaging formats" (*n*=172, 44.10%). By response rate, conflicting/complex information similarly ranked highest (19.81%), with overly specialized

content (16.67%) and monotonous formats (14.63%) also among the top contributors. "Questionable authenticity of information" (endorsement rate 40.77%; response rate 13.52%) and "lack of interactivity" (37.18%; 12.33%) were also frequently endorsed.

In identifying underserved populations, rural adolescents (endorsement rate 79.74%; response rate 27.28%) and left-behind children (75.38%; 25.79%) ranked first and second, while students under high academic pressure (66.67%; 22.81%) and adolescents with disabilities (60.51%; 20.70%) were also cited by over 60% of respondents. Together, these results point to three main blind spots in current outreach: geographic resource scarcity, weak family support, and academic pressure.

3.5. Gender differences and marginalized group identification

Gender-stratified comparisons (**Table 2**) showed that females had higher endorsement rates than males on most topics. The five largest gender gaps were for obesity (+21.57 percentage points), sleep health (+21.08), spinal health (+19.23), oral health (+18.20), and eye health (+14.37). Males showed only a small advantage in sports injury prevention (+1.46), and endorsement rates for organ structure were similar between genders.

Table 2. Top five communication topics with the largest gender gaps

Topic	Female (%)	Male (%)	Gap (Percentage points)
Obesity	59.92	38.35	+21.57
Sleep health	67.70	46.62	+21.08
Spinal health	46.30	27.07	+19.23
Oral health	49.03	30.83	+18.20
Eye health	57.98	43.61	+14.37

3.6. Regression analysis of factors influencing health communication behaviors

Pearson correlation analysis (**Table 3**) revealed that self-rated health was positively correlated with active learning frequency ($r = 0.25$, $P < 0.001$), while active learning frequency was negatively correlated with preferred session duration ($r = –0.14$, $P < 0.01$).

Multiple linear regression with active learning frequency as the dependent variable and self-rated health and gender as independent variables (enter method) yielded a statistically significant model ($F=12.973$, $P<0.001$, adjusted $R^2=0.058$). Self-rated health emerged as a significant positive predictor ($B=0.27$, $P<0.001$), whereas gender did not ($P=0.398$).

In a separate model with preferred session duration as the dependent variable and active learning frequency and self-rated health as independent variables, the model was also significant ($F=4.448$, $P=0.012$, adjusted $R^2=0.017$). Active learning frequency significantly and negatively predicted preferred session duration ($B= -0.13$, $P=0.019$), while self-rated health did not ($P= 0.229$).

Table 3. Multiple linear regression analysis of factors influencing communication behaviors

Dependent variable	Independent variable	Unstandardized coefficient B	Standardized coefficient β	*t* value	*P* value
Active learning frequency	Self-rated health	0.27	0.25	4.95	<0.001
	Gender	0.07	0.04	0.85	0.398
Preferred session duration	Active learning frequency	-0.13	-0.12	-2.35	0.019
	Self-rated health	-0.07	-0.06	-1.21	0.229

Note: Model 1 (active learning frequency): adjusted R^2=0.058, F(2, 387)=12.973, P<0.001; Model 2 (preferred session duration): adjusted R^2=0.017, F(2, 387)=4.448, P=0.012. Variance inflation factors were all below 1.1, indicating no substantial multicollinearity.

3.7. Qualitative feedback from open-ended responses

The open-ended item (Question 13) soliciting suggestions for communication improvement yielded 259 valid substantive responses (66.41% of the total sample). These were coded into eight thematic categories. The three most frequently mentioned themes were: use of plain and accessible language (≈60 responses), enhancing interest and engagement (≈40-45 responses), and diversifying presentation formats (≈30-35 responses). Additional themes included provision of real-life case examples, opportunities for interactive participation, broader dissemination coverage, targeted content for specific subgroups, and improved information integration and categorization.

4. Discussion

4.1. Summary of key findings

Based on survey data from 390 medical students, this study used descriptive statistics and multiple linear regression to examine demand preferences, cognitive barriers, and their influencing factors in adolescent health communication. The main findings are: (1) communication demands showed a "holistic physical-mental" pattern, with nutrition and dietary management (80.51%), mental health (65.90%), and sleep health (60.51%) ranking as the top three topics; (2) short videos (94.36%) and real-life case narratives (62.31%) were the most preferred and the most memorable formats, respectively, and fragmented time slots (48.72%) were the primary access period; (3) female respondents had higher endorsement rates than males for obesity, sleep health, and spinal health, with gender gaps all above 19 percentage points; (4) rural adolescents (79.74%) and left-behind children (75.38%) were seen as the most underserved populations; and (5) regression analysis showed that self-rated health positively predicted active learning frequency (B=0.27, P<0.001), which in turn negatively predicted preferred session duration (B=-0.13, P=0.019), indicating that poorer self-rated health goes with weaker learning motivation.

4.2. Demand patterns: The transition from "somatic disease prevention" to "holistic physical-mental health"

In the data, nutrition and dietary management, mental health, and sleep health ranked as the top three demanded topics, with endorsement rates of 80.51%, 65.90%, and 60.51%, respectively. The fact that mental health and lifestyle management outranked traditional disease-oriented topics suggests that adolescents' health perceptions are shifting from "disease prevention" to "holistic physical-mental well-being."

Two factors help explain this shift. First, the Report on the Development of Mental Health among Chinese Nationals (2021–2022) reported a depression detection rate of 14.8% among adolescents; the high prevalence of psychological morbidity has pushed communication resources toward mental health [14]. Second, medical students have been exposed to preclinical curricula and have begun to think within the biopsychosocial medical model; their sensitivity to the link between physical and mental health may be higher than that of the general adolescent population, which could raise the priority they give to mental health topics. Because medical students also judge health topics with more professional knowledge, their ranking may be more forward-looking than the general population's. If even medical students place mental health among their top concerns, communication for the broader adolescent population should move from a somatic-centered to a holistic physical-mental orientation.

The low ranking of sex education and self-protection (35.64%) may reflect the long-standing absence of comprehensive sex education during adolescence in China, which has made the topic culturally taboo; even when the need exists, stigma makes it hard to express. The low ranking of basic structure and function of human organs (29.49%) suggests that adolescents already learn basic anatomy in school; communication should therefore go beyond basic knowledge and move toward lifestyle interventions and behavioral skill development.

4.3. Core mechanism of the cognitive barrier: the "poorer self-rated health, weaker motivation" paradox

One core finding is that self-rated health positively and significantly predicted active learning frequency (B=0.27, P<0.001): each one-level increase in self-rated health corresponded to a 0.27-unit increase in active learning frequency. Among respondents rating their health as "very good," 36.08% engaged in multiple weekly learning sessions, versus 14.58% among those rating their health as "fair"; conversely, 9.38% of "fair" raters said they "almost never paid attention," versus 1.03% of "very good" raters. This pattern points to a cognitive barrier: adolescents with poorer self-rated health are less motivated to seek health information actively.

The Health Belief Model (HBM) offers one way to interpret this paradox [15]. The model holds that health-related action depends on perceived threat and perceived severity. Adolescents with poorer self-rated health would, in theory, perceive more threat; the data show that they are in fact the least active learners. Two psychological mechanisms may explain the contradiction. First, avoidant coping: when people see their health as poor but regard the problem as intractable or the cost of change as too high, they may avoid information as a defense against the anxiety of cognitive dissonance [16]. Evidence from chronic disease and mental health settings supports this mechanism [17]. Second, a bidirectional cycle between health literacy and self-rated health: people with limited health literacy struggle to appraise their own health accurately and also lack the skills and motivation to seek health information, which perpetuates a cycle of low literacy → inaccurate self-appraisal → weaker learning motivation → further eroded literacy [18].

This finding has practical implications. Traditional strategies assume that people with health concerns will look for solutions on their own; the results show that those who need health interventions most are the least likely to engage with available content. Delivery therefore has to go beyond the passive model of building platforms and publishing content, and actively reach populations with low health literacy. Mandatory or high-reach channels such as school-based curriculum integration, routine school entry health screenings, and parent-teacher meetings can serve this targeting.

4.4. The inverted duration preference and its implications for communication delivery

Active learning frequency negatively predicted preferred session duration (B=-0.13, P=0.019): "high-frequency users" preferred shorter sessions, while low-frequency learners tolerated longer ones. The inverted pattern reflects different information-seeking behavior across motivation levels. High-frequency learners are used to picking up information quickly in fragmented time windows and have little tolerance for long or wordy content. Low-frequency learners, without established information-seeking habits, have not formed clear duration expectations.

This finding goes against the intuitive assumption that high-frequency learners want in-depth, long-form content. All user segments, regardless of learning frequency, preferred brief sessions: 77.13% of respondents chose a preferred duration of ≤10 minutes. Tiered design should therefore vary content density and cognitive depth rather than duration. For high-frequency learners, short-form content should be information-dense and conceptually rigorous (for example, a 3-minute animation that explains a mechanistic pathway); for low-frequency learners, it should focus on engaging entry points and behavioral prompts (for example, a 1-minute real-life case narrative).

Self-rated health did not significantly predict preferred duration (P=0.229), which suggests that duration preferences depend more on information-seeking habits than on health status. This supports stratifying delivery by learning behavior profiles rather than by health risk level.

4.5. Format preferences: narrative primacy over technological novelty

Asked which format they found most memorable, respondents chose real-life case narratives (62.31%), far ahead of 3D stereoscopic displays (14.87%) and experimental demonstrations (8.46%); plain text descriptions received only 1.79% of endorsements. This pattern matches the open-ended feedback, where "incorporating real-life cases" was mentioned in about 20–25 responses. VR-based experiences reached a 38.72% endorsement rate as a "preferred format," but on memorability (14.87%) they trailed case-based narratives by a wide margin.

Narrative Transportation Theory in communication studies holds that when audiences become absorbed in a story, the story's internal logic engages their cognitive resources, lowers resistance to persuasive messages, and enables an educational-entertainment ("edutainment") effect [19]. 3D visualization and VR can produce visually striking experiences, but without a substantive narrative core, they may stay at the level of spectacle and fail to leave retrievable health knowledge.

For content developers, a sensible allocation of limited resources would follow this path: collect and distill authentic case material → turn cases into 1–3 minute narrative short videos → add illustrated comics for cross-platform dissemination. VR and similar tools can serve as supplements rather than core delivery vehicles, reserved for immersive teaching on specialized topics such as human anatomy.

4.6. Gender disparities and marginalized groups: Dual challenges to communication equity

In the data, females had higher endorsement rates than males on 12 of 14 topics, with the largest gaps for obesity (+21.57 percentage points), sleep health (+21.08), and spinal health (+19.23). This pattern probably reflects gender differences in how willing people are to voice health concerns: adolescent norms put greater bodily scrutiny on females, while males are expected to be strong and stoic, which may suppress both the perception and the expression of discomfort [20]. Lower expression among males should not be read as lower

risk: male adolescents have higher prevalence rates of unintentional injuries and cardiometabolic risks than females [21]. Communication strategies should therefore include "male-friendly" content that embeds health messages in culturally resonant frames such as competitive sports or military technology.

Rural and left-behind adolescents: structural blind spots in communication equity. 79.74% of respondents identified rural adolescents, and 75.38% identified left-behind children, as the populations whose communication needs are most underserved; this consensus ranked highest among all options. Rural adolescents face a triple disadvantage: weak school-based health education, weak family-level health literacy support, and limited access to health information on new media. Left-behind adolescents carry the added burden of mental health risks linked to parental separation, yet dedicated support resources are almost absent [22]. The most underserved populations also show the strongest cognitive barriers: lower self-rated health and weaker learning motivation. The authors therefore suggest adopting "health communication into schools" as an institutional mechanism, with rural schools and boarding schools as the basic delivery units, supported by a three-part supply framework of curriculum integration, periodic on-site outreach, and push-based digital resource distribution.

4.7. Limitations

This study has several limitations. First, the sample came from a single medical college, so the findings should be generalized to the broader adolescent population with caution. Second, the cross-sectional design does not allow causal inference; reverse causality or confounding by unmeasured variables cannot be ruled out, especially for the relationship between active learning frequency and self-rated health. Third, the regression models had modest adjusted R^2 values, which means important explanatory factors remain unidentified. As an exploratory study, its value lies in identifying patterns, quantifying associations, and generating testable hypotheses rather than in reaching definitive conclusions. Future work should run confirmatory surveys in general adolescent populations, use longitudinal designs to track behavioral change after communication interventions, and add socio-contextual variables such as family health literacy and school-based curriculum quality.

5. Conclusion

Using survey data from medical students, this study examined demand preferences and cognitive barriers in adolescent health communication. Adolescent communication needs have expanded from somatic disease prevention to include mental health and lifestyle management; at the same time, a cognitive barrier persists, in which poor self-rated health goes with weak learning motivation. Short videos and real-life case narratives were the most preferred formats, and duration preference showed a counterintuitive pattern: high-frequency users favored shorter sessions. Females expressed a higher need than males on most topics, and rural and left-behind adolescents were the most underserved groups. On this basis, the study proposes a multi-dimensional strategy covering content, format, duration, reach, and stratification, offering empirical support and actionable guidance for allocating communication resources precisely.

Funding

This study was supported by A Project Supported by the Scientific Research Fund of the Hunan Provincial

Education Department (23A0728); the Hunan Province Social Science Outcome Review Committee Project (XSP24YBC004); and the Hunan Provincial Natural Science Foundation of China (2026JJ80496).

Disclosure statement

The authors declare no conflict of interest.

Author contributions

Conceptualization: Penghui Yu, Liqin Wu
Questionnaire: Penghui Yu, Xiuyu Wu
Methodology: Liqin Wu, Penghui Yu, Xiuyu Wu
Statistical analysis: Liqin Wu, Yu Liu
Writing – original draft: Penghui Yu
Writing – review and editing: Liqin Wu, Shichang Cai

References

[1] Wei RH, Zhang HM, Liu SX, et al., 2023, Strengthening the Scientific Prevention and Control of Myopia in Children and Adolescents in China. Recent Advances in Ophthalmology, 43(1): 1–6. https://doi.org/10.13389/j.cnki.rao.2023.0001

[2] Xie TA, Huang XR, Wu ML, et al., 2025, Investigation and Analysis of Satisfaction and Needs for Spinal Health Science Popularization Education among Adolescents in Shenzhen. Shenzhen Journal of Integrated Traditional Chinese and Western Medicine, 35(21): 21–24 + 42. https://doi.org/10.16458/j.cnki.1007-0893.2025.21.005

[3] Wu YJ, 2025, Children's Voices Need to be Heard: Mental Health Science Popularization for Children and Adolescents. Health Required Reading, 2025(35): 72.

[4] Guo J, Liu R, Zhang Y, et al., 2024, Stand Straight, Grow Healthy: Science Popularization and Prevention of Adolescent Scoliosis. Disease Surveillance and Control, 18(5): 418–420. https://doi.org/10.19891/j.issn1673-9388.(2024)05-0418-03

[5] Zhang TM, Zhang ZH, 2025, Development and Exploration of Adolescent Sexual and Reproductive Health Science Popularization Courses under the Concept of Science Popularization with Ideological-Political Education. Tianjin Science & Technology, 52(S1): 28–31. https://doi.org/10.14099/j.cnki.tjkj.2025.s1.012

[6] Liu J, 2025, The Role and Impact of Short Videos in Health Knowledge Dissemination Among Adolescents. Yun Duan, 2025(43): 63–65.

