

Journal of Contemporary Educational Research

Honorary Editor-in-Chief

Vlasta Hus

University of Maribor Faculty of Education, Slovenia

Editors-in-Chief

Purificacin Alcaide-Pulido

Universidad Loyola Andaluc Communication and Education, Spain

Jandhyala B. G. Tilak

Council for Social Development, India

BIO-BYWORD SCIENTIFIC PUBLISHING PTY LTD

(619 649 400)

Level 10

50 Clarence Street

SYDNEY NSW 2000

Copyright © 2025. Bio-Byword Scientific Publishing Pty Ltd.

Complimentary Copy



Journal of Contemporary Educational Research

Focus and Scope

Journal of Contemporary Educational Research is an international, peer-reviewed and open access journal which is to promote the evaluative, integrative, theoretical and methodological research on contemporary education; shape a novel, broader view of issues in contemporary education; enhance the caliber of humanities research through active use of best domestic and foreign practices; and integrate the achievements of various sciences and knowledge areas with unconventional approaches.

All relevant papers are carefully considered, vetted by a distinguished team of international experts, and rapidly published. Original articles, short communications, case studies and comprehensive review articles can be submitted online via the journal's submission and peer review site.

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

Table of Contents

- 1 Teaching Reform of the Mechanical Drawing Course Incorporating Computer Graphics Technology**
Fenglian Zhang, Jing Zhu
- 7 Research on the Teaching Content of Power Electronics for the Major of Building Electricity and Intelligence**
Huijie Xue
- 12 Revolutionizing Learning: The Role of AI, IoT, and Cloud Computing in Smart Education**
Chiweng Leng
- 18 A Survey Research on the Current Status of the Integration of Qinghai's Regional Culture into College English Instruction**
Wenjing Zhang
- 25 Exploration of Quality Improvement in Graduation Projects (Theses) for Vocational Undergraduate Electronic Information Majors**
Xiaofeng Luo, Hongqi Wu, Caili Song
- 31 Bridging Tradition and Innovation: The College System as a Holistic Education Model for the Post-Globalization Era**
Yu Wang
- 36 Cultivation of Students' Critical Thinking Ability in College English Audio-Visual and Oral Teaching**
Hui Zhang
- 42 Logic and Practice of Ideological and Political Thinking in Advanced Mathematics Courses**
Yaxian Hao, Keyan Liu
- 50 Research and Practice of Higher Vocational English Courses Based on Core Competencies**
Xiaofang Tian
- 58 Exploration of Teaching Reform in Unmanned System Courses Based on the OBE Concept**
Hongfei Yu, Yuming Wang, Bo Li

- 65 Innovative Development Strategies for Ideological and Political Education in Chinese Applied Undergraduate Universities under the Background of Industry-Education Integration**
Zhenfeng Zhu, Jin Peng, Ling Peng, Zhiru Zhang, Xiong Deng, Zhoumei Ma
- 72 Research on the Teaching Reform Path of Digital Empowerment for Business Model Innovation from the Perspective of Ideological and Political Education in Courses**
Ling Peng, Xiong Deng, Zhenfeng Zhu, Lina Peng
- 80 Research on the Influencing Mechanism of College Students' Reliance on AI Tools and Weakened Learning Ability and Educational Coping Strategies**
Xiang Yuan, Ling Peng
- 87 The Change and Challenge of Teacher-Student Relationship in the Era of Artificial Intelligence: Teaching Interaction and Emotional Connection**
Jiaqi Liu, Ling Peng
- 94 Exploration on the Construction of an Intelligent Educational Evaluation System Integrating the CIPP Model and Artificial Intelligence Technology from the Perspective of New Engineering**
Shun Yu, Shasha Chen, Yuxiu Li
- 100 Research on the Optimization of Digital Technology-Based Higher Education Teaching Models**
Yuanwei Zhao
- 106 Intelligent Teaching Reform: Innovation of Personalized Learning Path Models Based on Artificial Intelligence**
Zhuolin Huang, Ling Peng
- 111 Exploring a Hybrid Teaching Quality Evaluation System Based on the CIPP Model Construction in Higher Education**
Lin Chen
- 123 Intelligent Educational Administration Management System Based on Data Mining Technology**
Xiaofei Yang
- 129 Connotation and Value of Study Travel Education in the Temple of Heaven from the Perspective of Ritual and Music Civilization**
Qianzhu Zhou
- 136 Research on the Integration of Ideological and Political Elements in the Civil Engineering Construction Organization Design Course**
Ying Xu

- 143 Artificial Intelligence in Diagnostics of Traditional Chinese Medicine**
Tingye Wang, Xuemei Wang, Ningyi Wei, Dan He
- 148 Reflections on Integrating Excellent Traditional Chinese Culture into High School History Teaching**
Nurjiang Yiganbadi
- 154 A Study on the High-Quality Development of Junior High School Physical Education and Health Classroom Teaching**
Yaru Han
- 160 Innovative Paths for Campus Media in the Context of Media Convergence**
Feng Han, Wenyun Zhao
- 166 Comparative Analysis of Educational Goals in Higher Education in Kazakhstan and China from the Perspective of Culture and Values**
Mengling Cai, Shakirova Araily Dalelovna
- 171 Educational Mechanism of Curriculum-Based Political and Ideological Education in Vocational Colleges under the Background of New Quality Productivity**
Shang Wang, Jinru Ma
- 177 Empirical Study on Patriotism Films and College Students' Party History Identity**
Can Mo, Ying Liang
- 182 Generative Artificial Intelligence Empowering Foreign Language Education and Teaching Reform: Mechanism, Risk, and Response**
Juan Bai
- 191 Research on the Value Connotation and Implementation Strategies of Blended Teaching in College Physical Education**
Wuqi Zhao
- 197 Teacher Development in the "AI + Education" Ecosystem: Application Ability of Artificial Intelligence for Primary School English Teachers and Construction of Training System**
Chunli Li
- 206 Research on the Construction of Aesthetic Education Courses in Universities from an Interdisciplinary Integration Perspective: A Case Study of Sichuan University**
Lingwei Zhang, Xiaoxi Fan, Yao Sun
- 215 Research on Strategies to Enhance Undergraduates' Willingness to Pursue Postgraduate Studies in the Context of Employment Pressure**
Mi Zhou, Xinrui Gu, Lingzhi Liao

- 221 Theoretical Logic of Organic Integration of Shenzhen Red Culture into the Teaching of Basic Principles of Marxism in Vocational Undergraduate Programs of Bay Area Characteristics**
Mengyao Yan
- 229 The Impact of Artificial Intelligence Technology on Contemporary Music Artists**
Yahan Liu
- 235 Artificial Intelligence as Co-Creator: Redefining Creative Identity in Design Education**
Meiling Jiang
- 243 The Influence of Digital Literacy on College Students' Entrepreneurial Opportunity Recognition: The Moderating Role of Innovation and Entrepreneurship Education**
Fanjing Lu, Zenghui Lu, Mingkai Luo, Cheng Wei
- 250 Exploration of the Cultivation Mode of Applied, Composite, and Innovative Talents in General Medicine under the Background of New Medicine**
Zhaoxiang Yu, Xiping Yang, Ya Li, Yuanyuan Jia, Yaodong Li, Shuijuan Zhang, Xuekun Zhou
- 257 Designing a Health Education Card Game for Adolescents Based on Constructivist Learning Theory: A Case Study of "Night of Hospital"**
You Zhou
- 264 A Study of the Three English Translations of Shen Congwen's *Border Town* Based on Reiss's Translation Criticism Model**
Yingzhi Qin
- 272 Empirical Study on Generative Artificial Intelligence Enabling Chinese Writing Teaching**
Manzi Zhu
- 282 Exploration of Teaching Models of College English Reading in the Internet + AI Era**
Shuang Cheng
- 286 Plato's Philosophy of Natural Education and Its Contemporary Value: A Textual Analysis Based on *The Republic* in Pursuit of "Natural Justice"**
Yuhan Wu
- 291 Research on the Implementation Path of Integrating MOOC and Blended Learning in Oncology Education**
Wei Wu, Ge Yang, Manman Xu

Teaching Reform of the Mechanical Drawing Course Incorporating Computer Graphics Technology

Fenglian Zhang*, Jing Zhu

School of Mechanical Engineering, Dalian Jiaotong University, Dalian, Liaoning, China

**Author to whom correspondence should be addressed.*

Copyright: © 2025 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: With the development and popularization of computer application technology, the use of computer graphics and image processing technology has become the main means of modern engineering design and drawing. Learning and mastering 3D modeling technology and mechanical information modeling technology have become an important goal of learning engineering drawing. To meet the teaching requirements of the “New Engineering” program, higher education should cultivate innovative talents with the ability to identify, express, analyze, and solve complex engineering problems; promote the transformation of teaching methods for the course of “Mechanical Drawing and Computer Drawing” from “teaching well” to “learning well.” This change is not only a change in course content, but also a change in training objectives. It introduces modern 3D design concepts into the drawing course, constructs a learning system with 3D modeling technology as the main line, solves the problem of imagination in traditional teaching, makes the learning process more in line with scientific cognitive laws, better meets the needs of modern manufacturing industry for new technologies, and improves students’ drawing skills and ability to use modern tools (computer drawing).

Keywords: Mechanical drawing; 3D modeling; Project-driven; Teaching reform

Online publication: June 13, 2025

1. Introduction

Applied technology undergraduate colleges cultivate technical talents who can apply mature technologies and theories to practical production and life on the front line. Mechanical drawing is a fundamental course that engineering students in universities must study. Engineering drawings are the language of the engineering community, so this course mainly aims to cultivate students’ basic drawing skills, the rules that must be followed when drawing, and the spatial imagination of innovative thinking, so that students can become qualified technical application-oriented talents after graduation. This requires students not only to be able to understand engineering drawings, but also to be able to draw them. Mechanical drawing is a fundamental knowledge necessary for students to study professional courses and design courses, and it is also the basis for

all drawing. In order to enable students to better adapt to future work, flexibly apply their knowledge, correct the shortcomings of traditional teaching models, improve the overall level of teaching courses, and better cultivate more technically application-oriented talents who can serve the front line in the future ^[1-3].

In modern industrial production, designers express design objects through drawings, and manufacturers process them through drawings. Drawings are known as the “technical language of the engineering world.” It is an effective carrier of engineering information and a form of expression for engineering data. With the development of high-tech, technologies such as computer graphics, computer-aided design (CAD), computer-integrated manufacturing (CIM), virtual reality manufacturing (VM), scientific visualization (SV), multimedia, and computer networks have fully demonstrated the powerful functions of using graphics and images to process data. It can be foreseen that in the future, the expression of engineering design ideas and results will be mainly in the form of graphics or images, as the saying goes, “one image is worth a thousand words.” Meanwhile, these technologies have changed engineering drawing techniques to varying degrees. Computer-aided design/manufacturing technology (CAD/CAM) has brought tremendous changes to engineering drawing technology, and its research content has far exceeded the scope of traditional engineering drawing studies. Many modern technologies have been introduced into traditional techniques, and computer graphics technology is also included in graphic technology. Engineering drawing technology has become one of the fundamental and key technologies in CAD/CAM. The theme of new engineering drawing technology research is how to use computer technology to quickly and effectively draw engineering drawings. In the process of national education informatization development, using computers for mapping is an inevitable need to adapt to education informatization and modernization. Introducing computer teaching systems in the classroom can enable students to have a deeper understanding of the relationship between geometry and space in design. The application of computer technology makes students more intuitive and three-dimensional in graphic expression and design, which is more conducive to students mastering the essence of graphic expression ^[4-7].

2. Problems in the mechanical drawing course

The course of mechanical drawing is usually scheduled for first-year study, and students do not visit enterprises or intern in school laboratories, so they have little knowledge of mechanical engineering, which affects the quality and effectiveness of teaching. The mechanical drawing course has fewer class hours but contains strong theoretical knowledge, requiring a lot of time to do exercises after class, which leads to students feeling bored and uninterested in learning this subject, with low learning enthusiasm and difficulty in cultivating students’ spatial imagination. The teacher was reciting the textbook on the podium, and the students only received theoretical knowledge, but their actual surveying and mapping abilities, image reading skills, and spatial imagination were not trained. Traditional engineering graphics teaching generally uses two-dimensional design platforms for teaching, and the main problems are as follows:

- (1) Traditional 2D design is only used for designing engineering drawings and cannot meet the information needs of subsequent courses such as CAE/CAM/PDM. It is easy to misunderstand the conversion process from 3D to 2D to 3D between design and manufacturing. It is also unable to express complex surfaces, with poor modeling, rendering, and animation abilities, making it difficult to provide a foundation for subsequent course graduation projects.
- (2) Teaching based on two-dimensional design is time-consuming and difficult to grasp and understand.

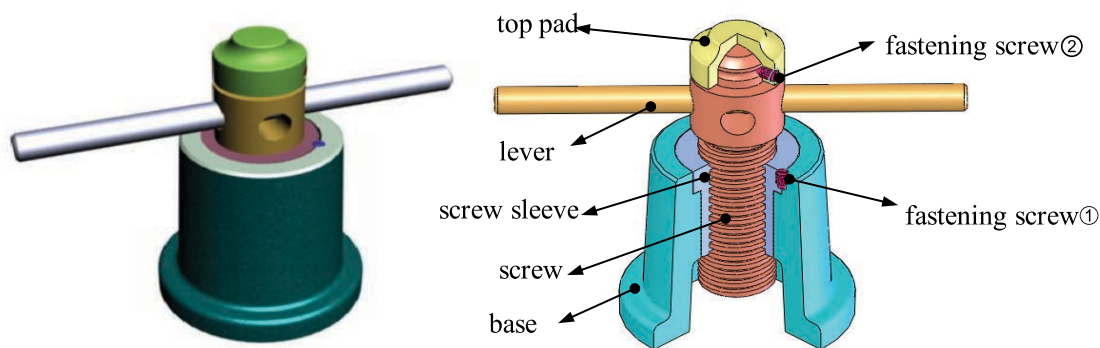
- (3) The knowledge imparted is outdated and unable to capture the characteristics of modern manufacturing technology, thus unable to meet the needs of employers.
- (4) The heavy workload of design, drafting, and editing makes it difficult for students to focus their main experiences on innovative design. Therefore, it is also not conducive to the cultivation of students' comprehensive innovation ability^[8-10].

3. Applying 3D modeling technology to reform mechanical drawing teaching

The purpose of the teaching reform of the mechanical drawing course is to start with 3D vision, increase students' learning interest, and thus achieve the ability to proficiently read and draw drawings. The characteristic of the drawing course for mechanical majors is its strong practicality. The curriculum system is based on 3D modeling as the main line, interweaving the content of drawing, coordinating and integrating 3D software modeling methods with mechanical drawing theory knowledge, and dispersing them into various teaching chapters. This method can promote students' intuitive understanding of the structure and interrelationships of components, help establish students' spatial thinking and imagination abilities, and facilitate their understanding of drawing content^[11,12].

Students first analyze the physical features and then practice 3D modeling. This can form a direct sensory understanding of the parts and cultivate an engineering graphics thinking mode that combines visual thinking and abstract thinking. Train students in the conversion between three-dimensional shapes and two-dimensional graphics, enhance their spatial imagination, and lay the foundation for learning, constructing, expressing, and recognizing body shapes in two-dimensional projection. The engineering object studied in this course is machine parts and components. Machines or components, regardless of size or shape, have certain functions, and people recognize and select components through their functions. To ensure the functionality of the components, what kind of structure is needed, that is, which types of parts are composed of? Based on the role of each part in the component, the shape of the part is designed, and its structural information is expressed in the form of engineering drawings.

By analyzing the lifting jack and understanding its structure and shape. The function of a lifting jack is to lift heavy objects. The lifting jack shown in **Figure 1(a)** uses a screw to rotate and lift a heavy object. The components of the lifting jack are shown in **Figure 1(b)**. The jack consists of 7 parts. Screw and screw sleeve achieve threaded transmission; The screw sleeve is fixed on the base by the fastening screw (1) and remains stationary; The contact surface between the top pad and the screw is a part of the sphere. When the screw rotates, the external force acting on the top pad points towards the center of the sphere to keep it stationary; The screwing position of the fastening screw (2) should ensure the flexible rotation of the screw, as well as prevent the top pad from falling off and coming into contact with the screw.



(a) lifting jack (b) The components of the lifting jack

Figure 1. Lifting jack and its components

Assembly drawing representation is an important part of engineering design, mainly expressing the mutual positional relationship (assembly relationship) between parts and assemblies to meet the functional requirements of mechanical products. Due to the overlapping relationship between multiple components, the expression of assembly drawings is complex and abstract. By utilizing the assembly function of SolidWorks and employing a bottom-up assembly design approach, students were able to gain a deep understanding of the assembly relationship through the dynamic demonstration of the jack assembly explosion in **Figure 2**, thereby fully comprehending the assembly drawings generated by the assembly. You can also rotate each view separately to obtain views from various angles, allowing students to have a clearer understanding of the shape, structure, and assembly relationship of the jack. Quickly improving students' intuitive understanding, shortening the cognitive cycle of converting three-dimensional solids to two-dimensional planes, and two-dimensional planes to three-dimensional solids, concretizing and visualizing abstract projection problems in teaching, reducing teaching difficulty, greatly stimulating students' interest in learning, and to a certain extent improving students' ability to use modern technological means. Starting from the teaching characteristics of mechanical drawing and combining the features of SolidWorks software, SolidWorks is applied in surveying practice, and a new surveying process is adopted to complete the surveying of parts and assemblies and generate engineering drawings.

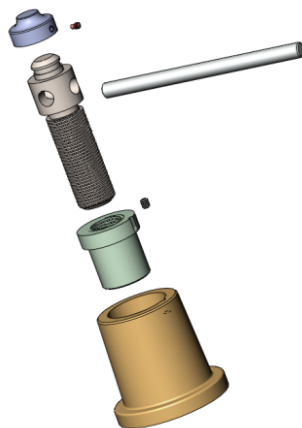


Figure 2. Explosion diagram of lifting jack

4. Future development direction and suggestions

- (1) In response to the continuous development and updating of 3D modeling technology, it is recommended that teachers keep up with the latest 3D modeling software and technology in a timely manner, maintain updated and cutting-edge teaching content, and ensure that students receive the latest and most practical knowledge.
- (2) Encourage students to practice more during the learning process, not only mastering basic modeling techniques, but also focusing on cultivating the ability to solve practical problems. Some practical courses or projects can be set up to continuously improve students' modeling skills and documentation abilities through practice.
- (3) Promote the integration of 3D modeling technology and mechanical drawing courses, and facilitate interdisciplinary cooperation. We can collaborate with engineering, design, and other related majors to expand students' understanding and application in different fields and improve their comprehensive abilities.
- (4) Strengthen the awareness and cultivation of lifelong learning among students, making them aware of the importance of 3D modeling technology in practical work, as well as the necessity of continuous learning and updating of knowledge. Relevant career planning and employment guidance courses can be set up to help students better integrate into the workplace.
- (5) Encourage students to participate in relevant competitions and contests, cultivate their teamwork spirit and competitive awareness, while improving their practical skills and problem-solving abilities. This will have a positive impact on their future career development.

5. Conclusion

The promoting effect of 3D modeling technology on the teaching of mechanical drawing course:

- (1) Enhance students' interest and participation in learning: Traditional mechanical drawing courses mainly focus on two-dimensional drawing, and students often have difficulty understanding the three-dimensional spatial relationships behind design drawings, resulting in low learning interest. After introducing 3D modeling technology, students can quickly understand the 3D structure of products through real-time display and interactive operation, stimulate learning interest, and improve participation.
- (2) Enhance practical ability and innovative thinking: Through the use of 3D modeling software, students can simulate the design and drawing process in real engineering environments, cultivating practical operational skills and problem-solving abilities. Students can compare and optimize multiple solutions during the design process, stimulate innovative thinking, and improve their design skills.
- (3) Promote interdisciplinary integration and practical application: 3D modeling technology is an interdisciplinary field of mechanical drawing, computer science, engineering mechanics, and other disciplines. Introducing this technology can promote the integration and exchange of knowledge between different disciplines. In practical engineering projects, 3D modeling technology also has a wide range of applications. By integrating it into the teaching of mechanical drawing courses, students can better understand the connection between theoretical knowledge and practical applications.
- (4) 3D modeling technology plays an important role in promoting the teaching of mechanical drawing

courses, which can enhance students' interest and participation in learning, strengthen their practical abilities and innovative thinking, and promote interdisciplinary integration and practical applications. In future teaching, the application of 3D modeling technology in mechanical drawing courses should be further promoted and deepened, providing students with richer and more practical teaching resources, promoting their comprehensive development and future career success.