[7] Wang X, Wang LL, Zheng J, et al., 2026, Analysis of the Current Status and Trends of Research in the Field of Health Science Popularization from the Perspective of Bibliometrics. Journal of Lanzhou University (Medical Sciences), 52(4): 76–82. https://doi.org/10.13885/j.issn.2097-681X.M20250913

[8] Lu B, 2025, The Inevitable Value, Realistic Situation and Proper Strategies of Cultivating Active Health Literacy of Adolescents under the Background of Healthy China. Bulletin of Sport Science & Technology, 33(2): 181–186. https://doi.org/10.19379/j.cnki.issn.1005-0256.2025.02.044

[9] Xu ZS, 2025, The Dilemma and Solution of Legal Regulation of Health Science Popularization Self-media — Taking Douyin Platform Health Science Popularization Self-media as an Example, thesis, Southwest Medical

University. https://doi.org/10.27215/d.cnki.glzyu.2025.000399

[10] Fan YF, Li YC, Wu XG, 2022, Construction of a New Model of Popular Science Health Education for Adolescents. Reference for Politics Teaching in Middle Schools, 2022(13): 91.

[11] Mi F, 2025, Current Situation and Improvement Strategies of Health Science Popularization. Chinese Journal of Health Education, 41(6): 569–574. https://doi.org/10.16168/j.cnki.issn.1002-9982.2025.06.017

[12] Li GT, 2025, Research on Methods to Enhance the Communication Effectiveness of Health Science Popularization in Public Hospitals in the New Media Era. Journal of News Research, 16(21): 36–41. https://doi.org/10.26918/j.xwyjdk.2025.21.008

[13] Chen L, Tao YT, Wu YT, et al., 2026, Investigation on the Current Status and Training Needs of Health Science Popularization Practice via All-media among Nursing Undergraduates. Journal of Qiqihar Medical University, 47(6): 582–588.

[14] Institute of Psychology, Chinese Academy of Sciences, 2023, Report on the Development of Chinese National Mental Health (2021–2022). Social Sciences Academic Press, Beijing.

[15] Rosenstock IM, 1966, Why People Use Health Services. Milbank Mem Fund Q, 44(3): Suppl: 94–127. PMID: 5967464.

[16] Hua J, Howell JL, 2022, Coping Self-efficacy Influences Health Information Avoidance. Journal of Health Psychology, 27(3): 713–725. https://doi.org/10.1177/1359105320965664

[17] Zhang LL, 2023, Analysis of the Impact of Chronic Disease Self-efficacy on Leukemia Patients Undergoing Chemotherapy. Journal of Shanxi Health Vocational College, 33(4): 123–125. https://doi.org/10.20281/j.cnki.wjyxb.2023.04.077

[18] Qi Q, Pan YY, Zeng LY, et al., 2024, Analysis of the Current Status of Health Information Literacy and Medical Health Education Needs Among Inpatients. Chinese Nursing Management, 24(4): 512–518.

[19] Green MC, Brock TC, 2000, The Role of Transportation in the Persuasiveness of Public Narratives. Journal of Personality and Social Psychology, 79(5): 701–721. https://doi.org/10.1037//0022-3514.79.5.701

[20] Zhu KK, Xu YJ, Chen HM, et al., 2022, Investigation on the Diagnostic Capacity of Syphilis and the Consultation Status of Primary and Secondary Syphilis in Hainan Province. Chinese Journal of Human Sexuality, 31(9): 132–135.

[21] Kong H, Yang WJ, Chen YY, et al., 2025, Study on the Prevalence and Influencing Factors of Hypertension among Adolescents Aged 11-17 in Ningbo. China Medicine and Pharmacy, 15(10): 166–170. https://doi.org/10.20116/j.issn2095-0616.2025.10.37

[22] Liu H, Zhou Z, Fan X, et al., 2020, The Influence of Left-Behind Experience on College Students' Mental Health: A Cross-Sectional Comparative Study. International Journal of Environmental Research and Public Health, 17(5): 1511. https://doi.org/10.3390/ijerph17051511

Publisher's note

Bio-Byword Scientific Publishing remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

International Education Forum, 2026, Volume 4, Issue 8
http://ojs.bbwpublisher.com/index.php/IEF
Online ISSN: 2981-8605
Print ISSN: 3083-4902

Development and Practice of a Quality Evaluation System for Professional Graduate Education in Engineering

Yuexia Lv, Yanbin Shi, Hui Zhang*, Wei Zhao, Jin Du

Faculty of Mechanical Engineering, Qilu University of Technology (Shandong Academy of Sciences), Jinan 250353, Shandong, China

Author to whom correspondence should be addressed.

Copyright: © 2026 Author(s). This is an open-access article distributed under the terms of the Creative Commons Attribution License (CC BY 4.0), permitting distribution and reproduction in any medium, provided the original work is cited.

Abstract: There are many limitations in the current quality evaluation of engineering professional graduate education, such as a lack of alignment between evaluation criteria and educational goals, neglect of the educational process, absence of assessment for industry-university cooperation, and limited application of evaluation results in quality improvement. Due to the above limitations, a quality assurance system for engineering practice, technological innovation, and professional ability has been established. The framework has set different evaluation criteria, multiple indicators, multi-party participation, and systematically used the evaluation results. The framework has been used for the professional graduate programs at the School of Mechanical Engineering. After implementation, the indices of engineering-oriented training, management of the educational process, participation in industry, and application of evaluation results for quality improvement have been observed.

Keywords: Professional graduate education; Quality evaluation; Engineering education; Industry-education integration; Continuous improvement

Online publication: August 31, 2026

1. Introduction

Graduate education is an important part of the national education system and plays a key role in training high-quality professionals and promoting scientific and technological innovation. With the continuous development of the socio-economic situation and the transformation of the industrial structure in China, the demand for high-level, application-oriented professionals has increased significantly. Professional graduate education has thus expanded, placing more emphasis on professional competence, practical skills, and the application of disciplinary knowledge. The rapid development of advanced manufacturing, new materials, artificial intelligence, new energy, and related fields has raised the level of expectations for the knowledge,

practical ability, and innovation ability of engineering professionals.

Engineering professional graduate students are supposed to not only obtain advanced disciplinary knowledge but also apply it to real engineering situations and contribute to technological innovation and industrial development. Therefore, the quality of professional graduate education has direct implications for the preparation of high-level engineering professionals and the translation of scientific and technological advances into practical applications. An evaluation system that reflects the objectives of professional graduate education and the distinctive characteristics of engineering training is therefore important for guiding educational practice and supporting quality improvement.

Graduate education quality has been examined from multiple perspectives, with increasing attention to educational inputs, processes, outcomes, and student development [1]. Existing evaluation frameworks have incorporated dimensions such as program objectives, faculty and supervision, curricula, research and practical training, educational outcomes, and career development [2–5]. Methodologically, approaches such as expert assessment, the analytic hierarchy process, fuzzy comprehensive evaluation, and combinations of qualitative and quantitative methods have been used to construct and assess educational quality frameworks [6–7]. In engineering education, increasing attention has also been given to professional competence, authentic engineering practice, employability, and collaboration between universities and industry. Systematic reviews have shown that engineering competence involves the integration of disciplinary knowledge with professional skills and engagement with real-world engineering problems, while university–industry collaboration can provide important opportunities for problem-solving, product development, workplace learning, and transition to professional practice [8–11].

Although previous studies have established a useful theoretical and methodological foundation for evaluating professional graduate education, further research is needed to address the specific characteristics and quality formation mechanisms of professional graduate education in engineering. Correspondingly, this study develops a quality evaluation system for professional graduate education in engineering that emphasizes engineering practice and industry-education integration and extends evaluation across the educational process. The proposed system is subsequently implemented in mechanical engineering programs to examine its practical applicability and its potential to support quality diagnosis and continuous improvement.

2. Major limitations of current quality evaluation

2.1. Misalignment between evaluation orientation and educational objectives

Professional graduate education in engineering aims to develop high-level, application-oriented professionals with strong competencies in engineering practice, technological innovation, and professional practice. Quality evaluation should therefore reflect these educational objectives. However, some evaluation practices remain strongly focused on conventional academic indicators, such as journal publications, research projects, and academic awards. Less attention is given to engineering design, technology development, process improvement, technology transfer, and the ability to solve complex engineering problems. Therefore, the evaluation criteria may not fully reflect the differences between professional and academic graduate education. This misalignment may weaken the distinctive focus of professional programs and limit the role of evaluation in promoting engineering practice and application-oriented innovation.

2.2. Insufficient evaluation of the educational process

The quality of graduate education is determined by several factors, namely coursework, supervision, research training, engineering practice, and thesis writing. Existing evaluation practices tend to focus on educational resources and conditions, such as faculty and training platforms, as well as outcomes such as degree theses, research achievements, and employment. Less attention is paid to the quality of the educational process itself. The number and composition of supervisors reflect the availability of faculty resources, but give little information about the actual quality of supervision. The number of practice bases indicates the availability of practical training opportunities but does not show how extensively students engage in engineering projects or develop their competencies through such experiences. As a result, evaluation may focus primarily on whether adequate conditions are provided and expected outcomes are achieved. It is difficult to identify problems that appear during the educational process.

2.3. Insufficient evaluation of the effectiveness of industry-education cooperation

Industry-education integration is a typical feature of professional graduate education in engineering. However, the current evaluation methods are often quantitative in nature, such as the number of industry supervisors, joint training bases, and university-industry projects. The above indices do not provide concrete data on the extent of industrial participation or its effect on students. Strengthen cooperation with the industry to promote joint construction and implementation of the curriculum, select relevant research topics, and organize engineering practice and thesis defense sessions. It is also important to assess whether students work on real engineering problems through industry-based projects and whether such experiences contribute to their engineering and innovation competencies. Current evaluation practices do not adequately capture these aspects. Consequently, they may reflect the presence of university–industry collaboration rather than its actual educational value.

2.4. Limited use of evaluation results for feedback and continuous improvement

Educational quality evaluation should not only assess educational outcomes but also identify weaknesses and support continuous improvement. However, evaluation results are often presented as overall scores, ratings, or rankings. Such results provide limited information about differences across evaluation dimensions or specific areas requiring improvement. In addition, evaluation findings are not always effectively translated into actions such as program revision, curriculum improvement, supervisor development, practice-based enhancement, and resource allocation. Follow-up mechanisms for monitoring corrective actions and assessing their effectiveness also remain limited. As a result, evaluation may serve primarily to judge educational outcomes rather than to diagnose problems and guide continuous improvement.

3. Development of a quality evaluation system for professional graduate education

3.1. Focusing on engineering competencies and differentiated evaluation

The educational objectives of professional graduate programs in engineering provide the basis for quality evaluation. Accordingly, engineering practice, technological innovation, the ability to solve complex engineering problems, and professional competence are treated as key evaluation components. This shifts the focus from conventional academic achievements toward engineering competencies and practical value.

Academic achievements remain part of the evaluation, but a broader range of representative outputs is

considered. These include engineering designs, technological developments, process improvements, product development, software systems, technical standards, and technology transfer. Evaluation considers both the results and whether they can solve actual engineering problems and what practical value they have.

The system will also consider the various types of engineering in different ways. In general, the basic quality level should be relatively high; otherwise, the other parts will have different requirements according to their own disciplines and engineering applications. Therefore, the evaluation criteria will be more closely in line with the educational objectives of all the professional engineering courses.

3.2. A five-dimensional framework for process-based evaluation

The evaluation framework extends beyond educational outcomes to cover the entire educational process. It follows the sequence of foundational support, educational process, collaborative education, educational outcomes, and developmental gains. Accordingly, five dimensions are included: educational foundations, educational process, industry-education integration, educational outcomes, and developmental gains.

Educational foundations cover program design, supervisors, curriculum resources, training platforms, and quality assurance mechanisms, which provide the basic conditions for graduate education. The educational process focuses on course delivery, supervision, research training, engineering practice, and thesis work, with emphasis on the quality of implementation. Industry-education integration examines the substantive involvement of industry in program development, joint supervision, curriculum development, enterprise-based projects, and joint training bases. Educational outcomes include degree theses, engineering practice, innovation achievements, technology transfer, employment quality, and employer evaluations. Developmental gains focus on students' progress in professional knowledge, engineering practice, innovation, teamwork, and professional competence.

The above five dimensions connect educational conditions, processes, industry participation, outcomes, and student development. Together, they provide a multidimensional view of educational quality and extend evaluation from final outcomes to the entire educational process.

3.3. Strengthening industry-education collaboration through multi-stakeholder evaluation

Professional graduate education in engineering involves multiple stakeholders and takes place across both university and industry settings. The proposed system therefore adopts a multi-stakeholder approach involving universities, supervisors, graduate students, industry partners, and employers. Universities and academic units focus on educational conditions, institutional arrangements, and program implementation. University supervisors assess students' professional knowledge, research training, and innovation capabilities, while industry supervisors focus on engineering practice, project performance, and the ability to solve complex engineering problems. Graduate students provide feedback on course delivery, supervision, and their educational experience. Employers assess graduates' professional competence and adaptability to workplace requirements.

The system has objective data and people's views. Quantitative indicators are academic results, the length of engineering experience, participation in corporate projects, and representative works. The attributes that are not easily quantifiable, such as engineering innovation, practical performance, professional ability, and the quality of industry-education cooperation, will be judged by experts, industry assessments, and questionnaires. Collect data from multiple sources and use various methods to assess the level of education in different areas.

3.4. Using evaluation results to support continuous quality improvement

The proposed system emphasizes the diagnostic role of quality evaluation and its use for continuous improvement. Rather than relying solely on an overall score or rating, evaluation results are analyzed separately across the five dimensions: educational foundations, educational process, industry-education integration, educational outcomes, and developmental gains. This dimension-specific analysis provides a quality profile that helps identify the strengths and weaknesses of each program.

Indicators associated with weaker areas are then examined to identify specific problems and determine appropriate improvement measures. The findings are communicated to academic units, degree programs, and supervisory teams. They are also used to inform program revision, curriculum improvement, supervisor development, engineering practice management, joint training base development, and resource allocation. Key indicators are reassessed in the next evaluation cycle to examine the implementation and effectiveness of these measures. This process establishes a continuous cycle of evaluation, diagnosis, feedback, improvement, and reevaluation, allowing evaluation to support both quality diagnosis and continuous improvement.

4. Practical outcomes

The proposed quality evaluation system was implemented in professional graduate programs within the School of Mechanical Engineering. Two training cycles, one before and one after implementation, were compared. The analysis focused on thesis topic selection, professional practice, industry supervisor participation, involvement in engineering projects, application-oriented outputs, and feedback on educational quality. Changes in these indicators were used to examine the practical application of the proposed system.

4.1. Stronger orientation toward engineering practice

Following implementation, changes were observed in thesis topic selection, participation in engineering projects, and application-oriented outputs. The proportion of theses derived from industry needs, engineering projects, or real production problems increased from 58.6% to 76.4%, an increase of 17.8%. The proportion of students participating in university–industry research or enterprise R&D projects increased from 65.2% to 82.7%, an increase of 17.5%. The proportion of students who have produced application-oriented results, such as patents, software copyrights, technical solutions, and process improvements, increased from 42.8% to 61.5%. The above changes show that the graduate training system is now closer to the actual work of engineers.

4.2. Improvement in the quality of the educational process

After implementation, some improvements have been made in the indicators of educational progress. The proportion of on-time completion for professional practice increased from 90.8% to 97.1%, and the proportion of students who received good or excellent ratings in the professional practice assessment rose from 76.5% to 88.9%. The proportion of students who wrote their graduation thesis proposals on time increased from 92.3% to 97.6%, and the first-attempt passing rate for the mid-term examination rose from 89.7% to 95.8%. Satisfaction among the students in the monitored department of the school has risen from 86.2% to 93.4%. In short, the above changes show that the new evaluation system has promoted professional practice, thesis progress, mid-term assessments, and supervision.

4.3 Greater depth of industry-education collaboration

Industry participation increased during the implementation of graduate education. The proportion of industry supervisors actively involved in joint supervision increased from 62.4% to 81.3%. Their participation in thesis topic selection or proposal guidance increased from 54.7% to 75.8%, while participation in professional practice assessment increased from 57.9% to 79.6%. The proportion of students completing professional practice within enterprises or through enterprise-based projects increased from 60.5% to 78.2%. In addition, the proportion of engineering practice projects jointly supervised by university and industry supervisors increased from 48.6% to 69.4%. This shows that industry involvement has been broadened in the development of theses, engineering practice, assessment, and joint supervision after the implementation of the evaluation system.