Disclosure statement

The authors declare no conflict of interest.

References

- [1] Wang A, Duan Z, Qin S, et al., 2025, Effect of Processing Conditions on the Structure and Properties of Poly(Trimethylene Terephthalate) Fibers and Nonwovens Produced in the Spunbonding Process. *Fibers and Polymers*, 2: 1–12.
- [2] Na H, 2024, Reflection on the Reform of Mechanical Drawing Fundamentals Course under the Background of Intelligent Manufacturing. *Times Automotive*, (13): 76–78.
- [3] Gummaluri VSSS, Annepu LN, Korada S, et al., 2024, Formative Learning Through a Spatial Visualization-Based Cadathon Contest. *Journal of Formative Design in Learning*, 12(08): 1–16.
- [4] Xie B, Liu J, 2025, The Application of Simulation Technology in the OBE + Project-Based Course Reform of “Fundamentals of Mechanical Design.” *Modern Agricultural Machinery*, (01): 88–90.
- [5] Zhao X, Gao X, Shi Z, et al., 2024, Exploration of Parallel Teaching Reform of Mechanical Drawing and 3D Modeling Software. *Journal of Texas College*, 40(06): 92–95 + 100.
- [6] Dai S, 2024, Design and Application Research of Virtual Surveying and Mapping Mechanical Drawing Teaching Assistant System: Based on WebGL Technology. *Journal of The Institution of Engineers (India): Series C*, 106(01): 1–13.
- [7] Song K, 2024, Research on Strategies for Improving the Quality of Mechanical Drawing Teaching Using SolidWorks. *Modern Vocational Education*, (09): 145–148.
- [8] Xu X, Zhu W, Li H, 2024, From Traditional to Digital: Transforming and Optimizing Mechanical Drawing Education. *Advances in Educational Technology and Psychology*, 8(05): 45–53.
- [9] Shen Y, Lu W, 2024, Technology of Animation in Multimedia Courseware of Mechanical Drawing. *International Journal of Electrical Engineering & Education*, 61(04): 438–451.
- [10] Innocent N, Ikenna UM, Ajah UC, et al., 2023, Design and Development of a Modernized Cassava Grating Machine. *Asian Journal of Advanced Research and Reports*, (01): 9–16.
- [11] Wang M, Bu S, 2022, Application of 3D Modeling Technology in Teaching. *Curriculum and Teaching Methodology*, 14(05): 8–15.
- [12] Zhang H, Wang X, Zhang Y, et al., 2022, Design on a Wireless Mechanomyography Acquisition Equipment and Feature Selection for Lower Limb Motion Recognition. *Biomedical Signal Processing and Control*, 77: 96–98.

Publisher's note

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

Research on the Teaching Content of Power Electronics for the Major of Building Electricity and Intelligence

Huijie Xue*

School of Intelligent Science and Technology, Beijing University of Civil Engineering and Architecture, Beijing 100044, China

**Author to whom correspondence should be addressed.*

Copyright: © 2025 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 present teaching content of the power electronics course is insufficient to cover the power electronics technology used in building electrical engineering. This paper analyzes the relationship between building electrical engineering and power electronics technology, investigates the main power electronics technology used in building electrical engineering, introduces the teaching content of current power electronics course, analyzes the insufficiency of current teaching content related to the practice of electrical engineering, and proposes the principles and directions for the reformation and innovation of the teaching content of the course of power electronics for the major of building electricity and intelligence.

Keywords: Teaching content; Power electronics; Building electricity

Online publication: June 12, 2025

1. Introduction

In recent years, the construction industry in China is facing both challenges and opportunities. By the end of 2023, the urbanization rate of China was close to 66.2%^[1]. China's urbanization growth rate will gradually decrease. The construction industry in China will decelerate as well, which is a major challenge for the industry. On the other hand, new opportunities have arisen for the construction industry with the proposal of the carbon peaking and carbon neutrality goals. The carbon emissions generated by the buildings are about 32% of total carbon emissions globally^[2]. There are many new technologies to reduce buildings' carbon emissions from the building electricity perspective, such as the renewable energy power generation, the direct current electrical system, and the full electrification of building energy. The major of building electricity and intelligence is a new major emerging with the rapid development of electrical and information technology. It is oriented to the building electrical engineering. Power electronics technology is very important in the building electrical engineering. It is particularly important for improving energy efficiency and reducing

carbon emission.

2. Power electronics and building electrical engineering

2.1. Introduction to power electronics

Power electronics studies the conversion and control of electrical energy using power electronic devices. The power electronic devices such as MOSFET, IGBT and passive components such as power transformers, inductors and capacitors can be used to form the main circuit of a power electronic converter. Additionally, the converter also includes control circuits, drive circuits, detection and protection circuits, etc.

2.2. Application of power electronics technology in building electrical engineering

2.2.1. Building lighting

The light sources in building lighting include gas discharge lamps and light-emitting diodes (LEDs), both of which cannot be directly driven by the AC grid. Electronic ballast, a resonant power inverter, are widely used to drive the gas discharge lamp. LED must be driven by a constant current source power converter. By controlling the output current of the ballast or the constant current source, a wide dimming range can be achieved for the light sources, and its carbon reduction effect is obvious^[3].

2.2.2. Reactive power compensation

Reactive power compensation is very important for the building electrical engineering. The conventional reactive power compensation devices used in building electrical engineering are mainly capacitors. New reactive power compensators based on power electronics technology are increasingly used in building electrical engineering, such as static var compensators (SVC) and static var generators (SVG) shown in Figure 1.

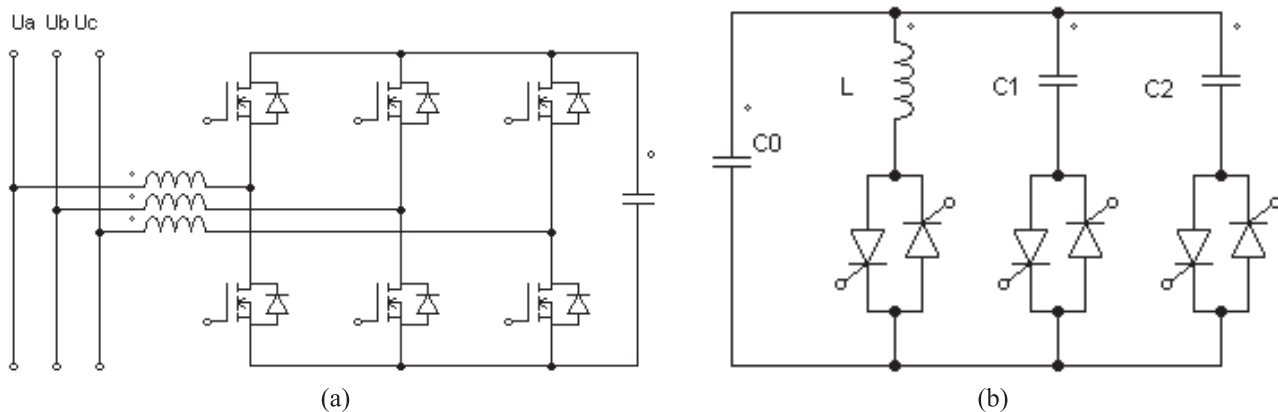


Figure 1. Main circuits of SVC (a) and SVG (b)

2.2.3. Power quality improvements

Improving power quality can boost the operational conditions of the power system load, increase its efficiency, and reduce harmonic losses in lines, trans-formers, and electrical equipment^[4]. Therefore, it is of great significance for the implementation of the carbon emission strategy. The commonly used power quality control equipment in building electrical engineering includes active power filter (APF), dynamic voltage

restorer (DVR), etc.

2.2.4. Building PV systems

Photovoltaic power generation directly generates electricity using solar energy. The power generation process is zero carbon emissions and does not consume any fuel. Photovoltaic power generation combined with buildings, such as Building Auxiliary Photovoltaic Power Generation System (BAPV) and Building Integrated Photovoltaic Power Generation System (BIPV) are important forms of photovoltaic power generation ^[5].

The power electronic converters used in photovoltaic power generation include photovoltaic controllers, photovoltaic power optimizers, photovoltaic inverters, etc.

3. Course content and analysis of power electronics

Although the contents of the most widely used power electronics textbooks are not identical, there is no significant difference ^[6-8]. This paper takes reference ^[7] as an example to analyze the teaching content.

3.1. Content of power electronics textbook

Figure 2 shows the content of reference ^[7].

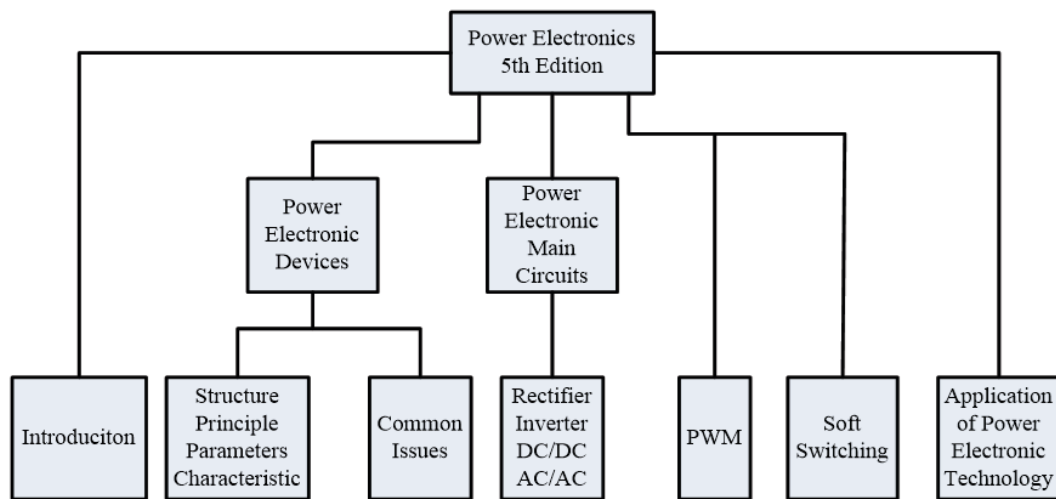


Figure 2. Content of power electronics textbook

The contents of the textbook include power electronic devices, power electronic circuits, PWM and soft switching, and the application of power electronic technology. The proportion for each section is shown in **Table 1**.

Table 1. Proportion of content of power electronics textbook

Content	Introduction	Devices	Main circuit	PWM soft switching	Application
Percent (%)	3.8	13.8	50.2	14.2	18.0

From **Table 1**, it can be seen that power electronic circuits are the core content of the entire course. It

accounts for about half of the total course content. This part is further divided into rectifier, inverter, DC/DC converter, and AC/AC converter. The proportion of these four parts in power electronic circuits is shown in **Table 2**.

Table 2. Proportions of content of power electronics main circuit

Content	Rectifier	Inverter	DC/DC	AC/AC
Percent (%)	45.0	18.3	17.5	19.2

The rectifiers account for 45% of the teaching content of power electronic circuits. In the four parts of power electronic circuits, thyristor-based converter circuits are involved in rectifier circuits, inverter circuits, and AC-AC converter, accounting for about 80% of the power electronic circuit section.

3.2. Analysis of content of power electronics textbook

Based on the analysis above, it can be concluded that there are the following issues with the current teaching content of power electronics course: The teaching content is outdated and fails to reflect the latest developments in power electronics technology. The content of power electronic systems is insufficient. The teaching content of power electronics technology focuses on power electronic devices and power electronic converter circuits, which is incomplete for a power converter. The content is not closely connected to the major of building electricity and intelligence. Most of the power electronics technology used in building electrical engineering investigated in this paper are not covered in the textbook.

4. Innovation and reformation of content of power electronics course

The content of power electronics course should be reformed in the following aspects.

Delete outdated content and incorporate the latest achievements of power electronics. Transfer the teaching content from the thyristors and their converter circuits to controllable switches and their converter circuits.

Add the content related to power electronic systems including driver circuit design, transformer and inductor design, heat dissipation calculation and small signal control model of power electronic converters.

Add the applications of power electronics technology in building electrical engineering investigated in this paper and disperse them to each chapter rather than a concentrated introduction at the end of the course.

5. Conclusion

This paper studies how to innovate the teaching content of power electronics course for the major of building electricity and intelligence to meet the new requirements on building electrical engineers. This paper firstly investigates the application of power electronics technology in the building electrical engineering. Secondly, by analyzing the teaching content in the mainstream textbooks of power electronics, problems of the teaching content were identified. Finally, measures for reforming the teaching content were proposed from several aspects, including updating teaching content, improving textbook structure, strengthening the connection between power electronics theoretical teaching, and building electrical engineering practice.

Acknowledgments

The author acknowledges Beijing University of Civil Engineering and Architecture's support on the relevant cloud courses construction at Super Star Learning APP.

Funding

Cloud Course of Beijing University of Civil Engineering and Architecture at Super Star Learning (YC240109)

Disclosure statement

The author declares no conflict of interest.

References

- [1] National Development and Reform Commission of the People's Republic of China, 2024, Expert Interpretation 1 | In-Depth Implementation of the New Urbanization Strategy to Steadily Improve the Level and Quality of Urbanization, viewed March 10, 2025, https://www.ndrc.gov.cn/xwdt/ztzl/xxczhjs/ghzc/202408/t20240805_1392240_ext.html
- [2] Tsinghua University Building Energy Efficiency Research Center, 2024, Annual Development Research Report on Building Energy Efficiency in China, China Architecture & Building Press, Beijing.
- [3] Abdelmessih GPZ, Alonso JM, Spode DnS, et al., 2022, High-Efficient Electrolytic-Capacitor-Less Offline LED Driver With Reduced Power Processing. *IEEE Transactions on Power Electronics*, 37(2): 1804–1815.
- [4] Bamigbade A, de Leon F, 2025, A Novel Time-Delay Filter Implementation for Resilient Control of Active Power Filters. *IEEE Transactions on Power Delivery*, 40(1): 191–202.
- [5] Schmid C, Alpert S, 2022, A Review of Roof Integrated Photovoltaics Systems, 2022 International Conference on Electrical, Computer and Energy Technologies (ICECET), Prague, Czech Republic, 1–4.
- [6] Ruan X, 2021, *Power Electronics*, 1st Edition, China Machine Press, Beijing.
- [7] Wang Z, Liu J, 2009, *Power Electronics*, 5th Edition, China Machine Press, Beijing.
- [8] Chen J, Kang Y, 2011, *Power Electronics-Electric Energy Conversion and Control Technology* 3rd Edition, High Education Publishing House, Beijing.

Publisher's note

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

Revolutionizing Learning: The Role of AI, IoT, and Cloud Computing in Smart Education

Chiweng Leng*

School of Education, Tsinghua University, Beijing 100084, China

**Author to whom correspondence should be addressed.*

Copyright: © 2025 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 rapid advancement of technology has paved the way for innovative approaches to education. Artificial intelligence (AI), the Internet of Things (IoT), and cloud computing are three transformative technologies reshaping how education is delivered, accessed, and experienced. These technologies enable personalized learning, optimize teaching processes, and make educational resources more accessible to learners worldwide. This paper examines the integration of these technologies into smart education systems, highlighting their applications, benefits, and challenges, and exploring their potential to bridge gaps in educational equity and inclusivity.

Keywords: Artificial intelligence; Internet of Things; Cloud computing; Smart education; Personalized learning

Online publication: June 30, 2025

1. Introduction

In the 21st century, education is undergoing a profound digital transformation driven by technological innovations. Among these innovations, artificial intelligence (AI), the Internet of Things (IoT), and cloud computing stand out as pivotal tools enabling the development of smart education systems^[1]. These systems prioritize learner-centered approaches, fostering dynamic, flexible, and efficient educational environments.

AI empowers educators and students alike by offering intelligent tools that can adapt to individual learning needs^[2]. IoT enhances interactivity and connectivity within classrooms by linking devices and resources^[3]. Meanwhile, cloud computing facilitates the storage, sharing, and accessibility of educational materials and data^[4]. Together, these technologies are revolutionizing traditional educational practices and addressing challenges related to accessibility, scalability, and quality^[5].

This paper explores the transformative role of AI, IoT, and cloud computing in education, delving into their practical applications, discussing the challenges associated with their implementation, and considering the future of these technologies in shaping a more inclusive and innovative educational landscape.

2. Research method

This study employs a systematic literature review to explore the impact of AI, IoT, and cloud computing on education. The methodology includes the following steps:

- (1) Data collection: Academic papers, case studies, and reports were sourced from databases such as Google Scholar and IEEE Xplore.
- (2) Screening: Abstracts were reviewed to ensure relevance to smart education, personalized learning, and technological integration, selecting only studies focused on AI, IoT, and cloud computing in education.
- (3) Analysis: Selected studies were examined to identify key findings, patterns, and emerging trends.
- (4) Categorization: Findings were grouped into three themes: AI applications, IoT-enabled classrooms, and cloud computing solutions in education.

3. Research results and discussion

3.1. Transformative role of technology in education

The transformative role of technology in education has shifted it from a complementary tool to an integral part of the teaching and learning process^[6], reshaping traditional educational practices and broadening access to knowledge. Through tools such as interactive digital platforms, virtual simulations, and cloud-based resources, technology has facilitated a shift toward more student-centered learning^[7], encouraging active engagement, collaboration, and critical thinking. These tools allow learners to explore complex concepts interactively, fostering deeper understanding and application of knowledge. Furthermore, technology has enhanced accessibility by providing remote and underserved communities with high-quality educational materials and virtual learning environments, breaking down geographical and socioeconomic barriers that have historically limited opportunities.

For educators, the integration of technology has transformed instructional practices. Teachers now have access to data-driven insights that allow them to track student progress, identify challenges, and tailor instruction to meet individual needs. Automated tools have streamlined administrative tasks, enabling educators to dedicate more time to fostering meaningful interactions and designing innovative lessons. In addition, virtual professional learning communities allow teachers to share resources and strategies, supporting continuous professional development and collaborative problem-solving. However, while these advancements have expanded the scope of educational possibilities, they also raise important questions about equity, the role of human interaction, and the balance between technological efficiency and educational depth.

Institutions, too, are undergoing a structural shift. Technology is enabling data-informed decision-making, from optimizing resource allocation to refining curricula based on student performance trends. IoT devices and cloud platforms have introduced efficiencies in classroom management and operational systems, allowing institutions to focus more on improving educational outcomes. Nevertheless, these changes require thoughtful policy and planning to address critical issues such as ensuring equitable access to technology, safeguarding data privacy, and training educators to use these tools effectively.

Ultimately, technology's impact on education goes beyond enhancing efficiency; it is reshaping the fundamental goals of education itself. By fostering personalized learning pathways, expanding global connectivity, and supporting lifelong learning, technology offers the potential to prepare learners not only for academic success but also for the demands of an interconnected and rapidly changing world. However, to fully realize this potential, the implementation of technology must be guided by educational principles that prioritize equity, inclusivity, and the central role of human relationships in learning. This balance will ensure that

technology serves as a means to enhance education, rather than as an end in itself.

3.2. The Internet of Things in smart classrooms

The IoT is revolutionizing the concept of smart classrooms by creating interconnected learning environments that enhance both teaching and learning experiences. IoT enables the integration of devices, sensors, and systems within classrooms, allowing for real-time monitoring and interaction that supports both students and educators. For instance, IoT-based environmental controls can automatically adjust lighting, temperature, and air quality to create optimal learning conditions, ensuring that physical environments support student focus and comfort. Additionally, wearable devices and interactive tools enable teachers to track student engagement, participation, and even physical activity, providing valuable insights into individual and group dynamics. These insights can help educators adapt instructional strategies on the fly, promoting more effective teaching methods. Furthermore, IoT facilitates the use of innovative tools such as smartboards, augmented reality (AR), and virtual reality (VR), which make learning more immersive and interactive. Such tools allow students to explore abstract concepts in a tangible way, enhancing their understanding and retention. However, while IoT promises significant benefits, its integration also raises critical concerns related to data privacy, equitable access, and the need for teacher training. Addressing these challenges is essential to ensure that IoT technologies in smart classrooms contribute meaningfully to educational outcomes without compromising ethical and practical considerations.

The adoption of IoT in smart classrooms also fosters collaboration and communication among students and between students and teachers, reshaping traditional classroom dynamics. By connecting devices such as tablets, smartboards, and sensors, IoT enables a seamless exchange of information and real-time feedback, encouraging active participation and group problem-solving. For example, students can collaborate on projects using interconnected devices that allow for shared editing, instant updates, and live discussions, even in hybrid or remote learning settings. This interconnectedness not only nurtures teamwork but also helps students develop essential digital literacy and collaboration skills that are critical in the modern workforce.

3.3. Cloud computing in education

Cloud computing has emerged as a cornerstone of modern education, offering scalable, accessible, and cost-effective solutions that enhance both teaching and learning ^[8]. By storing educational resources and tools on cloud platforms, institutions can ensure that students and teachers have seamless access to materials anytime and anywhere, eliminating traditional barriers such as geography and limited physical resources. This accessibility is particularly valuable in supporting remote and hybrid learning models, as well as providing opportunities for students in underserved or rural areas who might otherwise lack access to high-quality educational content. Cloud computing also fosters collaboration through shared workspaces, virtual classrooms, and real-time document editing, enabling students and teachers to engage in group projects and discussions regardless of their physical location. These collaborative tools are instrumental in developing essential skills such as teamwork, communication, and problem-solving, which are increasingly important in a globalized and digital workforce.

Beyond accessibility and collaboration, cloud computing facilitates efficient management of educational data. Institutions can securely store and analyze large volumes of information related to student performance, attendance, and learning outcomes. These insights help educators identify trends, refine curricula, and implement targeted interventions for students who may need additional support. However, the integration of cloud computing in education also raises concerns about data privacy and security. Schools must adopt robust

protocols and systems to protect sensitive information and ensure compliance with data protection regulations. Additionally, the reliance on cloud services highlights the need for equitable access to reliable internet connections and devices, as the digital divide continues to be a significant challenge in education. While cloud computing offers transformative benefits, its implementation requires thoughtful planning to address these challenges and ensure that it enhances, rather than hinders, educational equity and quality.

In addition to its practical benefits, cloud computing also supports the shift toward lifelong learning and continuous professional development, both for students and educators. By hosting massive open online courses (MOOCs), professional training programs, and a wealth of other educational content, cloud platforms make it possible for learners of all ages to upskill and reskill at their own pace. This flexibility is particularly important in today's fast-evolving global economy, where individuals need to adapt to changing workforce demands. Educators, too, benefit from cloud-based professional development opportunities, which provide access to workshops, teaching resources, and peer collaboration networks that help them refine their teaching practices and stay updated on the latest educational trends.

Moreover, the integration of cloud computing has enabled schools and universities to adopt more sustainable practices. By reducing the need for printed materials, on-premise servers, and extensive physical infrastructure, cloud technology supports greener operations and lowers costs. These savings can be reinvested in other areas of education, such as hiring more qualified teachers, providing scholarships, or improving classroom technology. Cloud systems also support the scalability of education systems, making it easier for institutions to handle growing student populations without significant additional costs or infrastructure changes.

However, the reliance on cloud computing also introduces the need for stronger institutional policies and technical expertise. Schools and universities must ensure that educators and administrators are equipped to manage and use cloud systems effectively, avoiding over-dependence on external providers while maintaining control over their data and resources. At the same time, there is a need to address the risk of unequal access, as under-resourced schools may lack the infrastructure to fully leverage cloud technologies. Policymakers and education leaders must work to ensure that the benefits of cloud computing are distributed equitably, offering subsidies, training programs, and infrastructure development for schools in underserved regions.

Ultimately, cloud computing has the potential to redefine the structure and delivery of education, creating a more flexible, inclusive, and data-driven approach to learning. However, its success depends on careful integration and a focus on bridging gaps in digital access and literacy. With the right investments and policies, cloud computing can become a powerful tool for creating equitable and sustainable educational systems that meet the demands of the 21st century.

4. Challenges in implementation

The implementation of advanced technologies in education, such as AI, IoT, and cloud computing, presents numerous challenges that must be addressed to fully realize their potential benefits. One of the most pressing issues is the digital divide, as unequal access to reliable internet, devices, and infrastructure leaves many students and schools unable to adopt these technologies. This disparity disproportionately affects underserved and rural communities, exacerbating existing educational inequalities. Another significant concern is data privacy and security, as the widespread use of connected devices and cloud-based systems generates vast amounts of sensitive student and institutional data. Ensuring that this data is protected from breaches and misuse requires robust cybersecurity measures, clear policies, and strict compliance with privacy regulations.

Additionally, teacher preparedness remains a critical barrier to successful integration. Many educators lack the training and confidence to effectively use these technologies in their teaching practices, leading to underutilization or ineffective application. Comprehensive professional development programs are essential to equip teachers with the technical skills and pedagogical strategies needed to integrate technology meaningfully into their classrooms. Furthermore, the cost of implementing and maintaining advanced technologies can strain school budgets, particularly in underfunded institutions. Decision-makers must balance the financial investment required for these technologies with other pressing educational needs.

Lastly, the rapid pace of technological change poses a challenge for long-term planning and sustainability. Educational institutions must ensure that their investments in technology remain relevant and adaptable to future innovations, avoiding obsolescence while maintaining a focus on pedagogical goals. Addressing these challenges requires a coordinated effort from policymakers, educators, and technology providers, emphasizing equity, ethical considerations, and sustainable implementation strategies to ensure that technology enhances education rather than deepening existing divides.

5. Conclusion

In conclusion, the integration of advanced technologies such as AI, IoT, and cloud computing is transforming education by creating more personalized, connected, and accessible learning environments. These tools offer immense potential to enhance teaching and learning processes, foster collaboration, and bridge traditional barriers to education, enabling students and educators to thrive in a rapidly evolving digital world. However, realizing this potential requires addressing significant challenges, including the digital divide, data privacy concerns, teacher preparedness, and financial constraints.

The success of these technologies lies in thoughtful and equitable implementation, guided by educational principles that prioritize inclusivity, ethical responsibility, and the importance of human interaction. Policymakers, educators, and stakeholders must work collaboratively to ensure that technology not only complements but also enhances the core values of education. By doing so, these innovations can empower learners, equip educators, and strengthen educational systems to meet the demands of the 21st century, fostering a future where education is not only more efficient but also more equitable, engaging, and impactful.

Disclosure statement

The author declares no conflict of interest.

References

- [1] Gubbi J, Buyya R, Marusic S, et al., 2013, Internet of Things (IoT): A Vision, Architectural Elements, and Future Directions. *Future Generation Computer Systems*, 29(7): 1645–1660.
- [2] Ahmed SH, Hossain MA, 2014, Cloud-Assisted IoT-Based SCADA Systems Security. *Proc. of Cloud and Service Computing Symposium*, 6: 25.
- [3] Armbrust M, Fox A, Griffith R, et al., 2010, A View of Cloud Computing. *Communications of the ACM*, 53(4): 50–58.
- [4] Sultan N, 2010, Cloud Computing for Education: A New Dawn? *International Journal of Information Management*, 30(1): 109–116.

- [5] Selwyn N, 2016, *Is Technology Good for Education?* Wiley & Sons, Cambridge.
- [6] Voogt J, Knezek G, Cox M, et al., 2013, Under Which Conditions Does ICT Have a Positive Impact? *Journal of Computer Assisted Learning*, 29(1): 4–14.
- [7] Zuboff S, 2015, *Surveillance Capitalism*. *Journal of Information Technology*, 30(1): 75–89.
- [8] Solove DJ, 2006, A Taxonomy of Privacy. *University of Pennsylvania Law Review*, 154(3): 477.

Publisher's note

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

A Survey Research on the Current Status of the Integration of Qinghai's Regional Culture into College English Instruction

Wenjing Zhang*

School of Foreign Languages, Qinghai University, Xining 810016, Qinghai, China

**Author to whom correspondence should be addressed.*

Copyright: © 2025 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: Language learning and cultural communication are inherently intertwined and mutually reinforcing. In the context of college English instruction, emphasizing “telling China’s stories well” aligns with the principles of foreign language education and inevitably promotes cultural exchange and mutual understanding across different cultures through foreign language learning. Many researchers have explored ways of cultivating students’ ability to communicate Chinese stories and spread Chinese culture in English. However, a few studies have been performed on exploring paths of incorporating regional culture into English language education. In particular, incorporating Qinghai’s indigenous cultural resources into college English teaching practice is rare. Therefore, a survey was conducted to ascertain the present situation concerning integrating Qinghai’s regional culture into college English teaching practice at Qinghai University. Based on the data from the survey, the present study discusses the results and implications obtained during the present teaching process and probes into practical strategies for the infiltration of Qinghai’s regional culture into college English teaching from the dimensions of curriculum, teaching materials, approaches, teachers’ professional development, and teaching evaluation, intending to achieve the goals of language teaching and cultural education in the college English course.

Keywords: Regional culture; College English instruction; Strategies

Online publication: June 30, 2025

1. Introduction

As a compulsory course for non-English majors in higher education institutions, college English is an effective means of enhancing students’ language proficiency. Moreover, it is a practical platform for them to carry out intercultural communication. For a long time, college English instruction has emphasized language skills training and information transfer while neglecting to emphasize the development of intercultural communication skills^[1]. Language, being the carrier and representation of culture, demands that we emphasize cultural inheritance and development in language learning^[2]. College English possesses the dual objectives of language

teaching and cultural education^[3]. It is argued that college English teaching must go beyond the mere delivery of linguistic knowledge; it is crucial to focus on conveying cultural essence. The concept of the new liberal arts has offered a new insight into incorporating regional culture into English instruction while inspiring innovative approaches to its implementation^[4]. It is the mission of every college and university to pass on and carry forward the excellent traditional Chinese culture^[5]. Regional culture represents the distinctive embodiment of a region's history, customs, ecology, craftsmanship, etc. It is an integral part of China's outstanding traditional culture, providing rich teaching resources for college English teaching. Qinghai Province is a region with a long history and rich cultural heritage. The province boasts remarkable tourism resources, vibrant ethnic minority traditions, and precious intangible cultural heritage resources. Therefore, it is recommended that we present Qinghai topics in college English instruction through a range of perspectives. In this way, language learning would be facilitated by enriching teaching content, and the spread and promotion of Qinghai's indigenous culture would be boosted to ensure the preservation and continued evolution of this rich cultural heritage. The present study focuses on the status quo of the integration of regional cultural resources into the college English course at Qinghai University, concluding with an exploration of the effective paths and methods of integrating indigenous culture into English instruction.

2. Survey research

2.1. Survey design

To better understand the specific implementation of the particular integration of Qinghai's indigenous culture in the present English teaching, a questionnaire was released among the 2023 and 2024 cohort students of Qinghai University. A total of 210 valid questionnaires were collected, comprising 97 male students (46%) and 113 female students (54%). For the distribution of survey respondents, first-year and second-year students accounted for 48.1% and 51.9%, respectively. The results and implications obtained during the present teaching process are analyzed using questionnaire data, and the effective paths and methods of integrating regional culture into English teaching are explored.

2.2. Analysis of the survey

2.2.1. The ways in which students gain knowledge and understanding of Qinghai's regional culture

According to the data from the questionnaire, students have a good knowledge of Qinghai's regional culture overall. More than 60% (64.76%) of respondents have a good understanding of Qinghai's indigenous culture, indicating that it has been effectively promoted to a certain extent. 28.1% of the students surveyed have learned about some cultural elements but are not clear about details, suggesting that some students have a general awareness of Qinghai's regional culture but do not know much about it. 5.71% have heard of it a little, knowing only that Qinghai has unique regional cultures. 1.43% are entirely unaware of them, which may be because a considerable proportion of students at Qinghai University are non-locals, which limits their knowledge of Qinghai's regional culture to a certain extent. Regarding how students learn about Qinghai's indigenous culture, narratives and traditions passed down by family elders (62.38%) play an essential role in cultural inheritance, which is a traditional and direct way. The second most popular way is learning through school courses (58.1%), which indicates that school education plays a significant role in promoting regional culture. Qinghai University has offered cultural courses with regional characteristics, providing students with rich learning resources to understand the regional culture. Third place goes to the Internet (57.60%), reflecting the fact that, in the digital

era, young people are more inclined to obtain information through digital media, leading to a decline in the use of traditional media such as TV, broadcasting, books, and newspapers, which accounted for a relatively low percentage. Because of the intuitive cultural experiences provided by field trips^[6], it not only enhances students' understanding and memory of regional culture but also increases their interest and participation in learning, accounting for a certain percentage (50.48%).

2.2.2. The degree to which Qinghai's regional culture is integrated into college English instruction

The analysis of the questionnaire data indicates that the majority of students (81.91%) have encountered the regional culture of Qinghai within the context of their college English courses. The findings demonstrate the integration of Qinghai's indigenous cultural resources within the college English curriculum, with these resources being presented in diverse forms. The proportion of students who selected the form of presentation indicates that teachers have endeavored to employ varied strategies for integrating regional culture into English courses. It is evident that reading English articles introducing Qinghai's regional characteristics is a prevalent and widely accepted approach. This pedagogical method enables students to broaden their knowledge of Qinghai's regional culture while concurrently acquiring English language competencies. The infiltration of Qinghai's indigenous culture into English vocabulary and grammar instruction is a successful method for enabling students to acquire Qinghai's regional culture without necessarily perceiving it as such^[7]. The other two forms of teaching, "English oral practice topics" and "English classroom presentation topics or English speeches," emphasize students' language output and practical application. By using the indigenous culture of Qinghai as a topic or theme in classroom teaching, students can practice their oral expression skills and, at the same time, enhance their understanding and expression of the regional culture. To facilitate students' ability to describe and explain regional culture in English, students are encouraged to write about Qinghai's regional culture in English. The viewing of English-dubbed and subtitled documentaries on Qinghai culture, together with the subsequent discussion and communication of these documentaries, will allow students to feel the charm of Qinghai indigenous culture more intuitively. Furthermore, discussion and communication will deepen their understanding of the culture further. Generally, it is evident that Qinghai's regional cultural resources have been incorporated into college English courses to a certain extent and are presented in various forms. In future college English teaching, this integration will be maintained. We will continue to give full play to the advantages of multiple forms of presentation to realize the goal of broader and deeper cultural education.

2.2.3. The interest and acceptance of students in Qinghai's regional culture

The questionnaire results reveal that an overwhelming majority (92.86%) of the students have a favorable attitude towards integrating Qinghai's regional cultural resources into college English classroom teaching, reflecting the students' expectations of and support for this teaching method. Only a small percentage of students (6.19%) selected the option that it was of no consequence and had little impact on English language learning. This group of students may adopt a neutral stance on this matter, perceiving this kind of integration as not having an obvious facilitating or hindering effect on their English learning. Alternatively, they are more concerned about English language knowledge, with relatively limited consideration given to cultural integration. The percentage of students who asserted that "There is no need, and English classrooms should prioritize common knowledge of English" is a mere 0.95%, indicating that a negligible number of students are in complete opposition to integrating Qinghai's regional cultural resources into college English classroom instruction. The vast majority of students acknowledge the significance of culture in language learning. In

light of the data above, it is imperative to emphasize the integration of Qinghai's indigenous cultural resources within the context of college English instruction. As for students exhibiting a neutral attitude, we can guide them to recognize the positive impact of culture on English learning. For the small number of students who hold opposing views, it is possible to understand their specific thoughts and communicate with them in a targeted manner to promote their understanding and acceptance of this teaching method. Overall, students have widely recognized and supported Qinghai's regional cultural infiltration into college English classroom teaching. It is important to note that this infiltration has significant teaching value and is worthy of further promotion and deepening.

2.2.4. The demand among students for the integration of Qinghai's regional culture in college English instruction

The highest proportion of the sample (65.24%) reported a preference for the "field visit experience," suggesting a preference for engaging with regional culture through an immersive approach. This approach has been shown to enhance interest and participation in learning and improve understanding and memory of regional culture. Additionally, it provides a real language environment for English learning. The majority of students (61.9%) selected the option of "expanding reading materials." This choice indicates that reading is a favored method among students for enhancing their comprehension of Qinghai's indigenous culture. The proportion of students choosing "presenting a theme speech" and "simulating a scenario" is the same, both at 54.29%. Theme-based speeches have been shown to improve students' oral expression and logical thinking skills while also allowing them to study and present Qinghai's regional culture in depth. Scenario simulations, on the other hand, have been demonstrated to improve students' ability to use English through role-playing in simulated situations. The "Display of Cultural Creation" (42.86%) is an initiative designed to motivate students to harness their creativity and showcase their comprehension of Qinghai's regional culture through the creation of paintings, writings, handicrafts, etc. This initiative functions as a platform for students to exhibit their work, thereby fostering their cultural literacy and innovation ability^[8]. Compared with other forms of teaching, the proportion of students opting for "group project work" is lower (31.9%), which may be attributed to the fact that cooperative learning demands higher levels of organization and time management. Alternatively, the practical operational challenges inherent in this approach could be a contributing factor. The absence of any alternative options being proposed by students suggests that no other formats are considered to be of interest to them beyond the current one. Furthermore, it can be assumed that the formats listed comprehensively cover the aspects that may interest students.

It is anticipated that the integration of Qinghai's indigenous cultural resources into college English classes will prioritize enhancing two specific competencies: cultural translation (69.52%) and intercultural communication (64.76%). Most students, approximately 70%, identified the accuracy of the English translation of Qinghai cultural terms as their primary objective, suggesting that a significant proportion of students expect to achieve greater precision in their translation of Qinghai cultural terms. This underscores their commitment to mastering strategies for translating culturally loaded words, intending to address the issue of semantic gaps in intercultural communication^[9]. The students' high expectations of "communicating regional culture appropriately" indicate their aspiration to articulate the distinctiveness of Qinghai's culture in English in intercultural communication contexts, thereby enhancing their proficiency and self-confidence in cultural exchange. The importance attributed to "stimulating the desire to explore regional culture" (52.38%) confirms the function of regional cultural resources as "cognitive scaffolding." That is to say, these resources activate

learning motivation through emotional resonance, thereby promoting students to shift from passive acceptance to learning to active construction of knowledge. Furthermore, they encourage cultivating habits and abilities to explore knowledge actively. 51.43% of the students anticipated reflecting on the regional culture of Qinghai and other cultures by comparing Chinese and foreign cultures. This anticipation reflects the students' ambition to evolve a more profound and comprehensive understanding through cultural comparison and reflection, and develop skills in logical argumentation and intercultural problem analysis. 41.43% of the students desired to obtain materials with more diversified perspectives, thus expanding their writing ideas. The expansion of English vocabulary accounted for the least longed competency (27.62%) among the set of competencies that students expected to improve. This observation may signify that students emphasize the capacity to apply language in cultural contexts instead of mere enlargement of vocabulary in isolation. In summary, integrating Qinghai's regional cultural resources into the college English teaching necessitates blending Qinghai cultural symbols. The fundamental concepts underpinning this approach are cultural translation and intercultural communication. It is of paramount importance that critical thinking training is embedded within cultural comparison activities^[10] and that independent learning ability is fostered through project-based learning^[11], forming a triad of mechanisms for the enhancement of "language-culture-thinking" competence.

3. An exploration of the strategies for integrating Qinghai's regional culture into college English instruction

3.1. Restructuring the curriculum

The college English curriculum system needs to be enriched through a multi-channel, hierarchical course setting, providing students with a more diversified range of learning choices. The program of study comprises compulsory courses, elective courses, and lectures on Qinghai's regional culture, which will be adopted to establish a special section on Qinghai culture within the college's English curriculum system. This initiative allows the allocation of a designated portion of class time to instruction on regional cultural themes, which can be undertaken within the framework of regular college English courses^[12]. Moreover, in the existing English elective course entitled "Introducing Chinese Culture in English" offered to second-year students, elements of Qinghai's indigenous culture are systematically infiltrated under the themes of the course chapters. Furthermore, a selection of courses, including "Amazing Qinghai," is to be offered to facilitate an in-depth and systematic understanding of Qinghai's rich and diversified regional culture. Concurrently, specialized English lectures on indigenous cultures are to be held regularly.