4.4. Greater use of evaluation results for quality improvement

The five indicators of the evaluation results were used, and only the overall score was not reported. The first round of assessment identified some deficiencies, such as low participation by industry supervisors and a lack of connection between professional practice and the thesis. Therefore, the following targeted optimization measures will be taken.

In the next evaluation period, the proportion of active participation by industry supervisors will be 18.9% higher, and their participation in thesis topic selection will increase by 21.1%. The proportion of thesis topics based on real engineering problems increased by 17.8%, and the proportion of good or excellent ratings in professional practice assessments rose by 12.4%. The proportion of happy students in the school has increased from 87.6% to 94.1%. The above changes indicate that the results of the evaluation were used to identify deficiencies and guide subsequent actions; thus, an initial cycle of evaluation, feedback, correction, and re-evaluation has begun.

5. Conclusions

Establish a quality assessment system that meets the goals of high-quality professional graduate education to enhance the overall level of the professional engineering program. To address the deficiencies in the current evaluation system, this paper has established a four-in-one quality evaluation system: setting up differentiated evaluation standards, developing multi-dimensional indicators, introducing multi-party evaluation, and enhancing the application of evaluation results. The five modules of the system are: educational foundations, educational process, industry-education integration, educational outcomes, and developmental gains.

Application of the system showed improvements in the indices for engineering practice, educational process management, and industry participation. Based on the evaluation results, some defects have been found, and corresponding countermeasures have been taken. These findings suggest that the proposed system better reflects the engineering, practice-oriented, and application-oriented characteristics of professional graduate education and provides a practical basis for quality diagnosis and continuous improvement. The study may therefore inform the development of differentiated quality evaluation approaches for professional graduate education in engineering and the preparation of high-level, application-oriented engineering professionals.

Funding

This work was carried out with the financial support by the Construction and Practice of the Education Quality Index Evaluation System for Engineering Professional Degree Postgraduates (SDYJG21175), Shandong Province Undergraduate Teaching Reform Research Project (Z2025232), Postgraduate Education and Teaching Research of Shandong Province (SDYJSJGC2024039), Jinan Urban University Integration Development Strategic Engineering Project (JNSX2025029) and Special Research Project on "Educational Digitalization and Industry–Education Collaboration" of the Ministry of Education of China (CSDP26LF1G211).

Disclosure statement

The authors declare no conflict of interest.

References

[1] Harvey L, Green D, 1993, Defining Quality. Assessment & Evaluation in Higher Education, 18(1): 9–34.

[2] Prados JW, Peterson GD, Lattuca LR, 2005, Quality Assurance of Engineering Education through Accreditation: The Impact of Engineering Criteria 2000 and Its Global Influence. Journal of Engineering Education, 94(1): 165–184.

[3] Felder RM, Brent R, 2003, Designing and Teaching Courses to Satisfy the ABET Engineering Criteria. Journal of Engineering Education, 92(1): 7–25.

[4] Zhang L, Huang L, Liu M, et al., 2021, Evaluation Index System of Education Quality for Nursing Professional Degree Postgraduate Using the Analytic Hierarchy Process. BMC Medical Education, 2021(21): 590.

[5] Binder JF, Baguley T, Crook C, et al., 2015, The Academic Value of Internships: Benefits across Disciplines and Student Backgrounds. Contemporary Educational Psychology, 2015(41): 73–82.

[6] Si Y, Chao N, Ma XQ, 2010, Fuzzy Comprehensive Evaluation of Graduate Education Quality Based on AHP. Advanced Materials Research, 2010(171–172): 663–666.

[7] Wang M, Zhang Z, Xu M, 2021, Postgraduate Training Performance Evaluation Applying Weighting and Comprehensive Fuzzy Evaluation Methods. International Journal of Emerging Technologies in Learning, 16(1): 124–133.

[8] Tennant S, Murray M, Gilmour B, et al., 2018, Industrial Work Placement in Higher Education: A Study of Civil Engineering Student Engagement. Industry and Higher Education, 32(2): 108–118.

[9] Winberg C, Bramhall M, Greenfield D, et al., 2020, Developing Employability in Engineering Education: A Systematic Review of the Literature. European Journal of Engineering Education, 45(2): 165–180.

[10] Vuoriainen A, Rikala P, Heilala V, et al., 2025, The Six C's of Successful Higher Education–Industry Collaboration in Engineering Education: A Systematic Literature Review. European Journal of Engineering Education, 50(1): 26–50.

[11] Zhang Y, Chen X, 2023, Empirical Analysis of University-Industry Collaboration in Postgraduate Education: A Case Study of Chinese Universities of Applied Sciences. Sustainability, 15(7): 6252.

Publisher's note

Bio-Byword Scientific Publishing remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

International Education Forum, 2026, Volume 4, Issue 8
http://ojs.bbwpublisher.com/index.php/IEF
Online ISSN: 2981-8605
Print ISSN: 3083-4902

Study on the Application Effect of CBL Combined with Standardized Patient (SP) Teaching Model in Clinical Teaching of Residents in Respiratory Medicine

Jing Niu, Jie Du*

Health Examination Center, Shaanxi Provincial People's Hospital, Xi'an 710000, Shaanxi, China

***Corresponding author:** Jie Du, 16584695@qq.com

Copyright: © 2026 Author(s). This is an open-access article distributed under the terms of the Creative Commons Attribution License (CC BY 4.0), permitting distribution and reproduction in any medium, provided the original work is cited.

Abstract: *Objective:* To explore the application value of casebased learning (CBL) combined with a standardized patient (SP) teaching model in the clinical teaching of residents during standardized residency training in respiratory medicine, and to compare the training effects between the traditional teaching model and the CBL+SP combined model, so as to provide practical evidence for optimizing the teaching program in respiratory medicine residency training. *Methods:* A total of 98 residents who rotated through the Department of Pulmonary and Critical Care Medicine in our hospital from July 2023 to July 2025 were selected as study subjects and randomly divided into a control group (n=49, receiving traditional lecturebased LBL teaching) and an observation group (n=49, receiving CBL combined with SP teaching model) using a random number table. The training period was 3 months. After training, the two groups were compared in terms of theoretical examination scores, clinical comprehensive ability (assessed by the MiniCEX scale), and skill operation examination scores; teaching satisfaction was surveyed using a selfdesigned questionnaire. *Results:* The theoretical examination scores, skill operation scores, MiniCEX subdomain scores, and overall teaching satisfaction in the observation group were all higher than those in the control group (all P<0.05). *Conclusion:* The CBL combined with SP teaching model can effectively enhance residents' theoretical mastery, clinical practical ability, doctorpatient communication, and clinical reasoning skills in respiratory medicine, with higher teaching satisfaction. This model is suitable for promotion and application in clinical teaching of respiratory medicine residency training.

Keywords: Casebased learning; Standardized patient; Respiratory medicine; Standardized residency training; MiniCEX

Online publication: August 31, 2026

1. Introduction

Standardized residency training is a critical component of clinical medical talent development, with the core objective of cultivating residents' solid theoretical foundation, clinical thinking, practical skills, and

doctorpatient communication abilities, thereby facilitating the transition from medical student to clinical physician [1]. Respiratory medicine encompasses a wide range of diseases, with conditions such as chronic obstructive pulmonary disease, bronchial asthma, and interstitial lung disease often presenting overlapping clinical manifestations, which places high demands on residents' comprehensive analytical and differential diagnostic capabilities [2]. The traditional lecturebased LBL teaching model, which emphasizes knowledge delivery through instructorled lectures, places residents in a passive receiving role, lacks opportunities for real clinical scenario practice, and often results in a disconnect between theory and clinical practice, as well as weak doctorpatient communication skills, making it difficult to fully meet the competency development requirements of residency training [3]. Casebased learning (CBL) centers on real clinical cases, using casebased questioning, discussion, and analysis to guide residents in actively structuring diagnostic reasoning, identifying key differential points, and formulating treatment plans, with a particular focus on strengthening clinical thinking skills [4]. Standardized patients (SP), after systematic training, can accurately reproduce the symptoms, signs, and emotional states of real patients, enabling repeated practice of historytaking, physical examination, and doctorpatient communication in a simulated setting, while avoiding issues such as patient noncooperation, nonreproducible clinical conditions, and medical safety risks inherent in real clinical teaching, thus providing residents with a safe environment for handson practice. CBL alone lacks facetoface doctorpatient interaction scenarios, while SP alone lacks the indepth case analysis component; the combination of the two can complement each other, integrating indepth case discussion with simulated clinical scenario practice. This study enrolled 98 respiratory medicine residents to compare the training effects of the CBL+SP combined model and the traditional LBL model, aiming to provide reference data for teaching reform in respiratory medicine residency training.

2. Materials and methods

2.1. General information

A total of 98 residents who completed their rotation training in the Department of Pulmonary and Critical Care Medicine in our hospital from July 2023 to July 2025 were selected as study subjects and randomly divided into a control group and an observation group using a random number table, with 49 residents in each group. Inclusion criteria: (1) fulltime clinical medicine bachelor's degree or above, entering the respiratory medicine rotation for the first time; (2) completed the residency orientation program, informed of the study content, and voluntarily signed informed consent; (3) completed the 3month training period and were able to participate fully in all teaching activities and assessments; (4) complete clinical teaching records. Exclusion criteria: (1) previous clinical work or rotation experience in respiratory medicine; (2) cumulative leave of more than 7 days during the training period, or withdrawal from the study; (3) absence from examinations or incomplete questionnaire responses.

There were no statistically significant differences between the two groups in terms of gender, age, educational background, or prerotation theoretical scores (P>0.05), indicating comparability (**Table 1**).

Table 1. Comparison of general information between the two groups of residents [Mean ± SD, n(%)]

Group	Male/Female	Age (years)	Education (Bachelor/Master or above)	Baseline theoretical score (points)
Control group (n=49)	22/27	24.71±1.83	31/18	72.26±5.41

Observation group (n=49)	20/29	24.45±1.76	33/16	71.84±5.67
t/x^2 value	0.167	0.715	0.180	0.384
P value	0.683	0.476	0.671	0.702

2.2. Teaching faculty and SP preparation

Teaching faculty: All instructors were attending physicians or above in the Department of Respiratory Medicine, with at least 5 years of experience in residency training. Prior to the teaching sessions, all instructors received unified training on teaching methods and became familiar with the CBL discussion process, SP assessment scoring criteria, and the evaluation standards of the MiniCEX scale.

Standardized patients (SP): Six SP actors were recruited. Senior respiratory physicians developed standardized case scripts covering five common respiratory diseases: acute exacerbation of chronic obstructive pulmonary disease, bronchial asthma, communityacquired pneumonia, pleural effusion, and interstitial lung disease. The SPs underwent a 4week specialized training program to become proficient in simulating patient complaints, history of present illness, past medical history, physical signs, and emotional responses, and to master the key points of providing feedback on residents' historytaking and communication behaviors. After training, they were assessed, and only those who passed the assessment were allowed to participate in the teaching activities. A respiratory medicine CBL case bank was established, with each case including complete clinical data such as medical history, physical examination findings, laboratory reports, chest CT, and pulmonary function reports.

2.3. Teaching methods

The rotation period for both groups of residents was 3 months, during which daily ward rounds and oncall duties were identical.

2.3.1. Control group: Traditional LBL (lecturebased learning) teaching model

The control group received teachercentered classroom instruction, with two theoretical lectures per week covering the pathogenesis, diagnostic criteria, and treatment principles of common and frequently occurring respiratory diseases. Bedside teaching was conducted using real ward cases, where instructors demonstrated historytaking and physical examination, while residents observed and learned. Routine assignments were given after class, and a unified endofrotation examination was administered upon completion.

2.3.2. Observation group: CBL combined with SP standardized patient teaching model

On the basis of basic theoretical lectures, the observation group received a combination of CBL case seminars and SP simulation exercises, with one CBL case discussion session and one SP simulation clinical training session per week.

(1) CBL case seminars: Complete case materials were distributed to residents three days before class, requiring them to review the materials in advance and prepare preliminary diagnoses, differential diagnoses, selection of ancillary tests, and treatment plans. Class sessions were primarily driven by resident presentations and discussions, with instructors guiding the discussion through questioning, exploring doubtful points of the case, and sorting out the diagnostic reasoning chain. At the end of the discussion, instructors summarized and provided feedback, corrected erroneous reasoning, and highlighted key and difficult points.

(2) SP simulation clinical training: Residents completed the full clinical process with SPs, including selfintroduction, history taking, focused physical examination, condition disclosure, communication and explanation, and preliminary treatment plan presentation. SPs provided interactive feedback on the spot. After the training, instructors used the MiniCEX scale to provide itembyitem feedback on the residents' deficiencies in historytaking, physical examination, communication, and humanistic care. Residents then reflected and practiced repeatedly on their weak areas.

The CBL cases and SP simulation cases were matched onetoone, ensuring close integration of theoretical case discussion and practical simulation.

2.4. Observation indicators

All assessments were conducted by senior physicians who were not involved in the teaching, using a blinded scoring method.

(1) Theoretical and clinical skills assessment: The theoretical examination was a closedbook written test, with a full score of 100, including multiplechoice questions, term explanations, and case analysis questions, covering all teaching content of the respiratory rotation. The clinical skills assessment (full score of 100) included preoperative evaluation for thoracentesis, procedural operation, aseptic technique, postprocedure management, and recognition of complications.

(2) MiniCEX scale scores: Seven dimensions were assessed: historytaking, physical examination, clinical judgment, communication skills, humanistic care, organizational efficiency, and overall performance. Each dimension was scored from 1 to 9, with 9 being the best and 1 being the worst.

(3) Teaching satisfaction questionnaire: The questionnaire included five items: stimulating learning interest, enhancing clinical thinking, improving communication skills, recognition of the teaching model, and overall teaching effectiveness. Responses were categorized as satisfied, average, or dissatisfied. Overall satisfaction rate = (number of satisfied cases) / total cases × 100%.

2.5. Statistical methods

Statistical analysis was performed using SPSS 27.0 software. Continuous data were expressed as mean ± standard deviation (Mean ± SD), and comparisons between groups were made using independent samples *t*tests. Categorical data were expressed as number of cases (percentage) and compared using the chisquare test. A P value of <0.05 was considered statistically significant.

3. Results

3.1. Comparison of theoretical and skills assessment scores between the two groups

The observation group achieved significantly higher scores in both theoretical examination and clinical skills assessment compared with the control group ($P < 0.001$), as shown in **Table 2**.

Table 2. Comparison of theoretical and skills assessment scores between the two groups of residents (Mean ± SD, points)

Group	Theoretical examination score	Practical skill examination score
Control group (n=49)	76.37±6.24	74.12±5.86
Observation group (n=49)	84.62±5.73	83.49±6.17

t	6.817	7.716
P	<0.001	<0.001

3.2. Comparison of mini-CEX Dimension scores between the two groups of resident physicians

The observation group scored higher than the control group in history taking, physical examination, clinical judgment, communication skills, humanistic care, organizational efficiency, and overall performance (all $P < 0.001$), as shown in **Table 3**.

Table 3. Comparison of Mini-CEX scale dimension scores between the two groups of resident physicians (Mean ± SD, points)

Dimension/Item	Control group (*n*=49)	Observation group (*n*=49)	*t*	*P*
History taking	6.04±0.71	7.42±0.65	10.109	<0.001
Physical examination	5.87±0.75	7.26±0.69	9.678	<0.001
Clinical judgment	5.73±0.68	7.31±0.72	11.168	<0.001
Communication skills	5.61±0.80	7.54±0.63	12.952	<0.001
Humanistic care	5.92±0.74	7.47±0.66	10.937	<0.001
Organizational efficiency	5.84±0.77	7.23±0.70	9.292	<0.001
Overall performance	5.80±0.72	7.36±0.64	11.018	<0.001

3.3. Comparison of teaching satisfaction between the two groups of residents

The overall teaching satisfaction rate in the observation group was 93.88%, which was higher than that in the control group (73.47%, $P<0.05$), as shown in **Table 4**.

Table 4. Comparison of teaching satisfaction between the two groups of residents [n (%)]

Group	Satisfied	Average	Dissatisfied	Overall satisfaction rate	x^2	*P*
Control group (*n*=49)	36 (73.47)	9 (18.37)	4 (8.16)	36 (73.47)	7.470	0.006
Observation group (*n*=49)	46 (93.88)	2 (4.08)	1 (2.04)	46 (93.88)		

4. Discussion

The core objective of standardized residency training is to cultivate residents' post competency, which requires not only a solid theoretical foundation but also the establishment of complete clinical thinking and proficiency in comprehensive skills including history taking, physical examination, clinical procedures, doctorpatient communication, and humanistic care. Respiratory medicine encompasses a wide range of diseases, some of which present with overlapping clinical manifestations and rapid progression, posing high demands on residents' comprehensive diagnostic and therapeutic abilities. The traditional lecturebased learning (LBL) model, dominated by teacher instruction, places residents in a passive knowledgereceiving role, lacking active thinking and simulated diagnostic scenarios, which can easily lead to a disconnect between theory and clinical practice. Meanwhile, constrained by factors such as real patient informed consent, disease variability, and medical safety, residents have limited opportunities for repeated practice in history taking and communication. Some residents, upon entering clinical settings, may encounter issues such as disorganized inquiry, rigid communication, and

weak humanistic awareness when facing real patients [5].

Casebased learning (CBL) uses real cases as carriers, guiding residents to independently consult materials and engage in discussion and analysis around the cases, translating textbook theoretical knowledge into concrete case scenarios, prompting residents to actively construct diagnostic and differential diagnostic reasoning chains, transforming the traditional didactic model, and enhancing selfdirected learning ability [6]. However, CBL alone is confined to paperbased case discussions and lacks facetoface doctorpatient interaction scenarios, so residents cannot obtain practical training in history taking, communication, and physical examination. Standardized patients (SP) can accurately reproduce real patient consultation scenarios, allowing residents to practice the entire patient reception process in a riskfree environment, including history collection, physical examination, condition disclosure, and doctorpatient communication. SP can also provide feedback on the consultation experience, helping residents identify shortcomings in humanistic care and communication skills, thereby compensating for the insufficiency of clinical teaching resources [7]. The combination of CBL and SP, first using CBL for indepth case discussion to sort out diagnostic reasoning and then relying on SP for simulated clinical practice, achieves an organic integration of theoretical thinking and simulated practice, leveraging the synergistic advantages of both teaching models [8].

The results of this study showed that residents in the observation group achieved significantly higher theoretical examination scores and practical skill scores compared with the control group ($P < 0.05$); and across all dimensions of the MiniCEX scale, the observation group scored higher than the control group. This indicates that the combined CBL+SP teaching model not only consolidates residents' theoretical knowledge but also significantly improves comprehensive clinical abilities, including history taking, physical examination, clinical judgment, doctorpatient communication, and humanistic care. The reasons are analyzed as follows: CBL case discussions prompted residents to actively consult literature and deepen their understanding of pathogenesis, differential diagnostic keys, and treatment principles of respiratory diseases [9]; SPbased simulations provided safe and repeatable clinical scenarios, allowing residents to repeatedly practice the entire consultation process, while instructors provided timely feedback and correction on onsite performance, accelerating the improvement of clinical thinking and practical skills [10]. Questionnaire survey results showed that the overall teaching satisfaction in the observation group was 93.88%, higher than 73.47% in the control group, indicating that residents generally approved of this teaching model and considered it capable of stimulating learning initiative and narrowing the gap between theory and clinical practice.

This study still has certain limitations: it is a singlecenter study with a sample size of 98 cases, which is limited; the SP cases only covered common respiratory diseases, with fewer involving critical or rare conditions; and no longterm followup was conducted, lacking data on residents' subsequent clinical performance in practice. Future studies may adopt a multicenter design, expand the sample size, and enrich the SP case bank to include severe and uncommon cases; meanwhile, incorporating DOPS operational assessments and OSCE objective structured clinical examinations will further improve the multidimensional teaching evaluation system and continuously optimize the residency training program in respiratory medicine.

In conclusion, the application of CBL combined with standardized patients in residency training of respiratory medicine can significantly improve residents' theoretical knowledge, clinical practical skills, clinical reasoning, and doctorpatient humanistic communication abilities, with high teaching satisfaction

and superior outcomes compared with traditional lecturebased teaching. This approach is worthy of wider promotion and implementation in standardized residency training in respiratory medicine.

Disclosure statement

The authors declare no conflict of interest.

References

[1] Tan JY, Yu Y, Liu HW, 2024, Application of TSDF Teaching Model in General Dentistry Residency Training. China Continuing Medical Education, 16(16): 172–176.

[2] Cui DY, Guan SH, Zhou J, 2026, Exploration of the "Teachingbypromotinglearning Feynman Technique" Teaching Model in Respiratory Medicine Education. Pharmaceutical Education, 42(2): 80–83.

[3] Sun HM, Lu YH, Chen ZR, 2024, Application of LBL Combined with PBL Teaching Method in Pediatric Respiratory Diseases Teaching. Education Teaching Forum, 2024(38): 137–140.

[4] Saiteer N, 2024, Application of PDG Combined with CBL Teaching Method in Respiratory Medicine Teaching. China Multimedia and Network Teaching Journal (First Half Month): 2024(8): 161–164.

[5] Tang M, Liu J, Tan QY, et al., 2025, Implementation Framework and Practical Pathways of Precise Ideological and Political Education in Standardized Residency Training. Chinese Journal of Graduate Medical Education, 9(10): 790–795.

[6] Zhang HT, Lu Q, Ma RN, et al., 2022, Comparative Study of Standardized Patient Combined with Casebased Teaching Versus Traditional Bedside Teaching in Respiratory Medicine Clerkship. Medical Information, 35(10): 47–50.

[7] He SD, Liang YJ, Yan MW, et al., 2020, Application of Standardized Patient Combined with PBL Teaching Model in Teaching Rounds for Chronic Cough. Health Vocational Education, 38(11): 97–98.

[8] Luo MQ, Jiang GX, Liang AW, et al., 2025, Implementation Effect of Medical Students as SP Combined with CBL Teaching Method in Clinical Internship Teaching of Respiratory Medicine. China Health Industry, 22(5): 159–161.

[9] Zhang Z, Wang BL, 2026, Application of PBL Combined with CBL Teaching Based on MDT Concept in Health Management and Respiratory Medicine Interns' Teaching. China Health Industry, 23(8): 33–36.

[10] Liang CC, Xiong SY, 2021, Application Experience of Multiple Teaching Methods in Respiratory Medicine Nursing Clinical Teaching. Medical Diet and Health, 19(14): 179–180 + 183.

Publisher's note

Bio-Byword Scientific Publishing remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

International Education Forum, 2026, Volume 4, Issue 8
http://ojs.bbwpublisher.com/index.php/IEF
Online ISSN: 2981-8605
Print ISSN: 3083-4902

Research on Cross-Cultural Emergency Education Based on an Editable VR Platform

Zhongyi Huang*

University of Shanghai for Science and Technology, Shanghai 200093, China

Author to whom correspondence should be addressed.

Copyright: © 2026 Author(s). This is an open-access article distributed under the terms of the Creative Commons Attribution License (CC BY 4.0), permitting distribution and reproduction in any medium, provided the original work is cited.

Abstract: Against the background of globalization, cross-border population mobility has become increasingly frequent. Differences in emergency responses among groups with diverse cultural backgrounds pose major challenges to traditional emergency education. Featuring customizable scenarios, iterative processes, and collaborative simulation, editable VR platforms provide a brand-new path for cross-cultural emergency education. Based on an analysis of practical dilemmas in cross-cultural emergency education, this paper elaborates on the core value empowered by editable VR platforms and emphasizes the closed-loop mechanism of "multi-player online experiment — data collection and analysis — educational content iteration." Participants from diverse cultural backgrounds carry out synchronous simulation on the VR platform; behavior and decision-making data are collected, and continuous optimization of emergency educational content and strategies is driven by analysis of cultural differences. A systematic implementation path is designed accordingly.

Keywords: Editable VR platform; Cross-cultural emergency education; Multi-player online experiment; Data-driven iteration; Behavior analysis

Online publication: August 31, 2026

1. Introduction

The acceleration of globalization has boosted cross-border population mobility. According to United Nations statistics, the number of international migrants worldwide reached 281 million in 2024. At the same time, natural disasters, public health incidents, terrorist attacks, and other emergencies occur frequently. Differences in risk perception, information comprehension, and behavioral reactions of groups with different cultural backgrounds have become increasingly prominent. Studies have shown that cultural background significantly affects individuals' compliance with emergency instructions, trust in authoritative information, and time preference for evacuation decisions. Such differences may lead to chaos and efficiency loss in emergency responses. Nevertheless, traditional emergency education mainly imparts general knowledge

under a single cultural context, which cannot meet the differentiated demands of multicultural groups. The lack of cross-cultural emergency education capacity has become a weak link in global urban safety governance [1].

The rise of editable VR platforms offers a technical breakthrough to resolve the above predicaments. VR technology has demonstrated unique value in public first-aid emergency education, yet its customization potential in the cross-cultural dimension has not been fully tapped [2].

2. Practical dilemmas of cross-cultural emergency education

2.1. Prominent and neglected cultural differences in emergency scenarios

Numerous empirical studies have verified behavioral disparities of groups with diverse cultural backgrounds in emergencies. Hofstede's cultural dimension theory states that individualism-collectivism cultural orientations affect people's willingness to help others and tendency to wait in crises; the degree of uncertainty avoidance influences individuals' tolerance for ambiguous information and compliance with emergency instructions; power distance shapes people's trust in and obedience to authoritative information sources [3]. In specific emergency scenarios, individuals with Western cultural backgrounds tend to evacuate rapidly and independently, while those from East Asian cultures prefer waiting for collective instructions or reaching group consensus before taking action. If such differences are not incorporated into emergency education and plan design, delayed responses or inappropriate behaviors may occur among specific cultural groups. However, current emergency education generally adopts a culturally neutral general content framework, failing to effectively respond to these substantial differences [4].

2.2. Cultural blind spots in traditional emergency education

Traditional emergency education has three limitations in the cross-cultural dimension. First, homogeneous content: it ignores disparities in cognitive habits and behavioral patterns of different cultural groups and lacks culturally adaptive design. The language selection of evacuation signs, expression of emergency instructions, and presentation logic of risk information all take mainstream cultural context as the default setting, without considering comprehension barriers for non-native language and non-local cultural groups [5]. Second, simplistic scenarios: it cannot simulate coordination and conflicts among multicultural groups within the same emergency scene, nor demonstrate how cultural differences impact emergency response processes. Third, insufficient verification methods: the effectiveness of cross-cultural emergency education is usually verified via subjective questionnaires without objective behavioral data. Teachers can hardly figure out the real emergency cognition and behavioral patterns of students from various cultural backgrounds, let alone adjust teaching contents accordingly [6].

2.3. Insufficient cross-cultural experimental data restricts educational iteration

Continuous optimization of cross-cultural emergency education relies on empirical data. Information about how people of different cultures make decisions and react in emergencies, and how they understand instructions, can only be obtained through systematic experimental observation. Nevertheless, organizing real cross-border and cross-cultural experiments faces practical obstacles, including difficult participant recruitment, high costs, and complicated ethical approval. Traditional questionnaires fail to capture instant reactions and real behaviors under emergency conditions. The dual shortage of experimental data and

empirical methods confines cross-cultural emergency education to experience-based assumptions rather than evidence-driven approaches. Updates and optimization of educational content lack scientific grounds, making genuine iteration impossible [7].

3. Core value of editable VR platforms empowering cross-cultural emergency education

3.1. Editable scenarios: Realize cultural customization of emergency educational contents

The editable VR platform developed by the author's team empowers teachers to independently construct emergency scenarios, breaking the restriction of "one-size-fits-all" content in traditional emergency education. Teachers can customize scenario elements targeting cognitive characteristics and behavioral preferences of specific cultural groups: adjust languages and graphic symbols of sign systems, modify presentation modes and information density of emergency instructions, and adapt the presentation to culturally specific preferences for receiving information from authoritative sources. For example, more explicit procedures and definite information can be added for groups with high uncertainty avoidance; presentation of individual action plans can be emphasized for highly individualistic groups; multi-language switching signs and voice prompts can be deployed for multilingual communities. The capacity of "teaching according to cultural traits" transforms standardized emergency education into differentiated adaptation, greatly improving the acceptability and effectiveness of educational content for diverse cultural groups [8].

3.2. Multi-player online mode: Build a large-scale collection platform for cross-cultural behavioral data

The multi-player online function of editable VR platforms provides empirical research conditions that were hard to achieve in the past for cross-cultural emergency education. Participants in different regions with various cultural backgrounds can enter the same virtual emergency scene simultaneously to carry out synchronous simulation and collaborative responses. More importantly, the platform automatically records complete behavioral data of every participant with high precision (millisecond timestamps, sampling rate ≥5 Hz), including movement paths, staying duration, operation sequences, decision-making time, instruction response speed, and social interactions. Subjective experience data are also collected via built-in questionnaires and emotion feedback modules [9].

The core breakthrough of this mechanism lies in advancing cross-cultural research from the questionnaire era to the behavioral experiment era. Researchers no longer depend on participants' post-event recollection and self-reports, but obtain authentic, continuous, and quantifiable behavioral data under emergency conditions. Meanwhile, the high immersion created by VR generates psychological stress and behaviors close to real situations, ensuring high ecological validity of collected data. Studies prove that risk decision-making behaviors in VR are highly consistent with those in reality, laying a reliable methodological foundation for scientific research on cross-cultural emergency behaviors [10].

3.3. Data-driven iteration: Construct a closed-loop optimization mechanism for cross-cultural emergency education

The core value of editable VR platforms goes beyond one-time customized teaching; it lies in building a continuous optimization closed loop of "teaching — data — analysis — iteration." After analyzing cross-

cultural behavioral data collected by the platform, researchers can identify universal rules and differentiated features of emergency responses among cultural groups, such as cognitive biases of certain cultural groups in specific scenes, cross-cultural comprehension barriers of some emergency instructions, and ineffective guidance strategies for particular populations. Such findings are fed back to the scenario editing terminal to support targeted adjustment of teaching contents, guidance strategies, and interface design. New adjusted scenes are verified in the next multi-player online experiment, and newly generated data drive another round of iteration [11].

This closed-loop mechanism transforms cross-cultural emergency education from static knowledge transmission into dynamic cultural adaptation. Educational content is no longer fixed standardized outputs but evolves alongside a deeper understanding of the behavioral rules of diverse cultural groups. Each multi-player online experiment serves as both a teaching activity and a data collection and research process, realizing organic integration of teaching, scientific research, and content production on the platform [12].

4. Implementation path of cross-cultural emergency education empowered by editable VR platforms

4.1. Hierarchical design of teaching scenarios

Teachers shall design differentiated VR scenarios according to hierarchical teaching objectives. The basic layer targets all learners, covering general emergency knowledge and basic operational skills with multilingual interfaces and culturally neutral design. The advanced layer carries out cultural adaptation for specific cultural groups, adjusting scenario elements, instruction styles, and behavioral guidance strategies based on cognitive traits of target populations. The research layer serves cross-cultural data collection, with standardized experimental scenes, control variables, and data acquisition schemes to provide evidence for educational iteration.