3.2. Redesigning the teaching materials

Based on the interdisciplinary concept of "regional culture + English" and the "collation + translation" method^[13], a comprehensive tapping and mining of the regional cultural resources of Qinghai has been undertaken to establish an extensive and multifaceted collection of teaching resources. Qinghai cultural resources are categorized according to themes. With the assistance of AI tools and technologies, English news reports and audio-visual materials related to Qinghai culture are collected and collated from the perspectives of material mining, content generation, and content expansion^[14], aiming to establish an English teaching resource bank. Qinghai's regional culture is the theme of this multimodal English teaching resource library, which contains audio, video, pictures, texts, etc. These materials offer a rich and diversified selection of reading and audio-visual materials for students and supplement the existing English teaching materials.

3.3. Refining teaching methods

The emphasis is placed on the in-depth coordination of the first and second classrooms to facilitate the establishment of a trinity teaching mode comprising theoretical learning, cultural experience, and practical application. Innovative teaching methods such as situational and project-based learning should be proactively adopted in the initial classroom teaching practice. Through the authentic language situation, students can learn by doing. The design of practical projects based on the theme of Qinghai culture aims to facilitate students' in-depth internalization and comprehensive application of knowledge in a practical context. Practices are increased in the second classroom. Building a multi-level and multi-dimensional practice teaching system ensures that students improve their English proficiency and deepen their understanding of Qinghai's regional culture.

3.4. Enhancing teachers' professional development

To broaden their teaching horizons and knowledge reserves, English teachers should strengthen their cultural literacy through self-study, research, and training. At the same time, they should actively explore effective paths for integrating regional cultural resources into classroom instruction. Secondly, teachers should regularly carry out experience exchanges and be encouraged to constantly reflect on their teaching strategies, solve practical teaching problems through sharing and mutual learning, and explore the path of blending regional culture and language learning to effectively improve their intercultural teaching ability.

3.5. Optimizing teaching evaluation

It is crucial to measure students' learning and the improvement of their literacy in multiple dimensions by establishing a diversified evaluation system in which the learning of regional culture and the cultivation of values are incorporated into the scope of evaluation of college English teaching. In terms of the assessment methods, a three-dimensional evaluation framework will be devised, encompassing written tests, oral expression, and presentation of project results. With a focus on process evaluation, the study pays particular attention to students' participation, learning attitude, and value cultivation in learning about regional culture^[15]. In the summative evaluation, content related to Qinghai's regional culture should be added. In this way, teachers' and students' enthusiasm to explore the regional culture of Qinghai is stimulated to promote the realization of the goals of language teaching and cultural education in the college English course.

Funding

The 2024 Qinghai University Ideological-Political Education Project "Research on the Paths and Methods of Telling Qinghai's Stories Well in the College English Teaching" (szzx2410)

Disclosure statement

The author declares no conflict of interest.

References

- [1] Tian J, 2025, Research on Strategies for Cultivating Cross-Cultural Competence in College English under the Integration of High and Low Context Cultures. *Contemporary English*, 26(01): 84–86.
- [2] Yin T, 2024, A Study on the Current Status of Intercultural Competence among Chinese University Students and

Its Association with the Ability to “Tell China’s Stories Well.” *Journal of Huainan Normal University*, 26(06): 86–93.

- [3] Hu M, 2020, A Literature Review on the Integration of Chinese Culture into College English Teaching From the perspective of POA. *English Teacher*, 20(08): 10–13.
- [4] An F, Li B, 2021, On the Training of Foreign Language Talents with Key Competencies and Curriculum-Based Political and Virtuous Awareness Education in the Context of New Liberal Arts Development. *Technology Enhanced Foreign Language Education*, 43(06): 45–50 + 7.
- [5] Chang H, 2021, Telling China’s Stories Well in College English Courses Current Situations, Pathways, and Methods. *Technology Enhanced Foreign Language Education*, 43(05): 96–100 + 14.
- [6] Wen Y, 2022, The Theoretical Logic and Teaching Practice of Telling China’s Stories Well in College English Education. *Social Scientist*, 37(08): 148–154.
- [7] Guo X, 2024, Exploration into the Integration of Traditional Chinese Culture in College English Teaching. *Contemporary English*, 25(12): 69–71.
- [8] Guo J, Ma J, 2023, The Value, Objectives, and Pathways of Integrating Excellent Traditional Chinese Culture into Higher Foreign Language Education. *Foreign Language Education*, 44(04): 63–68.
- [9] Lei X, 2022, A Study on the Cultivation of College Students’ Narrative Translation Ability by Integrating Chinese Stories into College English Classroom. *Journal of Nanchang Normal College*, 43(01): 108–112.
- [10] Jiang R, 2024, Research on the Teaching of Traditional Chinese Culture Translation in College English Classroom. *Jiangsu Foreign Language Teaching and Research*, 32(02): 17–20 + 24.
- [11] Mei C, Duan G, 2021, New Method of Local Culture Teaching Based on the Blended Teaching—Take the Teaching of Lingnan Culture as a Case. *China Educational Technology*, 28(10): 120–125.
- [12] Guo Y, 2023, Exploring the Integration of Leshan’s Local Culture into the English Major Curriculum Based on “Internet+.” *English Square*, 13(33): 30–33.
- [13] Lu D, 2021, Reality and Surpassing: Transforming Local Cultural Resources into Educational Resources, *Social Science Literature Press*, Beijing, 106–108.
- [14] Yang Z, 2022, Application and Exploration of VR and AI Technology in College English Teaching. *Advances in Multimedia*, (1): 1810177.
- [15] Chen Y, 2024, Construction of an Integrated Teaching-Learning-Assessment Evaluation System for Curriculum-Based Ideological and Political Education in Second Foreign Language Courses Based on the BOPPPS Mode. *Journal of Higher Education*, 10(35): 9–16.

Publisher’s note

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

Exploration of Quality Improvement in Graduation Projects (Theses) for Vocational Undergraduate Electronic Information Majors

Xiaofeng Luo^{1*}, Hongqi Wu¹, Caili Song²

¹School of Electronic Information, Xi'an Vocational University of Automobile, Shaanxi, China

²Shaanxi Liuchuan Tonghui Intelligent Technology Co., Ltd., Shaanxi, China

**Author to whom correspondence should be addressed.*

Copyright: © 2025 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 graduation project (thesis) in vocational undergraduate education aims to demonstrate students' comprehensive application of acquired knowledge and professional skills, with an emphasis on industry-oriented practical implementation. This paper first identifies key issues in vocational undergraduate graduation projects, then proposes solutions using the "Four Truths" principle adopted by electronic information majors at Xi'an Vocational University of Automobile. This approach requires students to solve real-world enterprise problems, deliver tangible outcomes, and gain practical competencies. Improvement measures include: optimizing topic selection to integrate theory with practice; enhancing school-enterprise collaboration to boost corporate involvement; implementing a "dual-tutor" system with jointly built training bases; and refining evaluation mechanisms to increase student engagement. These strategies collectively elevate the quality of vocational undergraduate graduation projects.

Keywords: Vocational undergraduate; Graduation project; School-enterprise cooperation

Online publication: June 30, 2025

1. Introduction

Vocational undergraduate education, a full-time undergraduate program focused on cultivating high-end skilled talents, holds equal importance to regular undergraduate education. It is a new form of undergraduate education that has emerged in the context of deepening the integration of industry and education, as well as school-enterprise cooperation in the field of vocational education. Through on-campus learning, a graduation design (thesis) is required in the fourth year of university, which is designed to showcase students' knowledge, skills, and abilities in their field through research and practice. According to the Ministry of Education's Qualification Assessment Indicators and Basic Requirements for Undergraduate Teaching Work in Vocational Schools, the graduation project (thesis) must meet three criteria: topics should closely align with production and social realities, with appropriate difficulty and workload reflecting professional training requirements; over

50% of the content must be completed through social practices such as experiments, internships, engineering projects, and social surveys; industry experts should participate in guidance and assessment, maintaining a reasonable teacher-to-student ratio, standardized processes, and high quality ^[1]. Taking the School of Electronic Information at Xi'an Vocational University of Automobile as an example, this article elaborates on the guidance and management model during the implementation of graduation projects (theses), aiming to provide references for related vocational undergraduate institutions.

2. Problems in vocational undergraduate graduation design (thesis)

2.1. Insufficient integration of theory and practice

The selection of topics is overly focused on theoretical research, and some students may only stay at the superficial stages of literature review and data collection. Some students may be too traditional or singular, failing to fully reflect the forefront of industry development and market demand, which limits their innovation capabilities and broadens their perspectives, leading to deficiencies in their ability to solve practical problems.

2.2. Low level of corporate participation

The school-enterprise cooperation mechanisms remain underdeveloped, with limited in-depth enterprise involvement. Consequently, graduation projects lack real-world industrial scenarios and professional guidance, leading to challenges in method selection, data collection, and potential unreliability of results and subjectivity in interpretations.

2.3. Uneven distribution of teacher resources and limitations in practical training conditions

Vocational undergraduate programs emphasize “dual-qualified” teachers, but some schools still need to improve their “dual-qualified” teaching staff. Additionally, certain schools have limited training conditions, which may hinder the implementation of complex graduation projects, thereby affecting the quality of project completion and the effectiveness of students’ practical training.

2.4. Imperfections in the evaluation system and insufficient student attitudes and engagement

Graduation theses often follow standard undergraduate requirements and lack attention to practical achievements and innovation, leading some students to adopt a perfunctory approach and resulting in poor-quality graduation theses.

Furthermore, many universities start graduation projects in the 8th semester, clashing with students’ job-hunting and exams, leading to insufficient time and poor quality ^[2].

3. Effective ways to improve the quality of vocational undergraduate graduation projects (theses)

To improve the quality of students’ graduation design (thesis) in response to the above issues, it is necessary to gradually solve them from the aspects of topic selection, industry education integration, mentor team, and evaluation system. Taking the electronic information major of Xi'an Vocational University of Automobile as an example, this article analyzes the guidance and operation mode in the implementation process of graduation

design (thesis), as shown in **Figure 1**.

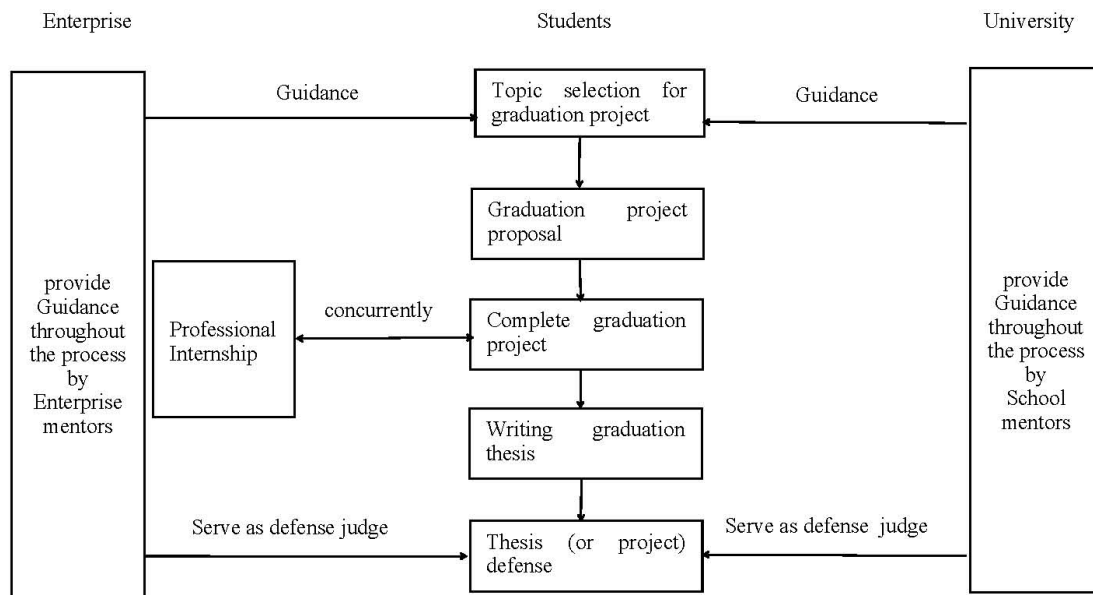


Figure 1. Guidance and operation mode for the implementation process of graduation design (thesis)

3.1. Optimizing the topic selection mechanism and emphasizing the combination of theory and practice

Deepening cooperation with industry enterprises, we establish a standardized information exchange platform and transform real-world technical challenges and product development needs into graduation project topics. This ensures that each topic has a clear application background and market demand, emphasizing practicality, innovation, and relevance to cutting-edge trends.

For example, Xi'an Vocational University of Automobile has collaborated with companies such as Guangzhou Yueqian Communication Technology Co., Ltd., Wuxi Fantai Technology Co., Ltd., and Beijing Huaqing Vision Technology Co., Ltd. In the 2023 and 2024 Internet of Things Engineering programs, graduation projects were derived from actual development projects, ensuring students work on real-world problems from topic selection to completion.

Additionally, students are encouraged to propose their own topics within a defined scope, based on their industry insights and personal interests. Enterprise mentors and academic supervisors then jointly assess feasibility and provide guidance, ensuring a strong integration of theory and practice.

3.2. Deepening industry-academia collaboration and enhancing enterprise engagement

By signing long-term cooperation agreements with enterprises, we jointly establish a project pool, converting real-world technical challenges, product upgrades, and management optimization needs into graduation project topics. This ensures practical relevance and application value. After completing project proposals at school, students conduct professional internships at enterprises (or use enterprise equipment on campus) ^[3].

For instance, despite pandemic restrictions preventing 2023 IoT students from interning onsite, standards remained uncompromised. To enhance employability and broaden perspectives, we meticulously selected partners like Guangzhou Yueqian Information Technology Co., Ltd., co-designing internship plans aligned with career goals. Resources were pooled to conduct embedded projects, such as STM32-based warehouse monitoring and smart home systems. These projects covered full development cycles—from background

analysis and job role alignment to hardware/software implementation—enabling students to master demand analysis, framework design, module development, system debugging, and corporate culture integration. Through hands-on work, students tackled actual operational challenges, completing graduation designs during internships to achieve tangible outcomes.

3.3. Implementing the “dual-mentor” system and collaborative establishment of laboratory (training) bases by schools and enterprises

Building a “dual-mentor” system guidance team, each electronic information major student in our university is assigned both an academic mentor (campus-based, with rich teaching experience and academic background, responsible for theoretical guidance, research methods, and literature review) and an enterprise mentor (senior engineers or technical experts from relevant industries, providing practical guidance on problem analysis, technical solutions, and on-site operations). Both mentors collaborate in topic selection that integrates theory with practice, and jointly oversee project determination, scheme formulation, mid-term inspection, and result acceptance to ensure graduation designs have solid theoretical foundations and align with industry needs. Through regular communication, dual mentors provide two-way evaluation and feedback to enhance students’ academic and practical skills.

Meanwhile, the university collaborates with enterprises to establish laboratories and training bases, introducing advanced equipment and technology platforms to offer real engineering environments. Joint industry-university-research platforms are built to organize regular skills training and project discussions, enabling students to engage in hands-on operations, solve practical production issues, and improve innovation capabilities ^[4]. Students are encouraged to participate in enterprise R&D projects, applying graduation design results directly to practice and promoting technological achievement transformation.

3.4. Optimizing the evaluation system to enhance student engagement

A scientifically reasonable evaluation system for graduation design (thesis) serves as a critical criterion for measuring and ensuring teaching quality. Through comprehensive and equitable assessment, it ensures that students meet established learning objectives and training requirements during their academic journey, guides them to prioritize and invest in graduation design, encourages in-depth research and active innovation, and effectively evaluates their independent thinking and problem-solving abilities, thereby stimulating initiative and creativity ^[5]. Moreover, an effective evaluation system not only assesses students but also provides feedback on teachers’ instructional effectiveness. By evaluating the quality of graduation projects (theses), teachers can identify strengths and areas for improvement in their teaching methods, content design, and other aspects to further optimize teaching strategies and curriculum development. To enhance the graduation project (thesis) evaluation system, our institution focuses on the following key aspects.

3.4.1. Constructing multiple evaluation indicators for graduation design (thesis)

Establish a multi-dimensional evaluation system covering theoretical research (e.g., circuit design, software architecture, sensor technology, related protocols), practical operation (e.g., hardware/software system design, system debugging), innovation ability, team collaboration, and communication skills. This system not only assesses students’ professional knowledge application but also emphasizes their performance and problem-solving capabilities in real-world work scenarios.

3.4.2. Combining process evaluation with outcome evaluation

Throughout the graduation design process, supervising teachers should not only focus on the final outcome but also track and evaluate the students' research attitude, literature reading and analysis abilities, experimental operation skills, scheme formulation, and system debugging during the design. This approach encourages students to fully engage throughout the entire project cycle ^[6].

3.4.3. Evaluation of “dual-mentors”

Mentor evaluation reflects graduates' overall performance during the graduation design (thesis) process. Compared with other evaluation methods, mentors have a better understanding of the difficulty and workload of students' research topics. Therefore, mentor evaluation accounts for a significant proportion of thesis evaluation. By adopting a “dual-mentor” system, campus teachers and corporate mentors, who jointly guide the graduation project, also participate in the entire evaluation process. This ensures that evaluation opinions consider both academic levels and industry practical needs, enhancing the fairness and comprehensiveness of the evaluation, as shown in **Table 1**.

Table 1. Evaluation of “dual-mentors”

	Campus mentor	Campus mentor	Proportion
Proposal defense	50%	50%	10%
Mid-term examination	70%	30%	20%
Graduation design	40%	60%	30%
Graduation thesis	60%	40%	40%
	Total		100%

3.4.4. Introducing an enterprise expert review mechanism

During the graduation defense phase, industry experts and business representatives are invited to participate in the defense and evaluation, providing the most professional insights and suggestions from an industry perspective for students' graduation designs. On-campus teachers assess from the perspectives of talent cultivation and graduation design (thesis) standardization. This enables students to undergo comprehensive campus and off-campus evaluations, helping them identify strengths and weaknesses, encouraging continuous improvement in future studies and work, and enhancing their understanding of and focus on market demands.

3.4.5. Conducting promotion and education activities for graduation projects

The graduation design works of electronic information students mainly include hardware design, software design, or software-hardware integration. After the graduation defense, each student submits physical hardware works to the college for preservation and records the operational processes of hardware and software via video for submission to professional custodians. Through subsequent campus exhibitions, lectures, and sharing sessions on graduation designs, students can fully appreciate the appeal of electronic information majors and the significance of graduation designs for their future careers, thereby consciously enhancing their focus on this aspect.

4. Conclusion

Improving the quality of graduation projects (theses) for vocational undergraduate electronic information

majors is a complex, systematic task requiring joint efforts from schools, departments, supervisors, and students. Beyond optimizing the topic selection mechanism (emphasizing theory-practice integration), key measures include deepening school-enterprise cooperation to enhance corporate involvement, implementing a “dual-mentor” system with joint school-enterprise construction of experimental (practical) bases, and improving evaluation systems to strengthen student focus. Experienced supervisors can also deliver lectures on literature research, thesis writing standards, and academic integrity education to help students improve the graduation design (thesis) quality from multiple dimensions.

Funding

- (1) 2024 General Project of Shaanxi Province’s Education Science “14th Five-Year Plan” (SGH24Y3100)
- (2) 2025 Research Project on Vocational Education Teaching Reform of Shaanxi Vocational and Technical Education Association (2025SZX674)

Disclosure statement

The authors declare no conflict of interest.

References

- [1] Yu X, 2021, Research on Quality Improvement Strategies for Vocational Undergraduate Thesis (Design). *Digital Boutique World (Education Frontier)*, 2021(4): 97–98.
- [2] Song B, Li Y, Wang Z, 2021, Exploration and Practice of the Combination Mode of Professional Internship and Graduation Thesis (Design) under the “3+1” Talent Training Model. *Modern Education Equipment in China*, (3): 109–110.
- [3] Li Y, Zhen T, Zhang Y, 2023, Exploration and Practice of Graduation Design (Thesis) in “4+0” Joint Training. *Industry and Technology Forum*, 2023(18): 167–168.
- [4] Xie J, Wu J, Yan D, et al., 2023, Exploration and Practice of the Whole Course Teaching System for Undergraduate Graduation Design (Thesis). *Higher Education Forum*, 2023(5): 48–49.
- [5] Wang C, Liu S, Sun Y, 2023, Reform and Practice of Improving the Quality of Undergraduate Graduation Design (Thesis). *Journal of Higher Education*, 2023(12): 125–127.
- [6] Xu X, Liu F, 2016, Exploration of the Applied Undergraduate Training Model of “Comprehensive Practice, Graduation Design, and Vocational Qualification.” *Vocational Technology*, 2016(12): 16–18.