4.2. Multi-player online experiment and data collection mechanism

Organization of multi-player online experiments shall follow standardized procedures. Before experiments, clarify research questions (e.g., response differences of various cultural groups to visual and voice emergency instructions), design experimental scenes and control conditions, and recruit participants with multicultural backgrounds. During experiments, all participants enter the virtual scene synchronously to complete response tasks independently or collaboratively under identical emergency conditions. The platform collects behavioral data (position, time, operations, etc.) and subjective feedback in standardized formats. After experiments, the system automatically generates individual and group behavioral analysis reports with cross-cultural comparison of key indicators.

4.3. Data analysis and educational iteration mechanism

Data analysis is the core link of the closed loop. Teachers and research teams shall adopt quantitative methods to systematically analyze multi-source collected data: identify evacuation path preferences and decision-making styles of cultural groups through behavioral trajectory analysis; evaluate comprehension speed and compliance of different populations toward various instructions via response time analysis; discover corresponding relations between cultural variables and behavioral performance by association rule mining.

4.4. Platform construction and teacher support

Schools and research teams shall jointly promote platform construction. First, the platform shall feature high-freedom scene editing, supporting independent adjustment of layout, facilities, emergency parameters, and role settings; embed multi-language switching, cultural symbol library, and cross-cultural communication auxiliary modules; and possess standardized data collection and automatic analysis report generation functions. Second, build a case and template library for cross-cultural emergency education to accumulate teaching designs and experimental data of various cultural scenes. Third, form interdisciplinary teaching teams integrating emergency management, cross-cultural communication, and educational technology specialists, and carry out special training on editable VR platform operation and cross-cultural curriculum design to provide manpower guarantee for sustainable curriculum iteration [13].

5. Conclusion

The globalization era puts forward new cross-cultural adaptation requirements for emergency education, while traditional educational tools have prominent limitations in coping with this challenge. Equipped with the three-in-one technical architecture of customizable scenes, collectible behaviors, and iterable contents, editable VR platforms provide a systematic solution to dilemmas in cross-cultural emergency education. The multi-player online experiment mechanism enables large-scale, high-precision collection of cross-cultural behavioral data, and analytical results drive continuous optimization of educational content. This model transforms emergency education from an experience-based static process into a data-driven dynamic adaptation process, turning the concept of "teaching according to cultural traits" into operable practice. Future research shall further verify learning effect disparities of diverse cultural groups in VR, explore deep integration schemes of editable VR platforms with AI-based behavioral analysis and big data mining, and push cross-cultural emergency education toward higher accuracy and effectiveness [14].

Disclosure statement

The author declares no conflict of interest.

References

[1] Li MD, Li W, 2023, Research on the Construction of Urban Emergency Language Signs and Slogans in China: Necessity, Current Situation and Path. Language Education, 2023(1): 52–61.

[2] Wang S, Liu ZQ, 2024, Research Progress on the Application of Virtual Reality Technology in Public First-Aid Emergency Education. Occupational Health and Emergency Rescue, 42(5): 587–592.

[3] Hofstede G, 2001, Culture's Consequences: Comparing Values, Behaviors, Institutions, and Organizations Across Nations. 2nd ed. Sage Publications, Thousand Oaks.

[4] Qiu X, 2010, Concept of Consciousness Integration of Cross-Cultural Communication in Disaster Emergencies. Journal of Chongqing University of Science and Technology (Social Science Edition), 2010(14): 54–56.

[5] Hou YR, 2023, Research on the Improvement of Cross-Cultural Skills in China's Emergency Language Service. Journal of Gansu Open University, 2023(1): 35–40.

[6] Yu ZB, 2023, Exploration of Public Emergency Education Evaluation System Based on Kirkpatrick Model. Fire

Today, 2023(4): 4–7.

[7] Mao JD, 2022, Research on VR Cross-Cultural Teaching Model Oriented to Smart Education. Media Foreign Language Instruction, 2022(3): 64–70.

[8] Wang JJ, Wang LL, Yin PP, 2021, Design and Practice of Foreign Language Virtual Simulation Experiment Projects — A Case Study of Japanese Cross-Cultural Communication Virtual Simulation Project. Media Foreign Language Instruction, 2021(3): 57–62 + 9.

[9] Ma J, Jiang M, Dong Y, 2023, Research on a Comprehensive Model of Learning Engagement Based on Multidimensional Sensing System in Virtual Reality Environment. E-education Research, 44(2): 107–113. https://doi.org/10.13811/j.cnki.eer.2023.02.013

[10] Zheng X, Sauzeon H, Zhou MQ, et al., 2010, A Review of Studies on the Application of Virtual Reality Technology in Neuropsychological Assessment. Advances in Psychological Science, 18(3): 511–521.

[11] Wang P, Fu ZL, 2014, Data-Driven Decision-Making System: A Powerful Tool for American School Improvement in the Era of Big Data. China Educational Technology, 2014(7): 105–112.

[12] Wang YF, Wang T, Huang MG, et al., 2022, Theory and Practice of Multi-party Collaborative Training Mode for Comprehensive Practical Teaching of Modeling and Simulation. Science and Education Review, 2022(25): 47–49.

[13] Peng Z, Li QF, 2021, Architecture Design of Emergency Command Simulation and Drilling Platform Based on TENA. Journal of System Simulation, 33(1): 231–238.

[14] Qi C, Wang HW, 2015, Design of Emergency Drill Simulation Platform for Senior Commanders. Systems Engineering — Theory & Practice, 35(7): 1871–1877.

Publisher's note

Bio-Byword Scientific Publishing remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

International Education Forum, 2026, Volume 4, Issue 8
http://ojs.bbwpublisher.com/index.php/IEF
Online ISSN: 2981-8605
Print ISSN: 3083-4902

Research on China-Malaysia New Engineering Talent Cultivation Paths from the Perspective of Industry-Education Integration: A Case Study of Xiamen University of Technology

Xiahui Fan*

Office of International Cooperation and Exchange, Xiamen University of Technology, Xiamen 361024, Fujian, China

Author to whom correspondence should be addressed.

Copyright: © 2026 Author(s). This is an open-access article distributed under the terms of the Creative Commons Attribution License (CC BY 4.0), permitting distribution and reproduction in any medium, provided the original work is cited.

Abstract: China-Malaysia higher education cooperation has become an important testing ground for cultivating new engineering talent that can operate across borders. Taking the partnership between Xiamen University of Technology (XMUT) and Universiti Sains Malaysia (USM) as its object, this documentary case study traces how cooperation beginning with a single research platform in November 2021 evolved, through four identifiable stages, into a systematic, three-dimensional, and sustainable architecture for cross-border, bachelor-through-doctorate cultivation of new engineering talent. Stage I (2021–2022) established the International Industrial IoT Research Institute under a four-party mechanism of Chinese and Malaysian universities and enterprises; Stage II (2022–2025) extended cooperation from joint master's training to doctoral training with mutually appointed supervisors; Stage III (2023–2026) added a Sino-foreign cooperative undergraduate program in microelectronics approved by China's Ministry of Education in May 2026, completing coverage of the bachelor, master and doctoral levels; and Stage IV (2025 onward) upgraded the jointly built China-Malaysia Artificial Intelligence Joint Laboratory into a national-level international research cooperation platform. The stages are cumulative rather than parallel: governance assets, co-developed curricula, dual mentorship, and mutual recognition created early become the enabling conditions of later stages. The study extracts the mechanisms behind this evolution, discusses operational constraints, and derives implications for replicating the model in other ASEAN-China partnerships.

Keywords: Industry-education integration; New engineering talent; China-Malaysia cooperation; Cross-border talent cultivation system; Xiamen University of Technology; Universiti Sains Malaysia

Online publication: August 31, 2026

1. Introduction

1.1. Transnational engineering talent and the industry-education integration imperative

Engineering practice is increasingly transnational: supply chains are being reconfigured, the ASEAN-China digital economy is integrating rapidly, and shared infrastructure frameworks continue to expand [1–2]. Engineers must therefore master not only technical domains such as intelligent manufacturing, microelectronics and green energy, but also cross-border project coordination, joint research governance and regulatory interoperability [3]. Nationally bounded curricula, however, rarely cultivate such institutional fluency; closing the gap requires industry-education integration at transnational scale — as foundational architecture for curriculum co-design, faculty exchange and competency benchmarking rather than peripheral internship add-ons [4]. China-Malaysia cooperation is an instructive laboratory for such models because the two countries combine complementary industrial structures with active education opening-up policies. Yet most studies examine isolated reform elements — one course, one internship scheme or one college — rather than the multi-stage process by which an entire cross-border cultivation system is built. How bilateral cooperation matures into an institutionalized, whole-pipeline system therefore remains under-explored, and this is the question addressed here.

1.2. The strategic position of Xiamen University of Technology

Xiamen University of Technology is an application-oriented public university in Xiamen, Fujian Province, at the heart of the China-Malaysia economic corridor. Formally designated a national pilot institution for applied engineering education, it is committed to practice-oriented curricula and industry-responsive pedagogy [5]. Since November 2021, it has pursued a progressively deepening partnership with Universiti Sains Malaysia (USM), a leading Malaysian research university in Penang, a node of the Malaysian electronics and semiconductor industry. The partnership is analytically valuable for its staged institutional trajectory: from one jointly established research institute, it expanded into joint master's and doctoral cultivation, then into a full Sino-foreign cooperative undergraduate program, and finally into a national-level international research cooperation platform — covering talent cultivation from bachelor to doctoral level and cooperation from talent co-cultivation to project co-research. This trajectory is documented in agreements, ministry-level approvals, and project archives accumulated under the funded program on constructing a China-Malaysia internationalized talent co-cultivation system for new engineering (Project No. JYCG202559).

1.3. Research questions, scope, and paper structure

Three questions guide this study: (1) through which stages and milestones did the XMUT-USM cooperation evolve between 2021 and 2026; (2) which mechanisms produced a systematic, three-dimensional, and sustainable cultivation architecture; and (3) what constraints emerged and what lessons are transferable to other ASEAN-China partnerships. The scope is bounded to cooperation in electronic information, flat-panel display, and integrated circuits at the higher education level, from bachelor through doctoral cultivation, and the study relies on documentary evidence so that every factual claim is traceable. Section 2 reviews the literature, Section 3 presents the evidence base and analytical framework, Section 4 reports the four-stage evolution, Section 5 discusses mechanisms and constraints, and Section 6 concludes.

2. Literature review

2.1. Industry-education integration: From policy discourse to institutional practice

Industry-education integration has moved from policy articulation to operational practice in both countries. In China, new engineering reforms and the construction of engineering industry colleges push universities toward co-governance with enterprises, shared curricula, and joint laboratories [6–7]; in Malaysia, quality assurance is outcomes-based, and employer co-design is encouraged. Both systems nonetheless face similar frictions — limited faculty industry immersion, weak incentives for curriculum co-development with firms, and underdeveloped feedback and assessment instruments — and integration depth depends less on formal agreements than on interactive environments and aligned stakeholder incentives [4, 8–10]. The literature concludes that sustainable integration requires durable institutional mechanisms, but offers little evidence on how such mechanisms accumulate through staged cooperation between two universities in two countries.

2.2. Bilateral engineering education: Structural asymmetries and convergence points

China's engineering education framework, governed by the Ministry of Education through centralized standardization and the Sino-foreign cooperative education approval system, differs structurally from Malaysia's outcomes-based system accredited by the Malaysian Qualifications Agency. The asymmetries appear most acutely in qualification articulation, credit transfer and cross-border degree conferral, yet convergent priorities — sustainability competencies, Industry 4.0 digital fluency and project-based assessment — make pragmatic alignment possible even where regulatory infrastructures are not yet interoperable [5, 11–12]. Postgraduate cooperation is especially instructive, because joint training bases and shared supervisors force quality assurance standards to be negotiated concretely [13]. The XMUT-USM case offers a rare, well-documented instance of such convergence across a full multi-stage trajectory.

2.3. The new engineering paradigm and the gap this study addresses

The new engineering paradigm shifts attention from atomized technical competence toward integrated professional identity, requiring engineers to combine domain expertise with intercultural collaboration, systemic awareness, and industry co-design capacity [14–15]. Reform studies across disciplines — rail transit course groups, architectural talent models, applied talent training systems, chemical engineering curricula, intelligent manufacturing specialty groups, AI-enabled civil engineering teaching and digital-twin supported integration — show that discipline-specific adaptation, not generic templates, determines success, while platform-based enablers such as industrial internet architectures and AI+X centers are increasingly emphasized [3, 5, 12, 16–23]. Two gaps remain: most studies are single-dimensional and rarely reconstruct the longitudinal process by which a partnership accumulates assets stage by stage, and few anchor analysis in the concrete regulatory steps through which a genuinely cross-border, full-level cultivation system becomes possible. This study addresses both gaps through process-oriented analysis of the XMUT-USM cooperation from 2021 to 2026.

3. Research design, data sources and analytical framework

3.1. Case selection and documentary evidence base

XMUT and USM were selected because their partnership is complete and well documented: by May 2026, it had achieved formal coverage of the bachelor, master, and doctoral levels, making the full pipeline observable

within one case. The evidence base comprises the November 2021 agreement establishing the International Industrial IoT Research Institute; the 2023 cooperation intention agreement for the undergraduate program; approvals from China's Ministry of Education, the Malaysian Ministry of Education, and the Xiamen municipal government; institutional reports on jointly built platforms and postgraduate cultivation; and the archive of the funded project (No. JYCG202559). The observation window spanning November 2021 to May 2026 is long enough to reveal stage transitions rather than isolated events. All documents underwent chronological process tracing and cross-verification, with ambiguous items flagged rather than inferred, yielding high internal validity; external generalizability is bounded and discussed in Section 6.

3.2. Analytical framework: Stage evolution and three anchor mechanisms

The analysis proceeds in two layers. The first is chronological, reconstructing the record as four stages defined by their dominant institutional logic and trigger events: platform foundation (2021–2022), joint talent cultivation (2022–2025), expansion of cooperative programs (2023–2026), and research leap (2025 onward). The second is interpretative, identifying at each stage the mechanisms that bind universities, enterprises, governments, and students into a working system through three anchors adapted from the literature: institutional commitment (governance and regulatory assets such as the four-party mechanism, ministry-level approvals, and mutually appointed supervisors), pedagogical mutuality (co-designed curricula, shared teaching teams, dual mentorship and joint assessment), and ecosystem interoperability (internship bases, joint laboratories, industry-funded projects, technology transfer, and mutual recognition of degrees). Applying both layers shows not only what happened at each stage but also why each stage made the next feasible.

4. Results: The four-stage evolution of XMUT-USM cooperation (2021–2026)

4.1. Stage I (2021–2022): Platform foundation through the international industrial IoT Research Institute

In November 2021, at the Maritime Silk Road International Conference on Industry-University-Research Cooperation, XMUT and USM signed an agreement with Chinese and Malaysian industry enterprises to jointly establish the International Industrial IoT Research Institute, addressing talent cultivation and key technology research in integrated circuits and the industrial internet of things through a four-party mechanism combining Chinese and Malaysian universities with Chinese and Malaysian enterprises. Leveraging this platform, XMUT was subsequently designated among the first batch of cooperating institutions under the Ministry of Education's China-ASEAN "Thousand Schools Hand in Hand" Program. Because the platform has grown across later stages, its cumulative outputs are recorded here: as of early 2026, the partners had jointly built the institute, the Intretech Technology Electronic Information Industry College (Intretech, a Xiamen-listed enterprise, stock code 002925) and an overseas postgraduate internship base, focused on electronic information, flat-panel display and integrated circuits. Joint research has extended to frontier topics such as brain-computer interfaces, and the industry linkages have generated more than 30 horizontal projects commissioned by enterprises, with patented technologies converted into applications adding more than 100 million yuan in new output value. Stage I thus created the governance platform, enterprise network, and physical infrastructure on which all later cultivation activities rely.

4.2. Stage II (2022–2025): Joint postgraduate cultivation from master's to doctoral levels

Building on the platform stage, the two universities enrolled the first cohort of jointly trained master's students in 2022. High-quality core courses from the Malaysian partner were introduced, and twelve "industry-close" courses were jointly developed by the universities and enterprises, supported by multi-stakeholder collaborative teaching teams. In 2024, doctoral joint cultivation was launched together with the mutual appointment of doctoral supervisors between the two universities, and the first jointly cultivated doctoral student enrolled at the end of 2025, focusing on integrated circuit design and artificial intelligence applications. By 2025, the cumulative number of jointly cultivated postgraduates had reached 23, with cultivation levels clearly spanning the transition from master's to doctoral training. Throughout this stage, a distinctive paradigm was consolidated — "university-enterprise dual supervisors plus research project-driven" cultivation, in which each student is guided by both an academic and an industry supervisor and advances through real research projects. The stage converted Stage I assets into a tested mode of cross-border postgraduate training: the master's track supplied the pipeline, mutually appointed supervisors supplied academic depth, and the enterprise network supplied the problems on which students trained.

4.3. Stage III (2023–2026): The Sino-foreign cooperative undergraduate program

In parallel, the two universities moved to the undergraduate level, where demand for integrated circuit talent is most intense. In 2023, they signed a cooperation intention agreement to apply for a Sino-foreign cooperative education undergraduate program in microelectronics science and engineering. The application then passed a sequence of regulatory milestones: in 2024 it received approval from the Malaysian Ministry of Education for the conferral of overseas degrees; in 2025 it was selected as a Xiamen municipal cultivation project for high-quality Sino-foreign cooperative education; and in May 2026 it passed the review of China's Ministry of Education and was officially approved. With this approval, the cooperation achieved formal coverage of the bachelor's, master's, and doctoral levels, offering an articulated cross-border pathway from undergraduate study into the jointly cultivated master's and doctoral tracks. During the same period, the skills training program in integrated circuit design and integrated systems co-delivered by the two universities was selected in 2025 as a Fujian provincial flagship project for the international opening-up of education, extending cooperation beyond degree education. Stage III thus added the base of the talent pyramid and, with earlier stages, turned the partnership into a complete education system reaching from first-degree students to doctoral candidates and continuing professionals.

4.4. Stage IV (2025–): Research leap to a national-level joint platform

The most recent stage elevates the research dimension of the partnership. In 2025, the China-Malaysia Artificial Intelligence Joint Laboratory, jointly built by the two universities, was included in the "Strategic Science, Technology and Innovation Cooperation" key special program under China's National Key Research and Development Program, administered by the Ministry of Science and Technology, and was thereby upgraded into a national-level international research cooperation platform — the first of its kind in the partnership. The upgrade changed the structure of the cooperation: earlier stages were led by joint talent cultivation with research as a supporting vehicle, whereas the cooperation has now evolved into a two-way synergistic mode of "talent co-cultivation plus project co-research," in which doctoral students and faculty move between joint projects and the cultivation pipeline. The stage matters for two strategic industries — artificial intelligence and integrated circuits — and, though still unfolding, already demonstrates the

completion of an evolution from project-level cooperation to an ecosystem in which talent cultivation and research are institutionally coupled at national scale.

4.5. Cross-stage synthesis: From isolated projects to an integrated cultivation architecture

The four stages follow a consistent logic of cumulation. Stage I supplied governance and infrastructure; Stage II validated the cross-border postgraduate training mode; Stage III completed the pipeline with an approved undergraduate program and professional training; and Stage IV coupled the completed pipeline to a national-level international research cooperation platform. The result is the systematic, three-dimensional and sustainable architecture that the partners describe: systematicity in articulating the bachelor, master and doctoral levels with degree education and skills training; three-dimensionality in the simultaneous presence of university, enterprise and government actors and of Chinese and Malaysian regulatory frameworks; and sustainability in the self-reinforcing loop whereby approved programs generate students, students feed joint research, and joint research attracts the industry projects and national programs that sustain them. **Table 1** summarizes the milestones.

Table 1. Milestones of the four-stage XMUT-USM cooperation (2021–2026)

Stage	Period	Representative milestones
Platform foundation	2021–2022	November 2021: joint establishment of the International Industrial IoT Research Institute under a four-party mechanism of Chinese and Malaysian universities and enterprises; selection among the first batch of institutions of the China-ASEAN "Thousand Schools Hand in Hand" Program
Joint talent cultivation	2022–2025	2022: first joint master's cohort and Malaysian core courses; twelve industry-close courses jointly developed; 2024: doctoral joint cultivation with mutual appointment of doctoral supervisors; end of 2025: first joint doctoral student; 23 jointly cultivated postgraduates cumulatively
Cooperative programs	2023–2026	2023: intention agreement for the undergraduate program in microelectronics science and engineering; 2024: Malaysian Ministry of Education approval for overseas degree conferral; 2025: Xiamen municipal cultivation project; May 2026: approved by China's Ministry of Education, completing bachelor-master-doctoral coverage; 2025: skills training program named a Fujian provincial flagship education opening-up project
Research leap	2025–	2025: China-Malaysia Artificial Intelligence Joint Laboratory included in the "Strategic Science, Technology and Innovation Cooperation" key special program and upgraded into a national-level international research cooperation platform

5. Discussion

5.1. How the four stages built a systematic cultivation architecture

The case shows that a transnational industry-education integration system is assembled stage by stage, each layer built on the assets of the previous one. Institutional commitment was established early and deepened continuously: the four-party mechanism created shared governance, successive ministry-level approvals in China and Malaysia converted private agreements into legally recognized programs, and mutual appointment of doctoral supervisors embedded commitment in academic careers. Pedagogical mutuality was built through the twelve industry-close courses, multi-stakeholder teaching teams, and the dual-supervisor paradigm, ensuring that Chinese, Malaysian, academic, and industrial perspectives all shaped what students learned. Ecosystem interoperability grew from the overseas internship base and enterprise-funded projects of Stage I to the jointly operated research platforms of Stage IV, while degree-conferral approvals and the articulated bachelor-master-doctoral pathway dismantled the credential barriers that typically obstruct cross-

border education. The central insight is that no single element sufficed: the platform made joint training possible, joint training justified the undergraduate program, and the completed pipeline made a national-level international research cooperation platform a natural next step. This cumulative logic explains why the partnership achieved measurable outputs at every stage.

5.2. Complementarity and asymmetry as catalytic mechanisms

Complementarity between asymmetric partners is a second mechanism. XMUT and USM do not replicate each other: USM contributes research depth, doctoral supervision capacity, and access to Malaysia's quality assurance system, while XMUT contributes applied teaching capacity, deep ties to the Fujian electronics industry, and proximity to the integrated circuit and display clusters of the Xiamen area. Structured through explicit role allocation, these differences become strategic assets: the doctoral track relies on USM's research infrastructure and XMUT's industry-funded projects; the undergraduate program leverages XMUT's microelectronics teaching strength while USM's postgraduate pipeline gives graduates a progression route; and the joint laboratory couples Malaysian research capacity with Chinese application scenarios. Symmetrical duplication would have required far larger investment for far smaller gains. Bilateral partnerships should therefore be engineered around comparative advantage rather than formal symmetry.

5.3. Constraints, enablers, and transferability

The case also reveals constraints. The bachelor's program was approved in May 2026 and enrolled its first cohort in September, while the doctoral track admitted its first student only at the end of 2025; thus, the full pipeline remains to be tested operationally. Cross-border alignment problems documented in the literature — academic calendar synchronization, credit transfer between differently accredited systems, intellectual property arrangements, and the administrative cost of dual-country approvals — appear here as ongoing management burdens, and the cooperation depends on sustained funding and on the continuity of key individuals. The mitigating enablers are equally clear: the four-party structure distributes risk; dual-country approvals provide regulatory stability that outlasts individual agreements; the dual-supervisor and mutual-appointment systems embed cooperation in careers rather than projects; and the completed pipeline generates a self-renewing supply of students whose training feeds the joint research agenda. For other universities, the transferable lesson is staged sequencing: begin with a bounded platform that both sides can staff and fund, convert early experience into formally approved programs, and only then scale toward full-pipeline and research-platform cooperation.

6. Conclusion

6.1. Core contributions

This study offers a process-oriented account of how China-Malaysia cooperation in new engineering education can mature from a single project into an integrated cultivation system. Empirically, it reconstructs the four-stage evolution of the XMUT-USM partnership from 2021 to 2026 and documents, within one case, the completion of bachelor-master-doctoral coverage and the elevation of a jointly built laboratory to a national-level international research cooperation platform. Theoretically, it shows that the systematicity, three-dimensionality, and sustainability of such an architecture result from cumulative stage sequencing rather than from any single agreement. Practically, it offers other universities a replicable roadmap: platform

foundation, level-by-level cultivation expansion, program formalization through dual-country approvals, and research-platform coupling, with role allocation based on comparative advantage at every step.

6.2. Recommendations

Five recommendations follow. First, the universities should move the newly approved undergraduate program into operation, aligning its curriculum and quality assurance with both the Malaysian Qualifications Agency framework and China's engineering education accreditation criteria so that bachelor-to-doctoral articulation works as designed. Second, they should convert the mutual appointment of doctoral supervisors into a standing cross-institutional mechanism with joint criteria, shared research funding, and explicit intellectual property protocols. Third, they should extend the industry-close course model and the dual-supervisor paradigm across the whole pipeline, downward to the undergraduate program and outward to the flagship skills training. Fourth, they should use the national-level artificial intelligence laboratory as the anchor of a shared research agenda integrating doctoral projects, industry-funded problems, and the internship base. Fifth, they should disseminate the staged model through the funded project's outputs and China-ASEAN cooperation frameworks so that other universities can adapt its sequencing logic.

6.3. Limitations and future research

Three limitations apply. First, this is a single case, and generalization to partnerships with different industrial bases or regulatory settings requires caution. Second, the observation window ends just as the undergraduate program is approved and the doctoral track begins, so operational performance of the complete pipeline cannot yet be evaluated. Third, the documentary method cannot capture informal dynamics that qualitative fieldwork would reveal. Future research should track the first cohorts of both new programs over several years, compare the XMUT-USM trajectory with other ASEAN-China partnerships, and develop quantitative indicators of the systematicity and sustainability of cross-border cultivation systems.

Funding

Construction of a China-Malaysia Internationalized Talent Co-Cultivation System for New Engineering under the "101 Plan": A Practice of Industry-University-Research Cooperation between Xiamen University of Technology and Universiti Sains Malaysia (Project No.: JYCG202559)

Disclosure statement

The author declares no conflict of interest.

References

[1] Lou YX, Zhang X, Zhao P, et al., 2024, Teaching Reform and Practical Exploration of Graduation Internship Based on the Industry-Education Integration. Polymer Bulletin, 37(12): 1821–1827.

[2] Ma MJ, 2026, Reconstruction of CNC Machining Teaching System from the Perspective of Industry-Education Integration Course Design and Practical Ability Improvement Guided by Real Production Tasks in Enterprises. Advanced Electromagnetics, 15(3): 8506–8511.

[3] Bai Q, 2026, Industry-Education Integration Drives the Development of Architectural Talent Development Models. Journal of Sociology and Education, 2(6): 1–4.

[4] Xu YJ, 2026, Real-time Assessment and Early Warning System for Industry-Education Integration in Higher Vocational Colleges Based on Multimodal Deep Learning. Advanced Electromagnetics, 15(3): 8133–8139.

[5] Gao Z, 2025, Research on the Construction of the "Industry-Education Integration + Intelligent Drive" Course Group for Rail Transit Major. Design Studies and Intelligence Engineering: Proc. DSIE 2025, Hangzhou, China, Dec. 13–14, 2025, pp. 2646–2654.

[6] Deng Y, 2026, Research on the Innovative Path of Industry-Education Integration in Engineering Industry Colleges under the Background of New Engineering. Journal of Modern Educational Theory and Practice, 3(5): 1–6.

[7] He H, 2026, Research on Reform Pathways for China's Higher Engineering Education to Meet Future Industrial Demands. 2026 ASEE Annual Conference & Exposition, Jun. 2026.

[8] Zheng XT, Ma LW, 2025, Research on Curriculum and Instruction in Digital Intelligence Empowered Engineering Education Based on First Principles. Frontiers in Education, 2025(10): 1659412.

[9] Yu Y, Huang Z, Hao Y, 2026, Designing Interactive Industry-Education Learning Environments: Technology Integration, Knowledge Transformation, Self-Efficacy, and Innovation Readiness. Interactive Learning Environments, preprint, 1–25.

[10] Song J, 2025, From Collaboration to Integration: Exploring the Path of Deep Integration of Industry and Education in Higher Vocational Colleges from the Perspective of Stakeholders. Open Journal of Social Sciences, 13(12): 282–293.

[11] Zhang X, Cao R, 2026, Research on the Construction Path of Local University Industry-Education Integration Community under the Drive of New Quality Productivity. International Conference on Intelligent Engineering and Next-Gen Healthcare System, 2026, pp. 1–7.

[12] Hu P, Ma J, Bai N, 2026, A Large Language Model-driven Virtual Simulation Platform advances intelligent Construction Teaching within an Industry-Education Fusion Framework. Scientific Reports, preprint.

[13] Yang E, Lu J, Song M, et al., 2026, Industry-Education Integration for Mechanical Postgraduates via a Joint Training Base: A Beibu Gulf University Case Study. International Journal of Educational Research, 9(4): 69.

[14] Xu Y, 2026, Industry-Education Integration and Communities of Practice: An Exploration from the Perspective of Higher Education Management. Academic Journal of Education, 2(2): 24–28.

[15] Chen X, 2025, Exploring Digital Empowerment Pathways for Core Competencies of "New Engineering" Talents in Greater Bay Area Universities under the Perspective of Industry-Education Integration. Design Studies and Intelligence Engineering: Proc. DSIE 2025, Hangzhou, China, Dec. 13–14, 2025, pp. 3131–3141.

[16] Lv WY, 2026, Research on Optimization and Practice Path of Applied Professional Talent Training System from the Perspective of Industry-Education Integration. Advanced Electromagnetics, 15(3): 7180–7191.

[17] Guo B, Duan W, 2026, Micro-project-based RFIC Teaching Reform in Emerging Engineering Education and Industry-Education Integration: A Case Study of 65-nm Wideband Multi-Core VCO Engineering Design. International Journal of Educational Research, 9(5): 1.

[18] Zhang Y, 2026, Innovative Paths for Cultivating Application-Oriented Talents in Chemical Engineering from the Perspective of Industry-Education Integration. Journal of Modern Education and Culture, 3(2): 1–6.

[19] Wang L, 2026, Research on the Collaborative Development Path of AI Teaching and Industry-Education Integration of Intelligent Manufacturing Specialty Groups in Higher Vocational Colleges. Frontiers in Humanities and Social Sciences, 2(2): 39–47.

[20] Liu C, Zhong X, Zhu L, et al., 2026, An AI-Enabled Integrated Blended Teaching Framework for Civil Engineering Education: A Case Study from an Undergraduate Program in China. Computer Applications in Engineering Education, 34(5): e70249.

[21] Liu Y, Xu J, 2026, Design of an Industrial Internet Platform Architecture for Intelligent Manufacturing under the Guidance of Industry-Education Integration. International Conference on Big Data and Intelligent Manufacturing, 2026, pp. 108–113.

[22] Ren L, Liu Y, 2026, Digital Twin System Construction and Simulation Optimization for Collaborative Effectiveness of Industry-Education Integration. IEEE Access, preprint.

[23] Huang F, You L, Sun G, 2026, Research on the Construction of an AI+X Industry-Education Integration Experimental Center in Application-Oriented Undergraduate Universities. Journal of Integrated Social Sciences and Humanities, 3(2): 8.