Publisher’s note

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

Bridging Tradition and Innovation: The College System as a Holistic Education Model for the Post-Globalization Era

Yu Wang*

School of Management, Shenzhen Polytechnic University, Shenzhen 518000, Guangdong, China

**Author to whom correspondence should be addressed.*

Copyright: © 2025 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 post-globalization era has intensified societal fractures, including populism and educational inequities, highlighting the limitations of traditional higher education models. This paper explores the college system as a transformative paradigm rooted in holistic education principles. By integrating academic rigor with moral, emotional, and social development, the college system fosters immersive residential communities that promote interdisciplinary dialogue, ethical awareness, and cultural agility. Through historical evolution and global adaptations, this model addresses existential challenges by cultivating well-rounded individuals capable of navigating a complex world. Empirical evidence supports its efficacy in reducing socioeconomic gaps and enhancing student engagement. Future research should investigate the integration of technology to further enhance this educational model.

Keywords: College system; Holistic education; Global higher education

Online publication: June 30, 2025

1. Introduction: The imperative for holistic education in the post-globalization era

The dawn of the post-globalization era has brought forth a paradox: while technological advancements have interconnected societies at an unprecedented scale, they have also amplified societal fractures, including rising populism, cultural isolationism, and educational inequities. These challenges expose the limitations of traditional higher education models, which often prioritize disciplinary specialization over holistic human development. The resultant “educational alienation”—characterized by rote learning, diminished ethical reflection, and lack of cross-cultural competence—has sparked a global call for educational reforms that nurture not just scholars, but compassionate global citizens.

Against this backdrop, the college system emerges as a transformative paradigm. Rooted in holistic education principles, it transcends the siloed structure of department-centric universities by integrating academic rigor with moral, emotional, and social development. Unlike conventional models where learning is confined to classrooms, the college system fosters immersive residential communities that serve as laboratories

for lifelong learning. By design, it cultivates interdisciplinary dialogue, ethical awareness, and cultural agility—competencies essential for navigating a world marked by geopolitical volatility, technological disruption, and ecological crises. This paper explores how this model, through its historical evolution and global adaptations, addresses the existential challenges of our time.

2. Historical origins: East and West in dialogue

2.1. Eastern foundations: The scholarly legacy of Chinese academies

The origins of the college system in East Asia trace back to the Tang Dynasty (618–907 CE), where private scholarly gatherings laid the groundwork for institutionalized learning. During the Song Dynasty (960–1279 CE), figures like Zhu Xi revitalized these spaces, transforming them into hubs of Neo-Confucian philosophy. The Yuelu College, founded in 976 CE, exemplified this model: it combined classical text exegesis, communal debates, and moral cultivation, operating as an autonomous counterpart to state-run schools ^[1]. Unlike modern universities, these academies prioritized “scholarship for self-cultivation,” emphasizing virtues such as filial piety and social responsibility alongside intellectual pursuit.

However, from the Yuan to Qing dynasties (1271–1912 CE), state intervention gradually eroded the autonomy of these institutions, shifting their focus to civil service exam preparation. Despite this, their legacy endured in the form of communal learning rituals, mentorship traditions, and the integration of nature and scholarship—principles that later influenced modern college designs.

2.2. Western evolution: From medieval communities to liberal arts hubs

In the West, the college system emerged from the medieval University of Paris (12th century), where student housing communities evolved into centers of intellectual life. At Oxford and Cambridge (13th century), colleges like Merton and Peterhouse became self-governing entities, blending residential care with academic instruction. Unlike their Chinese counterparts, Western colleges retained institutional autonomy, fostering a culture of academic freedom ^[2].

In the U.S., Harvard and Yale introduced residential colleges in the early 20th century to counteract the rigid specialization of German-inspired university models. Influenced by Oxbridge, these systems—such as Yale’s Berkeley College—incorporated tutorial systems and interdisciplinary seminars, aiming to nurture “well-rounded gentlemen” capable of leading in a globalizing world ^[3]. By the late 20th century, American colleges evolved into diverse ecosystems, integrating mixed-income housing and cross-cultural programs to reflect democratic values.

While Eastern and Western traditions diverged in governance—state-integrated vs. autonomous—both anchored education in the cultivation of character, not just credentials. This shared ethos of holistic development laid the groundwork for modern hybrid models.

3. Modern practices and defining characteristics

3.1. Global models: From elite institutions to mass higher education

Oxford and Cambridge: The collegiate system here remains synonymous with academic excellence. Each college functions as a microcosm of the university, offering tutorials, formal dinners, and extracurricular activities that reinforce a culture of intellectual camaraderie. For instance, Cambridge’s Trinity College has produced 32 Nobel laureates, a testament to its model of close faculty-student interaction.

The Chinese University of Hong Kong (CUHK): Since its founding in 1963, CUHK has blended Confucian humanism with Western residential college ideals. Its nine colleges—such as New Asia College—host “General Education” programs that integrate classical Chinese philosophy with global ethics, while residential life fosters cross-disciplinary collaboration.

China’s reforms: Driven by the “Double First-Class” initiative, universities like Peking University and Tsinghua University have established colleges to break disciplinary barriers. Tsinghua’s Zhiren College, for example, houses students from engineering, humanities, and social sciences, organizing joint projects on sustainability and AI ethics.

3.2. Core characteristics of the college system

Modern practices of the college system reflect the principles of holistic education by fostering a learning environment that promotes intellectual, emotional, and social growth, preparing students for the complexities of the modern world.

The fundamental ideology of the college system is rooted in the educational objective of “cultivating virtue through education,” aiming to integrate academic development with moral requirements through comprehensive and multi-layered educational practices. This ideology fosters high-quality talents with noble characters, profound knowledge, broad horizons, and innovative capabilities, which are embodied specifically and profoundly in the practice of the college system and form its distinctive core characteristics.

- (1) Mixed-housing communities: By assigning students from diverse majors to shared residences, colleges create organic platforms for interdisciplinary exchange. At Oxford, this has led to breakthroughs in fields like bioethics, where scientists and philosophers collaborate on ethical dilemmas in gene editing.
- (2) Academic freedom and mentorship: Unlike rigid departmental structures, colleges encourage curiosity-driven research. Yale’s residential colleges allow students to design independent studies with faculty mentors, such as exploring the cultural impact of AI through joint humanities-computer science projects.
- (3) Integrated general education: Colleges like Fudan University’s Zhide College require freshmen to complete the “Six Arts” curriculum—encompassing literature, history, and natural sciences—before declaring majors. This ensures graduates possess both depth and breadth.
- (4) Cultural and moral rituals: Many colleges preserve traditions like Cambridge’s May Balls (academic celebrations) or CUHK’s Confucian ancestral worship ceremonies, which reinforce communal values and historical memory.

4. Holistic education: Theoretical foundations and practical synergy

Holistic education, as articulated by scholars like Mahmoudi *et al.*, envisions education as the cultivation of the “whole person”—integrating cognitive, emotional, and spiritual dimensions ^[4]. Three principles underpin its alignment with the college system:

- (1) Student-centered learning: Colleges reject passive instruction, instead empowering students as co-creators of knowledge. At Harvard’s Adams College, student-led “intellectual salons” on topics like climate justice exemplify this, with faculty serving as facilitators rather than lecturers ^[5].
- (2) Experiential education: Learning extends beyond classrooms. Oxford’s “JCRs” (Junior Common Rooms) organize internships with local NGOs, allowing students to apply academic theories to real-

world problems, such as refugee integration ^[6].

- (3) Integration of learning and life: This principle suggests that education should not be separated from real-life experiences and that learning should be relevant and applicable to students' lives outside the classroom. The college system achieves this by integrating academic research with social life and by providing formative education activities that develop students' social responsibility and practical abilities. Holistic education underscores the significance of our interconnectedness with the broader environment, fostering a deep respect for all forms of life, which is a core aspect of ensuring that educational practices truly reflect and foster the comprehensive growth of students ^[7].

5. Empirical impacts and pathways for enhancement

5.1. Quantitative and qualitative evidence

Redressing socioeconomic gaps: A 2024 study of 615 Chinese students found that residential colleges significantly mitigated academic disparities linked to socioeconomic status (SES), with an adjusted β coefficient of -0.051 ($P < 0.01$). This suggests colleges provide equitable access to resources like mentorship and research opportunities ^[8].

Boosting student engagement: In the U.S., Jessup-Anger's survey of 1,811 students revealed that college environments accounted for 8.8% of the variation in students' "intellectual curiosity" scores ^[9]. Residents of colleges with strong faculty-student interaction reported higher motivation for lifelong learning.

Innovation in higher education models: Rose and Sriram conducted an in-depth exploration of residential academies as part of innovative models in higher education, with a particular focus on the role of point systems in enhancing student engagement. The findings revealed a high positive correlation between the point system and student engagement ($R^2 = 0.44$, $P < 0.001$), indicating that the point system serves not only as a tool for measuring student engagement but also as a direction for innovation in higher education models ^[10].

5.2. Recommendations for systemic improvement

Pedagogical innovation: Transition from lecture-based to problem-based learning. For example, Cambridge's colleges now use "supervisions" (small-group tutorials) where students present original research, fostering critical thinking.

Moral and civic integration: Integrate ethics across disciplines. Tsinghua's "College of Humanities and Social Sciences" requires all students to engage in community service projects, such as teaching in rural schools, to embed social responsibility.

Leveraging informal learning spaces: Design residential environments as "third spaces" for learning. Harvard's House System includes art studios, music rooms, and maker spaces, where students collaborate on projects outside formal curricula.

Cultural rituals as educational tools: Revitalize traditions like Yale's "College Halls," where alumni share career stories during formal dinners, bridging generational knowledge gaps.

6. Conclusion: The college system as a catalyst for global learning

The college system, with its millennia-long legacy and adaptive design, offers a blueprint for education in an age of complexity. By weaving together historical wisdom and modern insights, it addresses the dual crises of educational fragmentation and moral vacuity. Empirical evidence confirms its efficacy in fostering equity,

engagement, and cultural fluency—competencies vital for addressing global challenges like climate change and social injustice.

As higher education navigates the digital age, future research should explore how technologies like virtual exchange programs and AI-driven mentorship can enhance college experiences while preserving their humanistic core. Ultimately, the college system's enduring value lies in its commitment to cultivating not just scholars but individuals capable of envisioning and building a more interconnected and equitable world.

Funding

This paper was funded by the Research Center for Integrated and Innovative Development of Culture and Tourism in the Guangdong-Hong Kong-Macao Greater Bay Area (321-602324006Q), a provincial-ministerial level platform project under the Scientific Research Base of the Guangdong Provincial Federation of Social Sciences Circles, Guangdong Provincial Federation of Social Sciences, September 2023.

Disclosure statement

The author declares no conflict of interest.

References

- [1] Cobban A, 2002, *English University Life in the Middle Ages*, Routledge, London. <https://doi.org/10.4324/9780203006511>
- [2] Gui P, Alam GM, 2024, Do Chinese Residential Colleges Narrow Education Disparity? *Sustainability*, 16(12): 5079. <https://doi.org/10.3390/su16125079>
- [3] Hare J, 2006, Towards an Understanding of Holistic Education in the Middle Years of Education. *J Res Int Educ*, 5(3): 301–322. <https://doi.org/10.1177/1475240906069453>
- [4] Hutchison D, Bosacki S, 2000, Holistic Education and Experiential Learning. *J Exp Educ*, 23(3): 177–182. <https://doi.org/10.1177/105382590002300310>
- [5] Illuzzi MC, Duke A, 1998, Importing Oxbridge: English Residential Colleges and American Universities. *Hist Educ Q*, 38(3): 332–353. <https://doi.org/10.2307/369169>
- [6] Jessup-Anger JE, 2012, Examining How Residential College Environments Inspire the Life of the Mind. *Rev High Educ*, 35(3): 431–462. <https://doi.org/10.1353/rhe.2012.0022>
- [7] Mahmoudi S, Jafari E, Nasrabadi HA, et al., 2012, Holistic Education: An Approach for 21st Century. *Int Educ Stud*, 5(3): 17–24. <https://doi.org/10.5539/ies.v5n3p178>
- [8] McMahon D, 2005, The Yuelu College and Hunan's Nineteenth-Century Turn Toward Statecraft. *Late Imperial China*, 26(1): 72–109. <https://doi.org/10.1353/late.2005.0008>
- [9] Rose E, Sriram R, 2016, Examining the Usefulness of a Points System in a Residential College. *J Coll Stud Dev*, 57(3): 280–284. <https://doi.org/10.1353/csd.2016.0031>
- [10] Tangney S, 2013, Student-Centred Learning: A Humanist Perspective. *Teach High Educ*, 19(3): 266–275. <https://doi.org/10.1080/13562517.2013.860099>

Publisher's note

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

Cultivation of Students' Critical Thinking Ability in College English Audio-Visual and Oral Teaching

Hui Zhang*

Dalian Jiaotong University, Dalian 116000, Liaoning, China

**Author to whom correspondence should be addressed.*

Copyright: © 2025 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: With the increasingly prominent trend of globalization, English, as the common language of international communication, plays an increasingly important role in university education. As a key link in English teaching, the college English audio-visual oral course not only imparts language knowledge and skills, but also shoulders the important task of cultivating students' critical thinking. As one of the essential core qualities of modern talents, critical thinking ability plays an irreplaceable role in students' in-depth understanding of English knowledge, improving intercultural communication ability and cultivating innovative thinking. This paper expounds the significance of cultivating students' critical thinking ability in college English audio-visual and oral teaching, and puts forward a series of innovative teaching strategies to cultivate students' critical thinking ability combined with practical teaching experience and cutting-edge education theory, in order to provide new ideas and practical guidance for the improvement of college English teaching quality and the development of students' comprehensive quality.

Keywords: Critical thinking ability; College English; Audio-visual and oral teaching

Online publication: June 30, 2025

1. Introduction

In the current wave of globalization, international exchanges are increasingly frequent, which puts forward more stringent requirements for college students' comprehensive English ability. College English teaching not only requires students to master a solid language foundation, but also needs to focus on cultivating their critical thinking ability, so that in the context of cross-cultural communication, students can accurately express their views, rationally analyze various problems, and find effective solutions. As a key link in college English teaching, the audio-visual oral course has built a unique platform for cultivating students' critical thinking ability with the help of rich and diverse audio-visual resources and interactive teaching activities. So, how to fully tap the potential of this platform and effectively improve students' critical thinking ability has become an important issue for college English educators to think deeply and actively explore.

2. The significance of cultivating students' critical thinking ability in college English audio-visual and oral teaching

2.1. Meeting the needs of social development

In the current highly competitive social environment, employers' requirements for graduates' ability are increasing, and critical thinking ability has become one of the indispensable core competencies in the workplace. In the work scenario, whether analyzing market data, solving work problems, or participating in team discussions and decisions, you need to have the ability to think critically and analyze problems. For example, in the business field, employees need to analyze and judge market trends, competitors, and other information, and put forward reasonable business strategies; in the field of scientific research, researchers should critically consider the experimental data and previous research results, so as to promote scientific research innovation and development. After entering the workplace, students with critical thinking ability can quickly adapt to the working environment, use their knowledge and thinking methods to solve practical problems, and show stronger professional competitiveness ^[1].

2.2. Improving comprehensive language use ability

Cultivating critical thinking ability is conducive to students' more thorough understanding of language. In college English audio-visual oral classes, students are not exposed to isolated vocabulary and grammar, but to the language used in real scenes. Through the analysis, thinking, and discussion of audio-visual materials, students can understand the meaning and function of words and sentences in different situations from the purpose and intention of language use, rather than just the literal interpretation. Students with critical thinking ability will pay more attention to the organization of language in oral expression, and choose appropriate language strategies and expression methods according to different topics and communication objects. They will use critical thinking to sort out the views they want to express, avoid ambiguity and clutter, and make the language output more convincing. For example, in English speech or discussion, students can clearly state their own views and support them through reasonable arguments and the argumentation process, which is the specific presentation of the role of critical thinking ability in language expression ^[2].

2.3. Improving autonomous learning ability

Critical thinking ability is closely related to autonomous learning ability. In the teaching of the college English audio-visual oral course, cultivating students' critical thinking ability can stimulate their autonomous learning consciousness and enthusiasm. Students with critical thinking ability can use critical thinking to screen and evaluate the massive English learning resources, and select materials that match their learning goals and levels.

At the same time, critical thinking ability urges students to constantly reflect on their own learning methods and results in the learning process. They will actively think about their problems in listening comprehension and oral expression, and try to find solutions by analyzing the reasons. This ability of self-reflection and adjustment is the key element of autonomous learning. For example, if students find it difficult to understand some accents in listening, they will think about whether it is due to a lack of understanding of the local culture or a lack of targeted listening training, and then independently find relevant materials for intensive practice. Through this process of autonomous learning, students gradually get rid of excessive dependence on teachers and textbooks, form independent learning ability, and lay a solid foundation for lifelong learning ^[3].

2.4. Improving cultural comprehension and intercultural communication

College English audio-visual and oral materials are rich in diverse cultural content, involving customs, values,

social systems, etc., in different countries and regions. Cultivating students' critical thinking ability can guide them to examine this cultural information from a critical perspective and prevent blind acceptance or conflict. Students are no longer merely passive recipients of culture, but can actively analyze the deep causes behind different cultural phenomena and understand the root causes of cultural differences.

In cross-cultural communication, critical thinking ability is particularly important. When facing communication objects from different cultural backgrounds, students need to use critical thinking to understand the other party's thinking mode and behavioral habits, so as to prevent communication frustration caused by cultural misunderstanding. For example, when communicating with native English speakers, it is learned that they express their views more directly, while some people in the eastern cultural background are relatively euphemistic. Students with critical thinking ability can keenly perceive this difference, and flexibly adjust their own communication methods in communication, so as to achieve smoother and more efficient cross-cultural communication. This ability to understand and adapt to cultural differences can enable students to better interact and cooperate with people from different cultural backgrounds in a globalized environment ^[4].

3. Innovative strategies for cultivating students' critical thinking ability in college English audio-visual and oral teaching

3.1. Clarifying the teaching objectives and focusing on cultivating students' critical thinking ability

In the teaching of the college English audio-visual oral course, a clear and reasonable teaching goal is the cornerstone of cultivating students' critical thinking ability. Traditional audio-visual and oral teaching objectives focus on the teaching of language knowledge and the training of basic listening and speaking skills. However, in order to meet the needs of the development of the times for talents' critical thinking ability, teachers need to re-examine and adjust the teaching objectives, and emphasize the cultivation of critical thinking ability. Teachers should deeply study the syllabus and curriculum standards, combine the actual level and professional needs of students, and refine the training objectives of critical thinking ability. For example, for junior students, it can be set to cultivate their preliminary questioning and analysis ability by analyzing the views in simple audio-visual materials; for senior students, they are required to critically evaluate complex academic audio-visual content and put forward unique opinions. Only when the teaching objectives are clear and definite can teachers carry out teaching activities with a targeted aim, guide students to improve their English audio-visual and oral levels, at the same time, deeply exercise their critical thinking ability, and lay a solid foundation for their long-term development ^[5].

3.2. Optimizing the content of teaching materials and integrating speculative elements

Textbook compilers and teachers should optimize the content of textbooks and add materials that can stimulate students' speculation. On the one hand, choose audio-visual materials with depth and breadth, covering topics in different fields and cultures, such as scientific and technological development, social hot spots, cultural differences, etc. These topics can arouse students' interest and thinking, and provide rich materials for the cultivation of critical thinking ability. For example, audio-visual materials about the impact of artificial intelligence on the future society are added to the textbook to let students think about the opportunities and challenges brought by artificial intelligence. Teachers can also choose audio-visual materials that are both challenging and attractive according to students' actual level and acceptance ability. For example, when learning English listening, you can choose some movies or TV plays with vivid and interesting content and

moderate speaking speed, so that students can not only enjoy entertainment, but also improve their listening comprehension ability.

On the other hand, in the design of teaching exercises, in addition to the conventional listening comprehension and oral expression, the questions of analysis, evaluation, and discussion are added. Students are asked to express their opinions and explain the reasons, or put forward feasible solutions according to the materials. In practice, teachers can also appropriately expand and supplement the content of teaching materials according to the actual situation, and introduce more audio-visual materials close to real life, so as to enhance the speculative nature of teaching ^[6].