Publisher's note

Bio-Byword Scientific Publishing remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

International Education Forum, 2026, Volume 4, Issue 8
http://ojs.bbwpublisher.com/index.php/IEF
Online ISSN: 2981-8605
Print ISSN: 3083-4902

Economics Education into Medical Professional Education — A Literature-Based Normative Curriculum Design Study

Yongfeng Zhang[1], Xia Li[2]*

[1]School of Economics and Management, Yan'an University, Yan'an, Shaanxi, China
[2]Department of Endocrinology and Metabolism, Affiliated Hospital of Yan'an University, Yan'an, Shaanxi, China

Author to whom correspondence should be addressed.

Copyright: © 2026 Author(s). This is an open-access article distributed under the terms of the Creative Commons Attribution License (CC BY 4.0), permitting distribution and reproduction in any medium, provided the original work is cited.

Abstract: *Objective:* To examine how economics literacy can be systematically embedded into medical professional education in a low-cost, measurable, and sustainable way within an already near-saturated curriculum, and to build an operational curriculum integration model. *Methods:* The study conducted a literature-based normative curriculum design study. With Health Systems Science and constructive alignment as the analytic framework, the study synthesized international empirical cases and domestic policy texts, and derived the model through the progression "literacy positioning — curricular attribution — integration model." *Results:* The study built a curriculum integration model with three components — embedding strategy, teaching organization, and evaluation. Economics content is embedded into existing courses through a longitudinal curricular thread, distributed spirally across three stages totaling 20–28 credit-hours. Teaching is organized around clinical decision problems and supported by clinical teachers working with health economists. A three-tier evaluation (knowledge, skill/behavior, reflection) secures the observability of the literacy. *Conclusions:* Economics literacy is a core literacy of the medical profession, not a managerial add-on; it supplies the economic dimension of the "humanities" within the medicine–humanities integration advanced by the New Medicine initiative. Its curricular intervention is best realized by embedding through a longitudinal thread, organizing teaching around clinical decisions, engaging health economists as collaborators, and securing observability through explicit, hierarchical evaluation.

Keywords: Medical education; Health economics; Curriculum integration; Health Systems Science

Online publication: August 31, 2026

1. The problem

Medical education has never been technical training sealed off from its era. Each profound shift in society, science, or technology renews medical understanding, widens the range of available choices, and pushes the

discipline forward. the COVID-19 pandemic that began in late 2019 forced a society-wide reconsideration of the mission of medicine and of medical education. In September 2020, the General Office of the State Council issued the Guiding Opinions on Accelerating the Innovative Development of Medical Education, declaring that medical education "shall occupy a position of priority for the development of education and health," and called for the categorical cultivation of research-oriented, compound, and application-oriented talent under the New Medicine (xinyike) initiative [1]. New Medicine stresses "five combinations"; among them, the "integration of medicine and humanities" holds that medicine is both a science and a study of persons — curing disease while also tending to the soul — and therefore demands stronger humanistic quality, medical ethics, ethical decision-making, and communication in medical students [2].

That integration opens a direct policy and conceptual gateway for economics education to enter medical education. Economics literacy is not named in the framework, yet it is precisely a vital dimension of its "humanities" component. From the macro level — the rollout of diagnosis-related group (DRG) and big-data, the resource commitments of a single department — to the micro level — the design of a treatment plan, the choice among alternative drugs — physicians must constantly judge cost, efficiency, and value. This capacity weighs as heavily as the humanistic and ethical literacy rooted in the Hippocratic Oath, and indeed sets its practical limit. In short, economic literacy and economic reasoning are not external "add-on knowledge" but an indispensable facet of modern medical professionalism: beyond technique and professional identity, they oblige practitioners to face the real economic world and to reconcile professional judgment, ethical commitment, and feasibility under constraint. Together with the ethics and communication that the medicine–humanities integration emphasizes, they matter greatly for forming "warm and accountable" clinical decision-makers.

At the curricular level, integrating economics education has moved from "optional" to "necessary," though its feasibility remains "conditionally attainable." Domestic efforts fall into three orientations. The independent-course orientation: a few schools offer Health Economics or Pharmacoeconomics, but mainly for health-management and preventive-medicine students, with thin coverage of clinical medicine. The conceptual-advocacy orientation: most work stays at the level of arguing that integration "should" occur; although the New Medicine economics courses have been written into the core curriculum, the Chinese Standards for Undergraduate Medical Education — Clinical Medicine (2022 Edition) permits humanities and social-science content to be "integrated into professional courses," and exploratory curriculum work exists, the operational question of "how to integrate" receives little attention [3–4]. The local-pilot orientation: some institutions have tried embedding economic-evaluation content into evidence-based medicine and clinical subspecialties, but without a unified literacy framework or evaluation standard, so the experience rarely transfers. The literature thus shows a bias toward "argument over design, concept over evaluation," and notably lacks an integrated model explaining what economics literacy "where it is taught, and how it is assessed."

International experience supplies a comparatively mature reference. Germany embedded health economics in medical curricula from 2003, chiefly in the 8th–10th semesters [5]; the United States frames economics as a strand of the Health Systems Science "third pillar," carried longitudinally across the basic–clinical–clerkship continuum [6–7]; Canada's Choosing Wisely and STARS movements advance cost-consciousness through student societies and electives [8]. Yet these models rest on different payment environments and academic structures and cannot be transplanted wholesale. This paper fills that gap:

drawing on international experience, it builds an operational curriculum integration model for economics literacy fitted to the constraints of China's five-year medical program.

2. Research design

This study is a literature-based normative curriculum design study, pursued in three steps [9]. Scope of literature: the study included international empirical cases of health-economics and cost-consciousness education in medical education together with domestic policy texts, emphasizing representative cases — Germany, the US Health Systems Science framework, and Canada's Choosing Wisely/STARS — plus China's New Medicine policy documents and domestic curriculum explorations [1, 3–7, 8, 10]; the selection criterion was a clear description of the path chosen for curricular intervention. Analytic framework: Health Systems Science (HSS) and constructive alignment (Biggs) supply the theory — the former to justify the curricular attribution of economics literacy, the latter to hold learning objectives, teaching activities, and assessment in alignment. Derivation rule: following the progression "literacy positioning → curricular attribution → integration model," international experience is synthesized into one internally consistent scheme. A limitation of the study is that its conclusions are normative derivations not yet validated by curriculum implementation; their validity awaits pilot testing.

3. Why economics literacy is a core literacy of the medical profession

The claim that economics literacy belongs within the medicine–humanities integration of New Medicine, and thereby within the core literacy of the medical profession, rests on three cumulative grounds.

3.1. The economics-based resource-constraint hypothesis is the inherent context of clinical decisions

The medical services market differs from ordinary markets and carries distinctive properties. Arrow (1963) argued that it is set apart by information asymmetry and non-contractibility born of "uncertainty of disease occurrence" and "uncertainty of treatment effect," so that price cannot fully certify either quality or necessity [11]. Society therefore compensates for the incomplete market with "non-price institutions" — professional ethics, entry restrictions, non-profit organizations. A physician's professional ethics is, to a large extent, the institutional substitute for these market failures. The upshot is that medical decision-making has, from the outset, been the allocation of scarce resources under uncertainty; economic reasoning is not an external appendage but a structural premise of medicine. Medicine cannot explain its own distinctiveness on its own — it must locate itself through economics. Resource scarcity and opportunity cost have become the standing context of every clinical decision.

Health's dual character also fixes the complexity of clinical choice. Grossman's (1972) human-capital model treats health as both a consumer good and an investment good — a peculiar capital constrained by investment [12]. When a physician decides "whether to order a test or use a drug," he or she is simultaneously answering a resource-allocation question. In practice, the benefits of clinical decisions are weighed over a life cycle and against opportunity cost, not reduced to the marginal effect of a single encounter. Without this framework, a medical student facing "whether a costly intervention is worth extending limited survival" can only fall back on intuition or authority, unable to reason in a way that is expressible, testable, and shareable

with the patient. Adding economic literacy to clinical competence therefore supplies the long-missing economic dimension. At the competency level, this points to "interpreting trade-offs": under uncertainty and scarcity, turning "should we do it" into reasoning that can be stated and checked.

3.2. The economics-based price mechanism is the key to understanding medical decisions

The payment method is not a backdrop to care but an institution that continuously shapes the behavior of both parties through price signals. Under fee-for-service, volume and revenue are linked, so more tests and more procedures carry a built-in incentive; under value-based or case-based bundled payment (DRG/DIP), the same clinical act implies different cost consequences [13–14]. Price theory warns that a physician who misses this mechanism cannot explain "why the same clinical problem is handled differently across payment settings," nor form a stable cost-consciousness in practice. Cost-consciousness, then, is not a moral demand for personal thrift but an accurate grasp of how the payment system steers one's own behavior.

Clinical decisions also lean heavily on external evidence, whose transportability depends on the conditions of its production. The second requirement of economic literacy is to separate correlation from causation: an intervention that "saves money" in a trial may do so only because its subjects, payment structure, or follow-up differ from the local setting, and need not extend to one's own patients. Without this discernment, physicians either import external guidelines blindly or reject health-economic evidence altogether — and both reduce "cost-consciousness" to a slogan. Embedding economic literacy in clinical competence lets physicians read the silent guidance that payment methods exert on themselves and their patients, form cost-consciousness under constraint, and review external policy evidence in context — the real wellspring of the two competencies "reading evidence" and "interpreting trade-offs."

3.3. The economics-based incentive mechanism is the key to improving medical efficiency

Incentives act on the demand side as deeply as on the supply side. Behavioral economics has long shown that patients do not always behave as "rational actors" when they seek care: status-quo bias, loss aversion, and intuitive misreading of probabilities pull them away from their true preferences and health interests, while induced demand and defensive medicine show, from the supply side, that misaligned incentives distort decisions no less [15]. "Effective care" therefore means more than delivering the right clinical plan; it means helping patients choose in their own interest — which requires understanding why they appear to decide irrationally.

Understanding incentive structures also leads practitioner to design better communication and intervention. A chronic-disease patient who refuses needed follow-up out of loss aversion will not be moved by more information alone; once the bias is understood, the physician can reset default options, reframe the risk, and bring long-term benefit to the foreground, converting "correct advice" into a "decision the patient can act on." This is the substance of "participating in decision-making": not deciding for the patient, but building — on an understanding of behavior and incentives — an interface through which the patient can reason. Economic literacy lifts "communication" from technique to institutional–behavioral understanding: it explains why a given communication works, not merely how to phrase it. At the competency level, this points to "participating in decision-making."

The three dimensions sit at different levels, yet converge on one demand for medical education: reading evidence, interpreting trade-offs, participating in decision-making. None of these amounts to "making

physicians into economists"; each belongs to "letting physicians discharge their professional duties fully in a world of limited resources."

4. The curricular attribution of economics literacy in medical education

4.1. Curricular arrangements in existing models

International and domestic experience present several representative forms of attribution that can orient local choice.

Independent-course-module type. Germany has formally included health economics, health-care systems, and public health in medical education since 2003; Behmann et al.'s survey of 36 faculties places this content mainly in the 8th–10th semesters, mostly as seminars and lectures [5]. Its strength is clear status and concentrated faculty. But the "independent courses, late concentration" pattern does not naturally fit China's near-saturated five-year schedule — exactly why it should not be copied outright.

Systems-science-pillar type. US medical education does not set up economics courses separately; it treats them as part of Health Systems Science (HSS), the "third pillar," carried by a longitudinal thread across the basic–clinical–clerkship span [6–7, 10]. The logic insists that "economics is an organic part of the medical knowledge structure," not an "add-on management course"; some scholars argue directly that health economics deserves a clear place in the curriculum [16].

Student-led-movement type. Here economics enters through elective formats — Canada's Choosing Wisely and STARS embed cost-consciousness and resource modules via "student societies + case-based learning + electives" [8]. The lesson is that reform need not wait for top-down redesign; it can also grow bottom-up from the front-line teacher–student community.

Guiding-major-write-in and standard-integration types. This model rests on education-authority guidance and policy, while leaving execution to individual schools. In China, for instance, the Ministry of Education's New Medicine economics courses have been written courses into the core curriculum, and the Chinese Standards for Undergraduate Medical Education — Clinical Medicine (2022 Edition) permits integrating humanities and social-science content into professional courses [3]. Together they open institutional space for local attribution — the former licenses "writing it in," the latter supplies the interface for "integrating it in."

The four forms differ in path but reveal one fact: attribution has at least three basic shapes — independent module, systems-science pillar, and embedding into existing threads. For China, the pragmatic move is not to start anew, but to take the substance of the "systems-science pillar" and realize it by "embedding into existing curricular threads." That is the attribution premise of the model in Section 5.

4.2. The competency-model choice

Section 3 economics literacy at "reading evidence, interpreting trade-offs, participating in decision-making." To make it teachable and assessable, this section operationalizes it into three levels — knowledge, skill/behavior, reflection — with measurable learning objectives.

"Reading evidence" maps to the knowledge level: students distinguish correlation from causation, interpret the incremental cost-effectiveness ratio (ICER), willingness-to-pay threshold, and sensitivity analysis, and review external policy evidence in context. This turns "cost-consciousness" into a testable judgment.

"Interpreting trade-offs" maps to the skill/behavior level: under resource constraints, students transparently present to patients an intervention's cost and value, its health benefit and possible burden, converting "should we do it" from intuition into stated reasoning. Economics training lets professional spirit be "sayable and doable" under constraint; this competency also re-enacts Arrow's claim that professional ethics substitutes for market failure [11].

"Participating in decision-making" maps to the reflection/synthesis level: students build a decision interface the patient can rationally enter, rather than deciding for the patient — concretely, by understanding behavioral biases (loss aversion, status-quo bias) and converting "correct advice" into an actionable decision through reset defaults and reframed risk.

The three progress in sequence: reading evidence is the premise, interpreting trade-offs the bridge, participating in decision-making the aim; together they form the full competency portrait of "discharging one's duties in a world of limited resources."

4.3. Setting principles for economics-literacy courses

Given the attribution forms and the competency model, economics-related courses must obey three principles — not "best practices" invented from nothing, but a dual response to international evidence and local constraint.

Principle 1 — Spiral internalization, not a single exposure — indoctrination. Economics literacy must reappear at rising depth across the basic, clinical, and clerkship stages to be internalized in practice; this also grounds the content of **Table 2**.

Principle 2 — Organize by clinical problems, not by economics' internal logic. Each point must answer a concrete clinical decision, averting a "patchwork assembly." Teaching units are unified by clinical questions — "should it be chosen, and for whom," "should it be used, and on whom" — not by the discipline's own architecture. This is both the underlying logic of medical teaching organization and the vehicle on which dual-instructor collaboration depends.

Principle 3 — Evaluation drives learning. Literacy must enter assessment for learning to occur. The principles therefore rest on constructive alignment: objectives, activities, and assessment are designed together. Of the three, this one binds hardest — it converts the first two from "advocacy" into "accountability."

Spiral internalization settles "where and how much"; clinical-problem organization settles "whether it can be internalized"; evaluation-driven settles "whether it truly happens." The three support one another as an organic whole, and the Section 5 model is their operational unfolding.

5. Constructing the economics curriculum integration model

Building on Section 4'sn and principles, this paper proposes an integration model of three components — embedding strategy, teaching organization, and evaluation (**Table 1**) — and analyzes it from three angles.

Table 1. Curriculum integration model for embedding economics in medical professional education

Component	Theoretical basis	Operational points
Embedding strategy (longitudinal curricular thread)	Spiral curriculum theory (Harden); academic-structure constraints	Three-stage progression, 20–28 contact hours spiral distribution, no added independent semester

Teaching organization (clinical-problem unification + dual-instructor collaboration)	Situated learning theory; avoid patchwork assembly; health-economics positioning within the HSS third pillar	Clinical decision problems as units; clinical teachers collaborate with health economists
Evaluation (explicit, hierarchical)	Constructive alignment (Biggs); evaluation-driven learning	Three levels — knowledge, skill, reflection — including cost–value

5.1. Organic integration via a longitudinal curricular thread

The first strategic choice is independent course versus organic integration, and it hinges on faculty and institutional conditions. Germany's path puts "health economics, health-care systems, public health" into the curriculum, mainly in the 8th–10th semesters, as seminars and lectures — a "late, concentrated" pattern that does not suit China's saturated five-year program [5]. The US path is the integrative template: economics sits inside systems science and runs the whole length as a thread rather than a separate course [6].