3.3. Using multiple teaching methods to stimulate speculative vitality

In college English audio-visual teaching, it is very important to introduce diversified teaching methods, which are helpful in cultivating students' critical thinking ability. Teachers can use the question guidance method to design enlightening hierarchical questions. For example, after playing the English video about global warming, first help students master the basic content with factual questions such as "What global warming phenomenon is mentioned in the video?"; Then use the analytical question "what are the factors leading to these global warming phenomena?" to encourage students to explore the root causes of the problem; Finally, through such evaluative questions as "what do you think of the effectiveness of the measures taken to deal with global warming in the video? What are the reasons?" students are encouraged to elaborate their views and evaluations, stimulate their speculative interest, and cultivate their multi-dimensional thinking ability with a deep chain of questions ^[7].

The group cooperative learning method can also create many opportunities for students to communicate and speculate. The teacher will divide the students into groups to discuss specific audio-visual themes. For example, after watching English history movies, the group members will jointly analyze the theme, characters, and plot of the movies. Members share their opinions, listen to others' opinions, and deepen their understanding of the film through mutual discussion and debate. They not only improve their oral expression, but also learn to think from the perspective of others, so as to exercise their critical thinking and teamwork abilities.

In addition, role simulation is also an effective means to cultivate students' critical thinking ability. In Business English teaching, after playing the business negotiation video, students can simulate the negotiation scene in groups, and use their knowledge to explain their positions and communicate and negotiate according to their roles. In this process, students think about how to express and respond effectively, and exercise their critical thinking and language application ability. After the simulation, teachers can organize students to summarize and reflect to further promote the development of students' critical thinking ability. These teaching methods cooperate with each other to help cultivate students' critical thinking ability ^[8].

3.4. Taking multiple measures to improve students' critical awareness and ability

First of all, teachers should guide students to develop the habit of active thinking and questioning. In class, students are encouraged to ask questions about the content of audio-visual materials without blindly following the book. For example, after watching the report of a social phenomenon, teachers can guide students to think about whether the report's view is comprehensive and biased, and cultivate students' critical thinking consciousness.

Secondly, consolidating students' basic language skills is the premise of improving their critical thinking ability. Teachers should strengthen the teaching of vocabulary, grammar, pronunciation, and other basic knowledge to improve students' listening comprehension and oral expression ability. Only by accurately

grasping the audio-visual content and being able to express their views smoothly can students better carry out speculation. For example, vocabulary development and grammar training help students enrich vocabulary and master the correct expression structure. At the same time, we should strengthen listening and speaking practice, enhance language input and output skills, and lay a solid foundation for the cultivation of critical thinking ability.

Extracurricular activities are equally important. Teachers can organize English debate contests, speech contests, reading clubs, etc., so that students can deepen their thinking and improve their critical thinking skills in preparation, discussion, and communication. For example, in the debate competition, students should study, demonstrate, and refute controversial topics, which is of great significance to the cultivation of critical thinking ability. It can be seen that the effective strategy to cultivate students' critical thinking ability is to stimulate students' thinking and inquiry motivation in an all-round way in and out of class^[9].

3.5. Improving critical thinking ability with the help of multiple evaluations

In the teaching of the college English audio-visual oral course, the traditional single evaluation method fails to comprehensively evaluate students' critical thinking ability. Therefore, it is extremely necessary to build a diversified evaluation system.

On the one hand, the evaluation subject should be diversified. We should not only rely on teachers' evaluation, but also integrate students' self-evaluation and mutual evaluation. In the student self-evaluation link, teachers guide them to review their performance in audio-visual and oral activities with reference to the set standard of critical thinking ability. For example, think about the depth and breadth of your thinking when analyzing the views of audio-visual materials, and whether the logic is clear when explaining your personal opinions. Students' mutual evaluation can promote mutual learning. In the process of evaluating others, students can examine the speculative process from different angles and broaden their own thinking mode.

On the other hand, we should expand the form of evaluation. In addition to routine tests, classroom performance evaluation should be added. Pay attention to the students' performance in group discussion, role-play, and other activities to see whether they can actively participate in the discussion, put forward valuable views, and effectively refute or support others' views, so as to consider their critical thinking ability through these aspects. It can also carry out project-based evaluation, arrange projects such as making English video reports, and comprehensively evaluate the students' application of critical thinking ability in practical tasks, from data collection, viewpoint sorting to final display.

At the same time, the evaluation content should also be meticulous. We should not only focus on language expression, but also on speculative performance, such as whether the views are innovative, whether the arguments are reasonable, and whether the thinking is sensitive. With the help of multiple evaluations, comprehensively and accurately present the development status of students' critical thinking ability, give timely feedback and comments, and help students continuously improve their critical thinking ability^[10].

4. Conclusion

Cultivating students' critical thinking ability in college English audio-visual and oral teaching is of great significance for improving students' comprehensive quality. As an important way to cultivate students' critical thinking ability, college English audio-visual and oral teaching needs to be systematically optimized and reformed from many aspects, such as clarifying teaching objectives, optimizing teaching materials, adopting

multiple teaching methods and evaluations, so as to enhance students' critical thinking, logical reasoning, and innovation consciousness, and realize students' all-round development.

Funding

A Study on the Teaching Reform of College English Audio-Visual Oral Course Oriented towards the Cultivation of Critical Thinking Ability (2501032339)

Disclosure statement

The author declares no conflict of interest.

References

- [1] Cai J, 2024, Cultivation of Students' Critical Thinking Ability in College English Teaching. *English Square*, (34): 109–112.
- [2] Gu J, 2024, Cultivation of Students' Critical Thinking Ability in College English Teaching from a Cross-Cultural Perspective. *Modern English*, (23): 76–78.
- [3] Guo J, 2024, Integrated Cultivation of Intercultural Competence and Critical Thinking Ability in College English Teaching—A Case Study of New Future College English Audio Visual and Oral Course 3A Workplace. *Taste Classics*, (17): 132–135.
- [4] Zhang P, 2024, Exploration of College Oral English Teaching Mode Based on the Cultivation of Critical Thinking Ability. *English Square*, (30): 66–69.
- [5] Yang J, 2022, Cultivation of Critical Thinking Ability in College English Listening Teaching. *Overseas English*, (22): 188–190.
- [6] Wang X, 2025, Research on College Oral English Teaching Based on the Cultivation of Students' Critical Thinking Ability. *Journal of Jiamusi Vocational College*, 41(01): 166–168.
- [7] Li L, 2023, Research on the Cultivation of College English Critical Thinking Ability under the Blended Teaching Mode. *Journal of Chifeng University (Chinese Philosophy and Social Sciences Edition)*, 44(04): 76–80.
- [8] Zhao S, 2024, Reform and Practice of College English Teaching Based on Critical Thinking Ability. *Journal of Jilin Institute of Agricultural Science and Technology*, 33(01): 89–91 + 105.
- [9] Du W, 2024, Exploration of College Oral English Teaching Practice under the Cultivation of Critical Thinking Ability. *Modern English*, (24): 7–9.
- [10] Zhang K, 2022, How to Improve Students' Critical Thinking Ability in College English Teaching. *Shanxi Youth*, (05): 144–146.

Publisher's note

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

Logic and Practice of Ideological and Political Thinking in Advanced Mathematics Courses

Yaxian Hao*, Keyan Liu

School of Mathematics and Computer Science, Shanxi Normal University, Taiyuan 030000, Shanxi, China

**Author to whom correspondence should be addressed.*

Copyright: © 2025 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 a fundamental course in science and engineering education at universities, advanced mathematics plays an irreplaceable role in cultivating students' logical thinking, scientific spirit, and comprehensive qualities. Integrating ideological and political education into advanced mathematics teaching is not only an inevitable requirement for achieving the goal of "three-dimensional and holistic education" but also a crucial path for promoting students' comprehensive development. This article delves into the necessary logic, practical possibilities, and real-world challenges of ideological and political education in advanced mathematics courses, systematically analyzing the implementation pathways and illustrating practical approaches through specific cases. Meanwhile, to address issues such as insufficient teacher capability, lagging resource development, disconnected instructional design, and inadequate evaluation mechanisms encountered during implementation, this article proposes practical improvement strategies. It aims to provide theoretical insights and practical guidance for the further advancement of ideological and political education in advanced mathematics courses.

Keywords: Advanced mathematics; Curriculum ideology and politics; Logical framework; Practical pathways

Online publication: June 30, 2025

1. The proper logic of ideology and politics in advanced mathematics courses

As an important part of the national educational modernization strategy, the ideological and political construction of the advanced mathematics curriculum not only embodies the theoretical value of educational reform, but also shows its practical significance in the goal of all-round education in the new era. Through the implementation of ideological and political curriculum, advanced mathematics can guide students to establish correct values and cultivate noble moral qualities while imparting subject knowledge, and become an important link in cultivating talents with both ability and political integrity in the new era.

1.1. Policy orientation: An inevitable requirement of national strategy

The report of the 19th National Congress of the Communist Party of China clearly pointed out that it is

necessary to “fully implement the party’s educational policy and implement the fundamental task of establishing integrity and cultivating people,” emphasizing that curriculum construction must be closely integrated with ideological education to achieve the “three all-round” education goals of all-stuff, all-process and all-round education ^[1]. As an important policy document for the ideological and political construction of curriculum, the “Guidelines for the Construction of Ideological and Political Education in College Courses” further clarifies the positioning and tasks of ideological and political curriculum, and requires all kinds of courses to consciously undertake the function of ideological and political education in the process of knowledge transmission, forming a synergistic effect of whole-curriculum education. As the core basic course of science and engineering teaching in colleges and universities, advanced mathematics should explore the ideological and political educational elements contained in it and integrate the core socialist values into the teaching of mathematical thoughts because of its subject characteristics and universal applicability. For example, the logical derivation and theoretical proof processes of mathematics can not only reflect the scientific spirit, but also cultivate students’ attitude of pursuing truth and respecting facts. Through the teaching of classical problems in mathematics and demonstrating the important role of mathematics in the development of the national economy, national defense science and technology, and society, it can inspire students’ patriotic feelings and sense of mission. This value guidance of “moistening things silently” is an important way to realize the national education modernization strategy.

1.2. Curriculum attributes: The inherent requirements of subject characteristics

As a highly logical and theoretical discipline, advanced mathematics has the characteristics of strong logic, a complete system, and wide application. It not only provides theoretical support for students to learn other subjects, but also has unique advantages in cultivating thinking ability and scientific literacy ^[2].

Through rigorous logical reasoning and a meticulous argumentation process, it helps students form a rigorous academic attitude and the spirit of exploring truth. For example, when teaching mathematical induction, teachers can emphasize the importance of strictly following step-by-step derivation, which is not only the embodiment of a rigorous attitude in academic research but also the shaping of a scientific spirit of being responsible for facts and pursuing truth. Many problems require students to analyze them from multiple dimensions, emphasizing the dialectical nature of problem solving. Through this process, students are able to gradually develop critical thinking and complex problem-solving abilities. The research and application of some problems often require team cooperation. Through model construction and practical teaching in advanced mathematics, students can understand the power of collective wisdom in cooperation and cultivate their cooperation consciousness and communication ability. This discipline characteristic is highly consistent with the educational goal of curriculum ideological and political education.

1.3. Social demand: The practical appeal for cultivating well-rounded talents

With the increasing demand for high-quality comprehensive talents in the new era society, advanced mathematics courses should not only impart subject knowledge, but also pay attention to the cultivation of students’ humanistic qualities and social responsibility. This practical demand provides the impetus for the implementation of ideological and political aspects in the advanced mathematics curriculum ^[3]. The application of advanced mathematics in national scientific and technological progress, economic construction, and social governance is ubiquitous. For example, high-tech fields such as artificial intelligence, big data analysis, and blockchain technology are all inseparable from the support of mathematics. By integrating these application

cases into teaching, advanced mathematics courses can make students realize the importance of mathematics to national development and inspire their spirit of serving the country through science and technology. Advanced mathematics course not only helps students master professional knowledge, but also improves their logical thinking abilities and innovative consciousness. These abilities are crucial for cultivating all-round talents with an international vision, innovative spirit, and social responsibility. For example, by discussing the role of mathematical modeling in traffic management, students can realize the importance of mathematical thinking for complex system optimization, and enhance their practical application ability and professional quality.

The ideological and political construction of advanced mathematics courses closely follows the national requirements, the characteristics of discipline development, and the needs of social reality, and closely integrates discipline education with ideological and political education, which not only provides students with solid professional knowledge but also cultivates their correct values and social responsibility. By deeply digging into the ideological and political elements of mathematics curriculum, their unique role in comprehensive education can be fully leveraged, contributing to the realization of educational reform and talent cultivation goals in the new era.

2. The real possibility of ideological and political education in advanced mathematics courses

The realization of ideological and political education in advanced mathematics curriculum needs to be deeply explored from three aspects: the excavation of curriculum content, the innovation of teaching methods, and the optimization of teaching objectives.

2.1. Excavation and integration of course content

The content of the advanced mathematics curriculum contains rich ideological and political educational resources. Through appropriate excavation and integration, these resources can realize the organic combination of knowledge transmission and value guidance.

2.1.1. Combination of advanced mathematical thought and philosophical education

Logical thinking and dialectics: For example, by explaining the concept of sequence limit, students can be guided to understand the “gradualness” and “leap” in the development of things, helping them understand the dialectical relationship in the change of things. This kind of thinking is helpful to cultivate students’ dialectical thinking ability and enhance their ability to analyze and solve complex problems ^[4].

Infinity and scientific spirit: The concept of infinity and the thought of limits can be used to illustrate that the process of scientific exploration is endless, emphasizing the unceasing exploration spirit of scientists in the unknown world. For example, when discussing “ $1/2 + 1/4 + 1/8 + \dots = 1$,” students can realize that infinitesimal things may also have a huge impact on the whole, extending to the relationship between individual contribution and collective development.

2.1.2. Combination of advanced mathematics cases and national sentiment

Enlightenment of historical figures: In teaching, we can introduce the scientific research process of Chinese mathematicians such as Hua Luogeng, Chen Jingrun, and others. For example, Chen Jingrun’s achievement of overcoming some problems of Goldbach’s conjecture under the condition of scarce resources can not only inspire students to cultivate an innovative spirit, but also enhance their sense of pride in the development of

mathematics in China ^[5].

Practical applications and national rejuvenation: The wide application of mathematics in the field of science and technology can also serve as material for the ideological and political education curriculum. For example, by explaining the application of differential equations in spacecraft trajectory design, combined with the successful case of China's "Chang'e Project," students are guided to realize the key role of mathematics in the development of national science and technology, thereby enhancing their sense of mission.

2.1.3. Combination of cultural self-confidence and mathematical content

Traditional Chinese Mathematical Wisdom: Introducing ancient Chinese mathematical achievements, such as the contents of "The Nine Chapters on the Mathematical Art," can help students understand the unique contribution of the Chinese nation to the development of mathematics and enhance their cultural self-confidence. For example, when discussing the early application of the "Pythagorean Theorem" in "The Nine Chapters on the Mathematical Art," it can be combined with the derivation process of modern analytic geometry, so that students can realize the internal relationship between ancient wisdom and modern mathematical theories.

2.2. Innovation and optimization of teaching methods

Ideological and political curriculum involves not only the increase of content, but also the effective delivery of content to students through the innovation of teaching methods.

2.2.1. Situational teaching: Integrating theory into practical scenarios

Design real problem situations in the classroom and apply mathematical knowledge to practical problems. For example: Mathematical model in the epidemic situation: Taking the COVID-19 pandemic as the background, design a teaching case that uses an exponential function to predict changes in the number of confirmed cases. In the process of explanation, we can combine anti-epidemic stories to guide students to understand the importance of scientific research and their sense of social responsibility.

Mathematics and ecological conservation: When teaching the "extreme value problem" in calculus, in the context of protecting the biodiversity of a nature reserve, design the problem: How to allocate limited resources to maximize the protection of endangered species? Guide students to solve practical problems with mathematical methods, while thinking about the importance of protecting the ecological environment.

2.2.2. Multimedia teaching: Enhancing immersion with technology

Demonstrate practical applications of abstract mathematical concepts using virtual reality (VR) techniques. For example, when explaining curve length in calculus, use mathematical modeling software ^[6] to show the approximate length calculation of the Great Wall, which enhances students' sensory experience and makes them intuitively understand the practical significance of mathematics.

2.2.3. Problem-oriented teaching: Promoting teamwork and independent thinking

The problem-oriented teaching method (PBL) is used to allow students to design mathematical models around social issues. For example, the topic of "Optimization of Public Transport in a City" is put forward, and students are asked to model and calculate the optimal distribution location of bus stops in groups. This way can not only improve students' ability to solve problems, but also guide them to pay attention to social issues.

2.3. Diversified expansion of teaching objectives

Advanced mathematics curriculum should be expanded from knowledge imparting to ability cultivation and value guidance, so as to achieve the goal of students' all-round development.

2.3.1. From rigorous scholarship to value guidance

Rigorous academic attitude: The reasoning process of advanced mathematics emphasizes logic and standardization, and cultivates students' rigorous academic attitude through strict proof procedures. For example, when explaining mathematical induction, we can emphasize the importance of "one mistake and the whole is wrong," and guide students to pay attention to details and processes in their study and work. **Values guidance:** Through the explanation of the history of mathematics, students realize that scientific research needs not only intellectual support, but also morality and perseverance. For example, introducing Hua Luogeng's persistence in research during the War of Resistance Against Japanese Aggression can illustrate the importance of the power of science to the country and the people.

2.3.2. From professional ability to social responsibility

Social responsibility: By explaining the "multi-objective optimization" problem in optimization theory, students are guided to consider the balance of multiple interests when solving practical problems. For example, designing an optimization case that includes environmental protection and economic development can help students recognize the role of mathematics in sustainable development. **Awareness of innovation:** Through the discussion of open-ended questions, students are encouraged to explore the application of mathematical theory in new fields. For example, let students try to discuss big data versus mathematical modeling methods in machine learning.

3. Practical challenges of ideological and political education in advanced mathematics courses

Although ideological and political education in advanced mathematics curriculum has become an important direction of educational reform, it still faces many challenges in theoretical exploration and practical implementation, mainly reflected in teachers' quality, teaching resources, curriculum design, and evaluation mechanisms.

3.1. Insufficient quality of teaching staff

Advanced mathematics teachers pay more attention to knowledge transfer and ability cultivation in traditional teaching, but have insufficient understanding of the connotation and goals of curriculum ideological and political education, which leads to obvious obstacles in the promotion of curriculum ideological and political education.

3.1.1. Lack of ideological and political awareness of the curriculum

Some teachers think that advanced mathematics is a highly logical and formal subject, which is difficult to combine with ideological and political education. They tend to separate mathematics from "values," and even worry that integrating ideological and political curriculum into mathematics teaching will weaken the rigor of professional teaching. This kind of perception limits the expansion path of curriculum ideology and politics, which makes it difficult for teaching content to go beyond knowledge itself and to tap the potential of

curriculum ideology and politics.

3.1.2. Low ideological and political education abilities

Most mathematics teachers lack the professional background of ideological and political education, and lack methods on how to organically integrate ideological and political elements into the classroom. For example, when teaching mathematical theories, even if they quote historical stories or social application cases, they often remain at the level of simple knowledge supplementation and fail to dig deep into their educational value. For example, when explaining the application of calculus, teachers mention Einstein's theory of relativity, but do not further elaborate on the important role of mathematics in promoting the boundary of human cognition, which leads to students' superficial understanding of curriculum ideology and politics.

3.2. Insufficient construction of teaching resources

The construction of ideological and political education resources in advanced mathematics curriculum lags behind other disciplines, and the existing resources are difficult to meet the classroom needs, which becomes a restrictive factor of ideological and political practice in the curriculum.

3.2.1. Lack of systematic ideological and political education case resources

At present, the case development of ideological and political in advanced mathematics curriculum mainly depends on teachers' personal efforts, lacking systematicity, authority, and sharing. For example, the resources of mathematical thoughts, historical events, practical applications, etc., have not yet formed a unified case base, and it is difficult for teachers to find specific materials that meet the curriculum objectives. The lack of case resources directly leads to teachers' inability to integrate profound ideological and political elements into the curriculum, and the curriculum thinking is fragmented, making it difficult to form a systematic value guidance.

3.2.2. Outdated textbook content

Most advanced mathematics textbooks still focus on the traditional knowledge system and fail to fully integrate the content of ideological education. For example, textbooks rarely mention the achievements of Chinese mathematicians in the field of international mathematics, and it is difficult for students to feel the important role of mathematics in national development from the textbooks. Taking the "Advanced Mathematics" textbook as an example, the contributions of Western mathematicians such as Newton and Leibniz are generally the main topics, and the introduction of Chinese traditional mathematics and its modern achievements is ignored, which weakens the patriotic education of the curriculum to some extent.

3.3. Disconnect between curriculum design and implementation

The design and implementation of ideological and political education in advanced mathematics courses have not been able to realize the effective connection between theory and practice, which is manifested as formal and superficial problems.

3.3.1. Disconnection between content and ideological and political goals

Some ideological and political practices in courses pay too much attention to theoretical logic and ignore students' actual acceptance ability. For example, some teachers simply link mathematical formulas with patriotic feelings, but fail to organically link them through in-depth analysis. This disconnection makes the ideological and political education curriculum formal and empty, and it is difficult for students to really resonate. The

content of the course lacks internal logic and vividness, which leads to the ineffective realization of ideological and political goals, and students have a low acceptance of ideological and political education in the course.

3.3.2. Mismatch between teaching methods and the characteristics of the mathematics subject

In the course of ideological and political implementation in advanced mathematics curriculum, some teachers still use the traditional teaching method, ignoring the interaction and participation of students^[2]. For example, when teachers explain mathematical models, they pay more attention to the calculation results instead of guiding students to discuss the social significance behind the models. For example, the teacher conducted a course on the theme of “Calculus and Ecological Protection,” but the whole course was mainly taught by the teacher. Students were only required to follow the teacher’s calculation steps, and failed to feel the actual value of mathematics in ecological protection through practical experience.

3.4. Imperfect evaluation mechanisms

The evaluation of the ideological and political education effect of the curriculum is an important link to promote its implementation, but the current evaluation mechanism of the advanced mathematics curriculum has the following shortcomings.

3.4.1. Single evaluation content

At present, the evaluation of advanced mathematics courses is still centered on knowledge and ability, and there is a lack of comprehensive evaluation of the improvement of students’ ideological and political qualities. For example, course assessment usually focuses on problem-solving abilities and calculation skills, while ignoring the growth of students’ sense of responsibility and social commitment. The unity of evaluation content makes teachers and students pay more attention to knowledge acquisition, weakening the importance of ideological and political education, and making it difficult to stimulate students to pay attention to ideological and political education in the curriculum.

3.4.2. Lack of scientificity in evaluation methods

The existing evaluation methods often stay in the qualitative evaluation stage, lacking quantitative indicators. For example, there are no clear standards on how to measure the change of students’ values and the improvement of social responsibility, which leads to the fact that the evaluation results cannot truly reflect the implementation effect of curriculum ideological and political education in the course. For example, teachers try to evaluate the ideological and political effect of courses through classroom feedback questionnaires, but the questionnaire questions are too general, such as “Do you feel that there is ideological and political education content in the course?” which leads to students’ superficial answers and unable to provide substantive reference.

4. Conclusion

The construction of ideological and political education in the advanced mathematics curriculum is the concretization and practical application of curriculum ideological and political ideas in science and engineering teaching. By excavating curriculum content, innovating teaching methods, and optimizing evaluation systems, advanced mathematics curriculum can realize value guidance while imparting knowledge, and make contributions to cultivating innovative talents with all-round development in the new era. The realistic challenges of ideological and political education in advanced mathematics curriculum show that in order to

achieve the ideological and political goal of the curriculum, it is necessary to systematically promote it from the aspects of teacher training, resource construction, optimization of teaching methods, and improvement of evaluation mechanisms. Overcoming these challenges will help fully leverage the educational function of curriculum ideology and politics and provide strong support for talent cultivation in the new era.

Disclosure statement

The authors declare no conflict of interest.

References

- [1] People's Daily Online, 2016, Xi Jinping Emphasized at the National Conference on Ideological Work in Colleges and Universities: Incorporate Ideological Work Throughout the Entire Process of Education and Teaching, and Create a New Situation in the Development of Higher Education in My Country, viewed September 15, 2022, <http://politics.people.com.cn/gb/n1/2016/1209/c1001-28936072.html>
- [2] Li D, 2023, Exploration of Ideological and Political Construction in Higher Mathematics Curriculum. *Teaching Reference of Politics in Middle Schools*, (34): 92–93.
- [3] Zhang P, 2023, Mining Strategies of Ideological and Political Elements in Advanced Mathematics Teaching. *Theory and Practice of Education*, 43(18): 48–50.
- [4] Yang B, 2024, Research on Teaching Reform and Practice of Higher Mathematics Curriculum under the Background of Ideological and Political Curriculum. *Journal of Jiamusi Vocational College*, 40(11): 119–121.
- [5] You H, 2024, Research and Exploration on the Ideological and Political Construction of “Advanced Mathematics” Course Integrated into the History of Mathematics. *Education Teaching Forum*, (18): 149–152.
- [6] Pan W, 2024, Exploration of Ideological and Political Construction and Teaching Reform of “Advanced Mathematics” Course under the Background of “Innovation-Driven.” *Journal of Mudanjiang University*, 33(10): 73–78.

Publisher's note

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

Research and Practice of Higher Vocational English Courses Based on Core Competencies

Xiaofang Tian*

Department of Basic Courses, Tianjin Vocational Institute, Tianjin 300410, China

**Author to whom correspondence should be addressed.*

Copyright: © 2025 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 investigates and explores the teaching of higher vocational English courses for non-English majors from the perspective of core competencies. First, it outlines the current research status of core competencies and analyzes the national-level requirements for English core competencies. Subsequently, based on professional training objectives and curriculum standards, a questionnaire on the core competencies of English courses has been designed to understand students' perceptions and experiences regarding the development of their competencies in areas such as workplace communication, cross-cultural exchange, language thinking enhancement, and autonomous learning improvement. The survey results showed that the majority of students had a positive attitude towards the effectiveness of English courses in cultivating the aforementioned core competencies. However, some students also suggest improvements, such as increasing practical opportunities and strengthening cultural exchange. Based on this, the study further explores how to integrate the cultivation of core competencies into classroom teaching, including the use of a combination of formative and summative assessments, the design of teaching content and activities related to the workplace and cross-cultural communication, and the guidance of students to actively explore and apply their knowledge, thereby enhancing their English language application abilities. This study has certain reference value for the optimization of the higher vocational English curriculum system and the reform of teaching methods.

Keywords: Core competencies; Vocational English courses; Research and practice

Online publication: June 30, 2025

1. Overview of core competency research

Since the beginning of the 21st century, “core competencies” have received increasing attention within the field of education. Core competencies are the comprehensive embodiment of students' knowledge, skills, emotions, attitudes, and values. They represent the essential qualities needed by every student to achieve a successful life, adapt to lifelong personal development, and meet the needs of society ^[1]. In recent years, assessment based on core competencies has become an important trend in education ^[2]. The fundamental purpose of research into core competencies is to fully implement the Party's educational policies, practice socialist core values, and

fulfill the fundamental task of fostering virtue through education. The English Curriculum Standards for Higher Vocational Education (2021 Edition) clearly states that the core competencies for vocational English focus on four main aspects: workplace-related foreign communication, intercultural communication, the enhancement of linguistic thinking, and the development of autonomous learning.

The Overall Plan for Deepening Educational Evaluation Reform in the New Era clearly states the need to promote the fundamental task of fostering virtue through education, reform student evaluation, and encourage the all-round development of students in morality, intelligence, physique, aesthetics, and labor. The English Curriculum Standards for Higher Vocational Education (2021 Edition) also points out that learning assessments should be based on core subject competencies, aiming to establish a scientific teaching evaluation system and fully leverage the multiple functions of educational assessment. The release of these documents clearly signals that reform in evaluation is imperative, emphasizing a shift from single-dimensional knowledge assessment to comprehensive competency evaluation, and focusing on students' growth and progress across different fields to meet the needs of education development in the new era.

Especially with the rapid development of information technology, students' learning modes have undergone dramatic changes, and the integration of online and offline learning has become the norm. These changes not only alter the ways in which students acquire knowledge but also pose new challenges to teaching methods and evaluation systems. Therefore, it is necessary to adapt to the characteristics and changing learning modes of students, integrate elements of core competencies into teaching and evaluation systems, better align with new trends in educational development, and cultivate highly qualified talents capable of meeting future social demands.

2. Survey on core competencies in the English curriculum

Based on the professional talent training program and the English Curriculum Standards for Higher Vocational Education (2021 Edition) issued by the Ministry of Education, and relying on the “14th Five-Year” national planning vocational education textbooks—Advanced International English Audio-Visual Speaking Course for Vocational Colleges, Practical Comprehensive Course (Third Edition), —a self-compiled questionnaire was designed considering students' professional needs. There are 12 questions in this questionnaire. This questionnaire aimed to investigate participants' perceptions and experiences regarding the role of the English curriculum in workplace-related foreign communication, intercultural communication, enhancement of language thinking, and improvement of autonomous learning. The participants were students of Grade One from a higher vocational college, with approximately 300 non-English major students taking part in the survey. We collect and analyze the data via Sojump, an online survey platform (Wenjuanxing). The questionnaire uses a 5-point Likert scale, where 1 represents “strongly disagree” and 5 represents “strongly agree.”

According to the survey results, we summarize and analyze the effectiveness of the English curriculum in terms of workplace foreign communication, intercultural communication, language thinking enhancement, and autonomous learning improvement (**Tables 1 to 4**).

2.1. Workplace foreign communication

Table 1. Workplace foreign communication questions

Questions	1	2	3	4	5
1. Do you think the current English courses help you understand and express English information in workplace situations?	37.14%	45.71%	16.19%	0.95%	0
2. What is your level of satisfaction with the oral and written communication exercises in your English courses?	39.05%	46.19%	13.33%	0.95%	0.48%
3. Are there enough simulated workplace communication activities (such as role-plays and workplace case analyses) in your courses?	30%	38.57%	26.67%	2.86%	1.90%

Question 1 shows that participants generally find that English courses are quite helpful for workplace intercultural communication. For example, 37.14% of respondents believe the English courses are “very helpful,” 45.71% think they are “quite helpful.”

Question 2 shows that most students are satisfied with the oral and written communication practice provided in English courses. Specifically, 39.05% of students stated they are “very satisfied,” 46.19% are “quite satisfied,” and 13.33% feel “neutral.” Only a small number of students are dissatisfied or very dissatisfied with the practice.

Question 3 shows that over 68% of the respondents believe the course provides enough simulated workplace communication activities. Among them, 38.57% think there are “quite a lot,” and 30% consider them “sufficient.” Only 2.86% think there are “few,” and 1.9% believe there are “none.”

2.2. Intercultural communication

Table 2. Intercultural communication questions

Questions	1	2	3	4	5
4. Do you think the English courses have helped you enhance your understanding and respect for world multiculturalism?	40.95%	43.33%	15.71%	0	0
5. Have you learned intercultural communication skills in the course?	36.67%	49.52%	13.81%	0	0
6. Do you think the course contains enough content on the dissemination of Chinese culture?	41.43%	49.05%	9.05%	0.48%	0

Question 4 shows that 40.95% believe the courses are “very helpful,” and 43.33% think they are “quite helpful,” making a total of 84.28% who have a positive view of the courses’ effectiveness in this regard. This reflects that English courses contribute to improving understanding and respect for world multiculturalism.

Question 5 shows that among the students, 49.52% say they learned “some,” and 36.67% say they learned “a lot.” Another 13.81% feel they learned an “average” amount, and no one reported having learned “very little” or “nothing at all.” Overall, most participants hold a positive view of the effectiveness of learning intercultural communication skills in the course.

Question 6 shows that most people believe the course contains enough content related to the dissemination of Chinese culture. Specifically, 41.43% think the course “fully” includes Chinese culture dissemination, 49.05% think it is “comparatively included,” and 9.05% think it is included “to an average extent.” Only 0.48%

think it is “rarely included,” and no one thinks it is “not included at all.”

2.3. Language thinking enhancement

Table 3. Language thinking enhancement questions

Questions	1	2	3	4	5
7. Do you think the English courses have improved your ability to discern and understand the ways of thinking of English speakers?	37.62%	45.24%	16.19%	0.95%	0
8. Has learning English in the course enhanced your logical thinking, critical thinking, and creative thinking skills?	39.05%	40.95%	18.57%	1.43%	0
9. Do you have opportunities for in-depth discussions and reflective activities in class?	29.52%	44.29%	24.76%	1.43%	0

Question 7 shows that 37.62% believe the courses have “greatly improved” this ability, 45.24% believe they have “improved it to some extent,” and 16.19% consider the improvement “average.” Only 0.95% think the courses have “barely improved” this ability, and no one chose “not improved at all.” Overall, most respondents believe that English courses have enhanced their ability to discern and understand the ways of thinking of English speakers.

Question 8 shows that the vast majority of students believe that learning English in the course has strengthened their logical, critical, and creative thinking abilities. Specifically, 82 students (39.05%) think their abilities have been “greatly enhanced,” 86 students (40.95%) think they have been “somewhat enhanced,” and 39 students (18.57%) think the enhancement is “average.” Only a few students, 3 (1.43%), feel the enhancement is “slight,” and no one thinks there has been “no enhancement at all.”

Question 9 shows that the proportion of students who have opportunities for in-depth discussion and reflective activities in class is 29.52% (“very often”), 44.29% (“quite often”), and 24.76% (“average”). Only 1.43% reported “rarely” having such opportunities, and no one selected “never.” Overall, more than 70% of students indicated they have opportunities for in-depth discussion and reflective activities in class, with the largest proportion indicating “quite often.”

2.4. Autonomous learning improvement

Table 4. Autonomous learning improvement questions

Questions	1	2	3	4	5
10. Do you think the English courses have helped you develop good habits of autonomous learning?	34.29%	49.05%	15.24%	0.95%	0.48%
11. In the course, are you able to obtain diverse learning resources and support?	38.57%	46.19%	14.76%	0.48%	0
12. Do you think the course has helped you develop the awareness and ability for lifelong learning?	37.14%	44.76%	17.62%	0.48%	0

Question 10 shows that more than 80% of respondents believe that the English courses have, to some extent, helped them develop good autonomous learning habits. Specifically, 34.29% think the courses have “greatly helped,” 49.05% think they have “helped to some extent,” and 15.24% think the effect is “average.”

Only a very small number believe the courses have “barely helped” or “not helped at all.”

Question 11 shows that the majority of people (38.57%) are fully able to obtain diverse learning resources and support during the course, and nearly half (46.19%) say they are “quite able” to access such resources and support. Only a small proportion (14.76%) feel they are “average” in this regard. Very few (0.48%) say they can “barely” obtain diverse learning resources and support, and no one says they are “not able to obtain them at all.”

Question 12 shows that more than 80% of respondents believe the course has helped them develop the awareness and ability for lifelong learning. Specifically, 37.14% think the course is “very helpful,” 44.76% think it is “quite helpful,” and 17.62% believe it is “generally helpful.” Only 0.48% believe it is “not very helpful,” and no one thinks it is “not helpful at all.”

In summary, most students affirm the effectiveness of the English curriculum in workplace foreign communication, intercultural communication, language thinking enhancement, and autonomous learning improvement. However, some students have put forward suggestions for improvement, such as increasing practical opportunities and strengthening intercultural content. These suggestions will help further enhance the quality of the vocational English courses and better meet students’ needs in the workplace and intercultural communication.

3. Implementation of core competencies in English classroom teaching

Based on the questionnaire survey and considering students’ actual situations, core competencies have been integrated into classroom instruction. In the classroom, a combination of formative and summative assessments is primarily used, which respectively account for 60% and 40%.

Formative assessment can help improve students’ learning performance ^[3]. Formative assessment is often administered during instruction to answer questions such as “What are the strengths and weaknesses of students’ understanding of the course content?”, “How should I (as an instructor) adapt the lesson to make it more beneficial to students?” and “Is there any student who is falling behind in the class?” ^[4]. Especially as an assessment method capable of evaluating and developing a range of complex cognitive and non-cognitive abilities—such as problem-solving, communication and collaboration, critical thinking, and creativity—performance-based assessment aligns more closely with the intrinsic rationale of core competency development ^[5].

Formative assessment is carried out based on students’ performance before class (such as independent preview of vocabulary and texts according to task sheets assigned by teachers), during class (group discussions and practice of key points guided by the teacher, as well as group output tasks like oral presentations and written exercises), and after class (review, consolidation, and extended learning activities, such as uploading and displaying class notes on the Rain Classroom platform, or reviewing vocabulary on the Word Master platform).

Summative assessment is adopted at the end of the semester, mainly in the form of a closed-book examination.

Take intensive reading classes as an example: Before class, students preview workplace-related vocabulary and expressions, helping them accumulate English knowledge for professional scenarios and laying the groundwork for future workplace communication. In class, by reading the text, students compare differences between Chinese and Western cultures, cultivating their cross-cultural understanding and global perspective. During class, teachers analyze the language structures and expressions in the text, and students complete written expression tasks in groups to enhance their language thinking skills. After class, students complete self-directed preview tasks, which help them develop learning planning and self-management abilities. Formative assessment

is integrated in “before class, in class, after class.”

Classroom implementation details:

Learning materials:

Shanghai Foreign Language Education Press “14th Five-Year” National Planning Textbook for Vocational Education, Practical Comprehensive Course 3, Unit 4 “The Business World,” reading passage “A Smart Move or an Error?—The Story of New Coke.”

Teaching theme:

Market Strategies and Their Impact in the Business World

Teaching objectives:

- (1) Mastering key vocabulary and expressions: Students can accurately understand and use key vocabulary related to the text (such as marketing, advertising, classic product, consumer response, etc.).
- (2) Analyzing key events and causes: Students can sequence key events mentioned in the text in chronological order; discuss and analyze the background and reasons for Coca-Cola’s launch of a new formula, as well as the consumer response it generated.
- (3) Applying classroom knowledge in simulated scenarios: Students can play different roles in simulation activities, propose and present strategies to address consumer dissatisfaction, and use focus vocabulary and sentence structures from the text to express themselves in English.
- (4) Enhancing cross-cultural promotional awareness and skills: Students can use what they have learned to create an English PPT for promoting a product with Chinese characteristics to overseas markets.

[Pre-class activity]

Preview core vocabulary: Complete vocabulary study and testing tasks on the Word Master platform, such as marketing, advertising, classic product, consumer response, etc.

[In-class activities]

Activity 1: Context introduction

The teacher briefly introduces the brand history and market position of Coca-Cola and Pepsi, and shows video materials.

Activity 2: Text learning and discussion

Initial understanding: Exercise on sequencing the key events in the text.

Language knowledge learning and practice: Learn the key English expressions in the text and complete related exercises on the Rain Classroom platform; establish a vocabulary bank, summarizing the text’s theme-related vocabulary and collecting additional related vocabulary.

In-depth analysis and discussion: Carefully read the text in sections, engage in group discussions to answer questions in English, such as the background and reasons for the new formula launch, the consumer response to the new formula, and the measures the company ultimately took.

Activity 3: Scenario simulation

Students are divided into groups to role-play different characters, such as Coca-Cola’s department managers (e.g., marketing, public relations, sales), market analysts, and consumer representatives. They simulate a meeting and present strategies to address consumer dissatisfaction. Based on the text content, they use the key vocabulary and sentence structures from the vocabulary bank. Each group writes an outline of their strategies and delivers a 5-minute presentation to the class, explaining their solutions in English. Under the teacher’s guidance, students use a presentation evaluation form to provide peer feedback. The teacher offers comments and shares workplace communication skills, such as polite expression strategies (“We appreciate the

feedback...” etc.).

Summary:

The teacher summarizes the lesson and assigns post-class tasks.

[Post-class activities]

Activity 1: Language knowledge test:

Use Rain Classroom to complete the review and testing of the text’s key language knowledge.

Activity 2: Cross-cultural extension task:

Applying knowledge learned in class, students select a Chinese characteristic product (such as Wang Laoji herbal tea, BYD automobiles, etc.) and an overseas market (such as the US, Japan, South Africa, etc.), and create an English PPT to promote the product to potential customers in that market.

After two semesters of study in the first year, among the four small classes, each with 34 students, a total of 27 students successfully passed the College English Test Band 4 (CET-4). This is the students’ best level ever.