For most Chinese institutions, the pragmatic embedding is to "reinforce existing courses with a longitudinal thread" — organic integration. No new standalone course is added; instead, economics content is woven into preventive medicine, social medicine, evidence-based medicine, medical ethics, and clinical subspecialties. On that basis, the study designed the academic-year distribution in **Table 2**.

Table 2. Academic-year distribution of economics-literacy courses

Academic year/stage	Embedding vehicle	Module	Contact hours	Core activities
Year 1–2 (Stage 1)	Medical introduction, early clinical exposure	Theoretical foundation	4–6	Introduce scarcity, opportunity cost, marginal analysis, incentives through contexts
Year 3–4 (Stage 2)	Epidemiology, evidence-based medicine, clinical subspecialties	Evaluation methods + technical application	12–16	One ICER calculation and sensitivity analysis; literature critique; local case
Year 5 and post-graduation (Stage 3)	Internship, residency	Policy and ethics	4–6	DRG cost analysis; low-value care improvement; medical-record cost audit

Table 2's defining feature is the three-stage, spiral distribution. The same core concept (opportunity cost, incentive) reappears at increasing depth across the three stages rather than being taught once and dropped. Generally, the embedded thread is the lowest-cost, most sustainable main route. "Reinforcing existing courses with a longitudinal thread" therefore fits national conditions best: it keeps the substance of international experience (spiral, context, evaluation-driven) without copying its shell (standalone courses or full restructuring). When a school already has health-economics faculty and stable hours, an elective extension can meet the needs of students with spare capacity.

Implementation is not frictionless. A saturated curriculum means the 20–28 hours must come by replacement, not addition: priority goes to reclaiming equal hours from evidence-based medicine (literature-appraisal sessions), social medicine (health-policy sessions), and clinical subspecialties (case discussions) — not to cutting core basic-science hours. The embedding model also requires the curriculum committee to assign explicit objectives and vehicles for economics literacy in the training scheme; absent that, it decays into formalism.

5.2. Clinical-problem-led economics-instructor collaboration

The root cure for patchwork assembly is to invert the organizing logic — units are built from clinical

decision problems, not from the economics discipline. when teaching whether to screen, instructors can us "AI-assisted retinopathy of prematurity (ROP) screening" to have students define alternatives, estimate costs and health outcomes, compute the ICER, and set willingness-to-pay scenarios at 1–3 times per-capita GDP for the Chinese context [17–18]. Here economics is not "added on"; it is necessary to answer the clinical question "screen, and for whom."

The tightest constraint on avoiding patchwork is faculty. The workable solution is "clinical teacher + health economist" collaboration: clinicians pose the context and its rationale; economists handle method and evidence interpretation [4]. Economics stays in the clinical context; clinical work keeps its methodological rigor. Three operational elements make it real. Source: schools without dedicated health-economics faculty can draw on health-management or pharmacoeconomics teachers, or hire practitioners from payer agencies and hospital reimbursement offices as visiting collaborators. Division and training: clinicians lead context and decision guidance; economists teach concepts and methods; clinicians also receive about 4 hours of economics-methodology workshops to gain basic cost concepts and ICER literacy. Vehicle: joint lesson-planning meetings (one per module) keep economics content strictly in service of the clinical question, preventing drift into terminology teaching.

Supporting methods include case-based learning (local high-incidence diseases and high-value technologies carrying systems-science goals), cost–value communication stations in the Objective Structured Clinical Examination (OSCE) — such as VISTA's discharge-communication station — and reflective practice [19].

5.3. Professional evaluation secures observability

Evaluation is not the terminus of the path but the link that makes literacy observable and learning real. Economics literacy can be assessed at three levels — knowledge, skill/behavior, reflection — with methods matched to the competency, as in **Table 3**. The knowledge level sets ICER-interpretation and literature-appraisal items in evidence-based or clinical exams, testing whether one reads ratios, thresholds, and sensitivity analyses; the skill/behavior level adds a "discussing cost and value with patients" OSCE station and medical-record cost-reasonableness feedback during clerkships; the reflection level uses a portfolio recording students' reflections on low-value-care improvement.

Table 3. Evaluation mapping of economics literacy

Competency level	Maps to	Method	Example
Knowledge	Reading evidence	Exam ICER-interpretation items, literature appraisal	Given a pharmacoeconomics paper, judge whether its ICER falls below the willingness-to-pay threshold
Skill/behavior	Interpreting trade-offs, participating in decision-making	OSCE cost–value station, medical-record cost audit	Explain to a simulated patient "why this drug is not reimbursed"
Reflection	All three integrated	Portfolio, pre–post test	Reflection report on a low-value-care improvement project

For implementability, the three tool types need joint development and at least minimal reliability and validity statements. The knowledge-level ICER item uses a structured rubric: correct relation of ICER to threshold (1 pt), identification of key sensitivity-analysis assumptions (1 pt), and transferability to the local context (1 pt). The skill/behavior OSCE station can extend the existing patient-communication scale

with a "cost–value transparent presentation" item (e.g., "states self-pay and reimbursement ratios," "offers an affordable alternative"); two examiners score independently, with agreement reported by Kappa. The portfolio uses a rubric across four dimensions — problem identification, evidence use, plan improvement, self-reflection — each with three levels. The pre–post test employs a purpose-built "Medical Student Cost-Consciousness Scale," used only after Cronbach's α reliability is reported.

6. Conclusions and recommendations

6.1. Conclusions

Three conclusions follow. First, economics literacy is a core literacy of the medical profession, not a managerial add-on; it is the economic face of the "humanities" in New Medicine's medicine–humanities integration, and the structural premise that lets clinical decision-making produce reasoning that is expressible and testable under constraint. Second, attribution has at least three basic forms — independent module, systems-science pillar, embedding into existing threads; for China's five-year program, the pragmatic attribution is embedding via a longitudinal thread. Third, curricular intervention is carried by the three-component model — embedding strategy, teaching organization, evaluation: strategy sets where and in what dose content appears, organization sets whether students internalize it, evaluation sets whether learning truly occurs.

6.2. Contributions

This study's contribution is to rejoin the questions "why teach" and "how to teach" in one chain. Theoretically, it anchors economics literacy to the health-economics dimension of Health Systems Science (the third pillar), shifting it from "embellishment of humanistic literacy" to "organic part of the medical knowledge structure," and — via Arrow and Grossman — shows economic reasoning to be the structural premise of clinical decisions, not an external extra. Curricularly, it proposes a progressive framework of "three attribution forms — three competency levels — three setting principles," turning scattered international experience into comparable coordinates and curbing arbitrariness in path choice. Model-wise, it uses the three components to state each one's theoretical basis, operational points, and corresponding tables, directly enabling the arrangement of objectives, activities, and assessments.

6.3. Recommendations

Three implementation recommendations follow for local institutions. First, point-to-surface, pilots first: start with one evidence-based or social-medicine course, embed a 2–4-hour economics module, and collect pre–post data to validate the model at minimal cost before scaling. Second, form a cross-disciplinary curriculum group: led by the teaching dean and including clinical core faculty, health economists, and curriculum-committee members, charged with credit-hour replacement, faculty training, and evaluation-tool development. Third, harness evaluation to drive learning: bring "cost–value communication" into the existing OSCE station system, converting economics literacy from "advocacy" into an "assessable, feedback-enabled" objective so that learning truly occurs.

6.4. Limitations and prospects

The study's limitation is that its main evidence comes from North America and Europe (VISTA, STARS,

Choosing Wisely Canada), whose payment environments and academic structures diverge sharply from China's five-year program, so external validity must be judged cautiously; systematic reviews also note that cost-consciousness interventions for students are mostly single lectures or short modules, with thin evidence of long-term behavior change [20]. The model itself is a literature-based normative derivation not yet tested in implementation. Follow-up should advance through a "design–implementation–evaluation–revision" cycle; concretely, a single-group pre–post pilot could embed a 4-hour economics module in one school's evidence-based medicine course, using the Cost-Consciousness Scale (to be developed and validated in and one decision-case item to measure knowledge and attitude change in 60–80 students before and after, paired with semi-structured interviews of 6–8 students to explain the mechanism — supplying empirical ground for local revision.

Disclosure statement

The authors declare no conflict of interest.

References

[1] General Office of the State Council, 2020, Guiding Opinions on Accelerating the Innovative Development of Medical Education (GBF [2020] No. 34). https://www.gov.cn/gongbao/content/2020/content_5549881.htm.

[2] X, XC,2021, New Medicine Construction Must Strengthen the "Five Combinations". China Education Daily, November 15, 2021, 5.http://www.jyb.cn/rmtzgjyb/202111/t20211115_636749.html ht.

[3] General Office of the Ministry of Education, 2023, Guide to Guiding Majors for Cultivating Talents Serving the Health Undertaking and Health Industry. http://www.moe.gov.cn/srcsite/A08/moe_740/s3864/202401/t20240104_1098007.html

[4] Xu J, Jiao Y, Wu Z, et al., 2026, Exploration of the Construction of Economics-Evaluation Courses in Clinical Medicine Teaching. Medical Education Research and Practice, 34(2): 321–326. https://doi.org/10.13555/j.cnki.c.m.e.2026.02.022

[5] Behmann M, Brandes I, Walter U, 2012, Teaching Health Economics, Health-care System → Die Lehre and Public Health at German Medical Faculties. Das Gesundheitswesen, 74(7): 435–441. https://doi.org/10.1055/s-0031-1280847

[6] Gonzalo JD, Haidet P, Papp KK, et al., 2017, Educating for the 21st-century Health Care System: An Interdependent Framework of Basic, Clinical, and Systems Sciences. Academic Medicine, 92(1): 35–39. https://doi.org/10.1097/ACM.0000000000000951

[7] Gonzalo JD, Dekhtyar M, Starr SR, et al., 2017, Health Systems Science Curricula in Undergraduate Medical Education: Identifying and Defining a Potential Curricular Framework. Academic Medicine, 92(1): 123–131. https://doi.org/10.1097/ACM.0000000000001177

[8] Born KB, Moriates C, Valencia V, et al., 2019, Learners as Leaders: A Global Groundswell of Students Leading Choosing Wisely Initiatives in Medical Education. Academic Medicine, 94(11): 1699–1703. https://doi.org/10.1097/ACM.0000000000002868

[9] van den Akker J, Gravemeijer K, McKenney S, et al., 2006, Educational Design Research. Routledge, London. ISBN: 9780415365721

[10] Skochelak SE, Hammoud MM, Lomis KD, 2021, Health Systems Science. 2nd ed. Elsevier, Amsterdam. ISBN:

9780323694629

[11] Arrow KJ, 1963, Uncertainty and the Welfare Economics of Medical Care. American Economic Review, 53(5): 941–973. https://doi.org/10.1257/aer.53.5.941

[12] Grossman M, On the concept of health capital and the demand for health. Journal of Political Economy, 1972, 80(2): 223–255. https://doi.org/10.1086/259880

[13] National Healthcare Security Administration, 2021, Notice on Printing and Distributing the Three-Year Action Plan for DRG/DIP Payment Method Reform (NHSA [2021] No. 48).https://www.nhsa.gov.cn/art/2021/11/26/art_37_7406.html ht.

[14] National Healthcare Security Administration, 2025, Interim Measures for the Administration of Disease-Based → DRG/DIP Payment in Medical Security (NHSA [2025] No. 18).https://www.gov.cn/gongbao/2025/issue_12346/202510/content.

[15] Evans RG, 1974, Supplier-induced Demand: Some Empirical Evidence and Implications, in The Economics of Health and Medical Care. Macmillan, London, 162–173. https://doi.org/10.1007/978-1-349-63660-0_10

[16] Beecroft C, 2016, Why Health Economics Deserves a Place in the Medical Curriculum. Journal of Comparative Effectiveness Research, 5(4): 321–323. https://doi.org/10.2217/cer-2016-0028

[17] World Health Organization, 2001, Commission on Macroeconomics and Health. Macroeconomics and Health: Investing in Health for Economic Development. WHO, Geneva.

[18] Tan-Torres Edejer T, Baltussen R, Adam T, et al., 2003, Making Choices in Health: WHO Guide to Cost-Effectiveness Analysis. World Health Organization, Geneva.

[19] Dagher T, Oyler J, Press VG, et al., 2024, Development and Implementation of an Experiential Longitudinal Health Systems Science Thread Into an Existing Medical School Curriculum. Academic Medicine, 99(9): 971–975. https://doi.org/10.1097/acm.0000000000005784

[20] Stammen LA, Stalmeijer RE, Paternotte E, et al., 2015, Training Physicians to Provide High-Value, Cost-Conscious Care: A Systematic Review. JAMA, 314(22): 2384–2400. https://doi.org/10.1001/jama.2015.16353

Publisher's note

Bio-Byword Scientific Publishing remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

Integrated Services Platform of International Scientific Cooperation

Innoscience Research (Malaysia), which is global market oriented, was founded in 2016.Innoscience Research focuses on services based on scientific research. By cooperating with universities and scientific institutes all over the world, it performs medical researches to benefit human beings and promotes the interdisciplinary and international exchanges among researchers.

Innoscience Research covers biology, chemistry, physics and many other disciplines. It mainly focuses on the improvement of human health. It aims to promote the cooperation, exploration and exchange among researchers from different countries. By establishing platforms, Innoscience integrates the demands from different fields to realize the combination of clinical research and basic research and to accelerate and deepen the international scientific cooperation.

Cooperation Mode



Clinical Workers



In-service Doctors





Foreign Researchers





Hospital



University



Scientific institutions

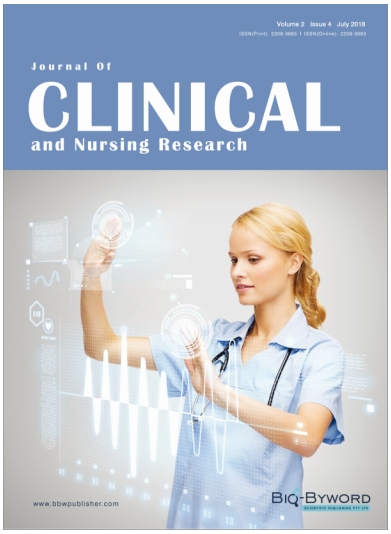
Our Journals



The *Journal of Architectural Research and Development* is an international peer-reviewed and open access journal which is devoted to establish a bridge between theory and practice in the fields of architectural and design research, urban planning and built environment research.

Topics covered but not limited to:

- Architectural design
- Architectural technology, including new technologies and energy saving technologies
- Architectural practice
- Urban planning
- Impacts of architecture on environment



Journal of Clinical and Nursing Research (JCNR) is an international, peer reviewed and open access journal that seeks to promote the development and exchange of knowledge which is directly relevant to all clinical and nursing research and practice. Articles which explore the meaning, prevention, treatment, outcome and impact of a high standard clinical and nursing practice and discipline are encouraged to be submitted as original article, review, case report, short communication and letters.

Topics covered by not limited to:

- Development of clinical and nursing research, evaluation, evidence-based practice and scientific enquiry
- Patients and family experiences of health care
- Clinical and nursing research to enhance patient safety and reduce harm to patients
- Ethics
- Clinical and Nursing history
- Medicine



Journal of Electronic Research and Application is an international, peer-reviewed and open access journal which publishes original articles, reviews, short communications, case studies and letters in the field of electronic research and application.

Topics covered but not limited to:

- Automation
- Circuit Analysis and Application
- Electric and Electronic Measurement Systems
- Electrical Engineering
- Electronic Materials
- Electronics and Communications Engineering
- Power Systems and Power Electronics
- Signal Processing
- Telecommunications Engineering
- Wireless and Mobile Communication