4. Conclusion

This paper shows research and practice based on core competencies. From the questionnaire survey, we can see that it is necessary to integrate the core competencies into the higher vocational English course. By the implementation of core competencies in English classroom teaching, it is very effective in enhancing the effects of classroom teaching. Through the research and practice of this paper, we can see that the majority of students believe that the integration of core competencies has to some extent helped them improve their English performance, expand their knowledge of Chinese and Western cultures, enhance their autonomous learning abilities, and provide support for their future career development, thus improving their English language application skills. Some students have achieved good results in the Word Master vocabulary competition, English writing competition, or oral English competition. This not only strengthens their confidence in English learning but also inspires them to be more active and proactive in further improving their English proficiency. As a result, they have become more actively engaged in exploring and applying the knowledge they have learned, further enhancing their English language application abilities.

Funding

The General Subject of the 2023 Vocational College Foreign Language Education Reform Special Project of the Foreign Language Education Committee, China Vocational and Technical Education Association “Research and Practice on the Reform of the Evaluation System for Public English Teaching in Higher Vocational Education from the Perspective of Core Competencies” (WYW2023A29)

Disclosure statement

The author declares no conflict of interest.

References

- [1] Lin C, 2016, Core Competencies for Student Development: What Kind of People Should be Cultivated for the Future? China Education Journal, 6.

- [2] Wang Y, et al., 2023, A Study on the Design of Core Competency Performance-Based Assessment in Academic English Reading Based on Multi-Agent and Hybrid Retrieval. *Journal of Modern Educational Technology*, 29(3): 75–82.
- [3] Morris R, Perry T, Wardle L, 2021, Formative Assessment and Feedback for Learning in Higher Education: A Systematic Review. *Review of Education*, 9(3): 3292. <https://doi.org/10.1002/rev3.3292>
- [4] Bulut O, Gorgun G, Yildirim-Erbasli SN, et al., 2023, Standing on the Shoulders of Giants: Online Formative Assessments as the Foundation for Predictive Learning Analytics Models. *British Journal of Educational Technology*, 54(1): 19–39. <https://doi.org/10.1111/bjet.13276>
- [5] Fei N, Zhang Q, 2023, Value Orientation and Practical Approach of Performance-Based Assessment in Competency-Oriented Classroom Teaching. *Journal of Educational Studies*, 19(4): 112–120.

Publisher's note

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

Exploration of Teaching Reform in Unmanned System Courses Based on the OBE Concept

Hongfei Yu*, Yuming Wang, Bo Li

Dalian Naval Academy, Dalian 116013, Liaoning, China

**Author to whom correspondence should be addressed.*

Copyright: © 2025 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 response to the problems existing in the teaching of unmanned systems courses, such as being confined to traditional teaching models and insufficient focus on practical application, this paper proposes to guide the teaching with the OBE concept, carry out the teaching goal planning of unmanned systems application based on the OBE concept, innovate teaching methods, reconstruct course content, revitalize the teaching process, improve the evaluation model, and stimulate learning motivation to enhance the quality of course teaching and achieve the teaching goal of “knowledge + ability.” This has a certain reference value for the reform practice of unmanned systems courses.

Keywords: OBE concept; Unmanned systems courses; Teaching design

Online publication: June 30, 2025

1. Introduction

The outstanding performance of unmanned systems in recent local wars has drawn much attention^[1]. With the continuous innovation and development of the combat concepts, deployment patterns, and application models of unmanned systems, new challenges have emerged for teaching in military academies. Military academies are established for war and thrive in war. Cultivating combat-ready talents is the core mission of military academies. To achieve this goal, teaching in academies should further approach the battlefield and focus on practical application. Unmanned systems courses aim to enable students to apply their professional basic knowledge, gain a deep understanding of the combat environment, combat targets, combat modes, and combat effectiveness, and achieve the training goal of being close to the battlefield and practical application.

Due to the insufficient connection between the unmanned systems course teaching and practical application and the lack of close alignment with the battlefield, some problems have gradually emerged, such as the lack of practical application teaching, the rote learning of textbook theories, and the neglect of cultivating students' practical application abilities. These issues have restricted the development of students' initiative, analytical, and problem-solving abilities. To improve teaching quality and enhance the effectiveness of student ability cultivation, some universities have gradually adopted the OBE (outcome-based education) concept to address

these problems. OBE is generally understood as “results-oriented education,” which emphasizes diversified teaching and evaluation models, and focuses on learning outcomes as evaluation indicators. It advocates active and differentiated teaching design.

OBE is an education model oriented towards students’ learning outcomes, emphasizing the subjectivity of students in the educational process and the measurability of educational results^[2-5]. The OBE concept includes six core elements: student-centered, outcome-oriented, continuous improvement, diversified evaluation, backward design, and alignment integration. These elements are interrelated and together form a complete OBE framework. To address the challenges faced by unmanned systems courses, the OBE concept can be introduced to design the teaching goals of unmanned systems courses based on the OBE concept, with the main goal of enhancing operational application capabilities and the output of students’ active application as the driving force. This aims to explore new paths for the in-depth practical application and close alignment with the battlefield of unmanned systems courses.

2. Design concept

To improve the teaching quality of unmanned systems courses and enhance the effectiveness of student ability cultivation, the teaching goals of unmanned systems courses are designed based on the OBE concept. The teaching design is centered around the expected learning outcomes of “understanding principles, analyzing problems, and applying knowledge,” with application ability output as the teaching driver. The overall teaching goal is set as “professional knowledge + application ability,” and sub-goals are designed for each teaching link, including course construction, teaching implementation, and teaching evaluation. Teaching content is configured based on students’ learning outcomes, and the teaching model is continuously improved through feedback on learning outcomes. Diversified, multi-modal, and multi-faceted teaching methods are comprehensively utilized^[6,7]. The design concept mainly includes the following six core elements.

2.1. Student-centered

All teaching activities and course designs should revolve around the needs and interests of students, paying attention to individual differences and providing personalized learning support to stimulate students’ interest and motivation in learning. The teaching approach should shift from mainly imparting textbook theories to students and students’ passive learning to mainly active student engagement and supplemented by theoretical instruction.

2.2. Outcome-based approach

Outcome-oriented means focusing on the learning effect, clarifying educational goals, and ensuring that students possess specific knowledge and skills upon completion of their studies. Design challenging learning tasks to help students achieve expected learning outcomes. According to the talent demands of the military for the unmanned systems field, the training goal of being able to command and apply will influence the entire teaching process. The teaching design and implementation of the entire course should be centered around this goal to achieve timely output and meet standards based on ability, and to cultivate high-quality professional application talents for national defense construction.

2.3. Continuous improvement

Regularly assess students’ learning outcomes and teaching quality, and promptly adjust teaching strategies and course designs to enhance educational effectiveness. Pay attention to students’ learning progress, promptly

identify problems, and take effective measures for improvement, emphasizing continuous feedback on the learning process and results. The OBE concept establishes comprehensive evaluation requirements for teaching goals, requirements, and processes. Divide the entire unmanned systems course into learning stages and evaluate each student's learning outcomes at each stage to understand their attainment of expected application goals. Use the evaluation results to improve the teaching implementation process in the next stage. Finally, conduct a comprehensive application evaluation and feed the results back into other related courses or the training process of the next batch of students to form a virtuous and sustainable improvement cycle.

2.4. Diverse evaluation

The entire course, in line with the OBE concept's principle of diverse evaluation, adopts multiple evaluation methods and tools to comprehensively assess students' learning outcomes and abilities. Evaluation focuses on students' knowledge, skills, attitudes, and values, providing comprehensive feedback and valuable guidance.

2.5. Backward design

The OBE concept emphasizes backward design, constructing the curriculum system and teaching process through this method to enhance teaching efficiency and quality. For unmanned systems courses, start from the expected learning outcomes and design the curriculum and teaching strategies in reverse. Clearly define students' learning goals, design learning tasks and activities that align with these goals, to ensure students achieve expected learning outcomes, master relevant knowledge of unmanned systems applications, and enhance their job competitiveness and potential for development in the military.

2.6. Alignment and integration

The OBE concept emphasizes alignment and integration, ensuring the alignment and integration of educational goals, course design, teaching evaluation, and students' learning outcomes. The coherence and consistency among various teaching links should be ensured to enhance the overall effectiveness of education.

3. Ability development

In response to some issues revealed in the teaching of unmanned systems courses, relying on teaching and research platforms and other environments, and based on the foundation of practical application analysis, integrate combat application scenarios, exercises, and debriefings, to achieve the goal of cultivating students' knowledge structure, planning and analysis, command and decision-making, and emergency response capabilities. The generation of comprehensive application abilities generally includes basic knowledge and skills in unmanned systems, combat theory, combat simulation and experimentation, application analysis, application innovation, command and decision-making, and emergency response capabilities.

4. Teaching design

Teaching design for unmanned systems courses based on the OBE concept should center on the cultivation of application abilities, allowing students, knowledge, specialties, and battlefields to be integrated into the entire teaching process, making learning an exploration activity, fully mobilizing students' initiative, tapping their innovative potential, and enhancing their ability to apply knowledge. Teaching objectives should be specific and measurable, and closely related to the future career needs and learning development of the trainees. The needs

of trainees can be analyzed through means such as surveys, tests, and interviews to determine their learning foundation, interests, learning habits, and future job requirements, so as to determine appropriate teaching content and methods. Methods such as case teaching, mission-driven teaching, and cooperative learning can be selected to stimulate the trainees' interest and motivation in learning. At the same time, effective teaching strategies such as personalized learning and flipped classrooms should be formulated to meet the learning needs of different trainees. Through the design and practice of new concepts and ideas in teaching, trainees can quickly integrate into classroom activities and participate in teaching experiences, thereby quickly mastering the course system of unmanned system application.

4.1. Objective design

A thorough understanding and mastery of the overall teaching objective of unmanned system courses based on the OBE concept is essential. This objective not only includes the imparting of knowledge but also the internalization of knowledge and the cultivation of abilities. The design of teaching objectives based on the OBE concept is a systematic and continuous process that requires in-depth analysis of trainee needs, clear definition of teaching objectives, formulation of teaching strategies, design of teaching activities, and setting of evaluation standards. Only in this way can the effective realization of teaching objectives be ensured, and the core abilities and knowledge levels of trainees be improved. The focus should shift from teaching-centered to learning-centered, with an emphasis on trainee performance and evaluation. Trainees should master the basic principles, methods, and general strategies of unmanned systems, deeply understand the key and difficult points involved in this type of course, actively participate in the practical application of unmanned systems, and meet the requirements of this type of course for trainees' unmanned system application abilities, achieving flexible application and reasonable utilization of unmanned system professional knowledge.

4.2. Course design

The design of unmanned system courses based on the OBE concept focuses on the design of course content, teaching implementation, and teaching evaluation.

4.2.1. Reconstruction of teaching content

The teaching content of unmanned system courses based on the OBE concept needs to be constructed based on the expected learning outcomes of trainees. According to the teaching content, it can be divided into modules such as basic theoretical knowledge and application practice. Set unmanned system application tasks and problems that are closely related to the battlefield to enhance the practicality of trainees' learning. Set course content driven by tasks, allowing trainees to actively participate in course practice as the "creators" of application ideas. While completing course tasks, trainees can understand the principles of each knowledge point and the extensive connections between them, and apply theoretical knowledge to solve practical problems.

4.2.2. Innovative design of teaching mode

When implementing unmanned system courses based on the OBE concept, diversified teaching methods should be adopted to enrich teaching links. According to the characteristics of unmanned system courses, a combination of online and offline teaching methods can be used, implementing diversified teaching methods such as case analysis, combat scenarios, group discussions, simulation exercises, and comprehensive drills. Before class, an online teaching mode can be adopted to select professional course resources and guide trainees to conduct

personalized autonomous learning. During class, common problems encountered by trainees in self-study can be addressed through methods such as case introduction and group discussions, combined with case analysis to complete the internalization of knowledge. After class, based on real-time status information of trainees, guide them to complete knowledge expansion and transfer through simulation exercises and comprehensive drills. In addition to the required practical links in the plan, encourage trainees to participate in diversified practical teaching to promote the coordinated development of course teaching and practical teaching, as well as knowledge imparting and ability cultivation.

4.2.3. Design of teaching evaluation and feedback

When implementing the teaching of unmanned systems courses based on the OBE concept, diversified teaching methods are adopted to enrich the teaching process. According to the characteristics of unmanned systems courses, a blended online and offline teaching approach can be used to carry out diversified teaching methods such as case analysis, combat scenarios, group discussions, simulation exercises, and comprehensive drills. Before class, an online teaching mode is adopted to select course resources with professional characteristics and guide students to conduct personalized self-study. During class, common problems raised by students in their self-study are addressed through case introductions and group discussions, and knowledge internalization is achieved through case analysis. After class, based on the real-time status information of students, they are guided to complete knowledge expansion and transfer through simulation exercises and comprehensive drills. Besides the required practical sessions in the plan, students are encouraged to participate in diversified practical teaching to promote the coordinated development of course teaching and practical teaching, as well as knowledge imparting and ability cultivation.

5. Notes to emphasize in the teaching design

The teaching design of unmanned systems courses based on the OBE concept should be student-centered and pay attention to the following points.

5.1. Emphasizing knowledge reserves

Unmanned system courses attach great importance to the reserve of professional basic knowledge. During the learning process, students will be inspired by this knowledge. The teaching design should start from the students' professional knowledge reserves. Students' professional knowledge reserves are multi-faceted. Some knowledge is not in line with the application connotation, and some theories still need to be applied and elevated. The teaching design should make full use of students' professional knowledge reserves as the basis for the teaching design of unmanned system courses.

5.2. Emphasizing multiple combinations

The teaching design of unmanned system courses based on the OBE concept advocates that students gain inspiration through problem analysis, task setting, and discussion. This requires the teaching design to pay attention to the combination of knowledge and problems, tasks and discussions, etc., and emphasize the integration of theoretical knowledge and application scenarios when analyzing problems and setting tasks. This approach enables students to focus on tasks, conduct extensive and in-depth discussions, and fully mobilize their enthusiasm for active learning.

5.3. Emphasizing inspiring thinking

The teaching design based on the OBE concept should emphasize guiding students to think about how to independently learn knowledge and improve application ability. It should leave room for students to think and be conducive to students' exploration of unmanned system applications. Instructors should provide direct or indirect guidance to students and implement creative teaching. Due to the dynamics of application scenarios, which can lead to different results, instructors should guide students to think from multiple perspectives and analyze and solve problems in different scenarios.

5.4. Emphasizing innovative thinking

Unmanned system courses do not follow the traditional methods and emphasize innovative applications. Therefore, the teaching design based on the OBE concept should emphasize inspiring students' innovative thinking, creating application scenarios or tasks that are compatible with the course connotation, and stimulating students' inspiration and innovative consciousness. The dialectical unity of innovative thinking and application emphasizes that the design of application-oriented courses is not to design applications freely, but requires instructors to change their concepts, abandon traditional teaching models, and at the same time emphasize that students consciously conduct innovative thinking training in the created scenarios and tasks.

6. Conclusion

Unmanned system courses focus on cultivating students' planning and application abilities, innovative application abilities, and innovative thinking. The OBE concept has many advantages and can effectively enhance teaching effectiveness and cultivate students' comprehensive qualities. The implementation of teaching based on the OBE concept requires instructors to make more efforts and spend more time to ensure the achievement of teaching goals and the realization of students' learning outcomes. This paper proposes a teaching design for unmanned system courses based on the OBE concept, with the goal of cultivating students' abilities, students as the main body and application as the leading factor, and with the driving force of stimulating learning enthusiasm and innovative application methods. Starting from the teaching design, aiming at the goal, and carefully designing, students can actively explore and independently construct knowledge to analyze and solve problems in application practice, ensuring the match between what students have learned and their application abilities.

Disclosure statement

The authors declare no conflict of interest.

References

- [1] Wu X, Qing X, Su J, et al., 2025, Reform of Control System Computer Simulation Course Based on OBE Concept. *Higher Education Journal*, 11(S2): 129–132.
- [2] Huang Y, 2025, Exploration of the Construction of Chinese Modern and Contemporary Literature Curriculum in Normal Universities under the OBE Concept. *Higher Education Journal*, 11(13): 104–107 + 112.
- [3] Yu S, Wang Y, Zhao Y, et al., 2025, Research on Teaching Design and Practice of Applied Statistics Course Based on OBE Concept under the Background of New Engineering. *University Education*, (09): 28–32.

- [4] Li J, 2025, Research on the Construction of Military Theory “Course Ideology and Politics” System under the OBE Education Concept. *China Military to Civilian Conversion*, (08): 157–158.
- [5] Yu H, Zhu Y, Chen J, et al., 2025, Research on the Application of OBE Concept in Blended Teaching of Descriptive Geometry and Mechanical Drawing. *Journal of Higher Education*, 11(12): 23–27 + 31.
- [6] Song W, Yi W, 2025, Exploration of Practical Teaching Mode of Pneumatic Technology Based on OBE Concept. *Laboratory Science*, 28(02): 106–110 + 114.
- [7] Liu Y, 2025, Research on the Integration Model of Case Teaching and Practical Drills in Public Security Colleges under the OBE Concept. *Science and Education Guide*, 12: 74–76.

Publisher’s note

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

Innovative Development Strategies for Ideological and Political Education in Chinese Applied Undergraduate Universities under the Background of Industry-Education Integration

Zhenfeng Zhu, Jin Peng, Ling Peng, Zhiru Zhang, Xiong Deng*, Zhoumei Ma

Guangdong University of Science and Technology, Dongguan 523083, Guangdong, China

**Author to whom correspondence should be addressed.*

Copyright: © 2025 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: Applied undergraduate universities are an important component of China's higher education system, aimed at cultivating applied and versatile talents. Their adherence to the integration of industry and education and the coordinated innovation of ideological and political education is not only a strategic choice to respond to the fundamental task of national moral education, but also a key path to solving the talent paradox of "strong skills, weak literacy." This article is based on the current situation of the integration of industry and education and the development of ideological and political education in application-oriented undergraduate universities. It deeply analyzes the collaborative mechanism and practical difficulties between the two in terms of goals, processes, and resources. It innovatively proposes a strategy for the coordinated development of ideological and political education in application-oriented undergraduate universities under the background of industry-education integration, which has important practical significance for achieving the organic unity of the education chain, industry chain, and talent chain of application-oriented universities.

Keywords: Applied undergraduate universities; Integration of industry and education; Ideological and political education; Dual teacher and dual ability

Online publication: June 30, 2025

1. Introduction

Since the 21st century, China has built the largest higher education system in the world. However, with the deepening of the structural contradiction between supply and demand of China's talent market, accelerating the training of application-oriented and compound talents that meet the needs of the Chinese path to modernization is an important choice to deal with the new normal of economic and social development ^[1]. Based on this, the Chinese government has issued a series of policies such as the "National Pilot Implementation Plan for the Integration of Industry and Education" and the "Opinions on Promoting the High Quality Development

of Modern Vocational Education,” aiming to promote the deepening of the school-enterprise collaborative education mechanism. In addition, China actively promotes the transformation of applied universities, continuously deepens the integration of industry and education, and vigorously advocates the comprehensive implementation of ideological and political education in higher education institutions, fully realizing the fundamental task of cultivating morality and talents and the goal of talent cultivation. However, in the above process, there is a certain logical mismatch between traditional ideological and political education and the integration of modern industry and education ^[2]. On the one hand, ideological and political education in higher education institutions is facing a dual dilemma of formalization and marginalization. Adhering to the classroom indoctrination model makes it difficult to guide students to integrate into real production scenarios, leading to an increasingly prominent structural contradiction of “strong skills but weak literacy” among students; On the other hand, most higher education institutions currently focus too much on technical skills training in the process of application-oriented transformation, while neglecting the cultivation of core competencies such as professional spirit and social responsibility ^[3]. How to fully balance the cultivation of moral character under ideological and political education and the ability-based integration of industry and education still needs continuous exploration. This article conducts a special study aimed at providing inspiration and reference for applied undergraduate universities to achieve collaborative innovation and development of ideological and political education under the integration of industry and education.

2. Current situation of the integration of industry and education and the development of ideological and political education in applied undergraduate universities

2.1. Current status of industry-education integration development in applied undergraduate universities

Applied undergraduate universities are an important component of national higher education and even strategic education, with the responsibility and obligation to provide talent demand for regional economic development and intellectual support for technological breakthroughs ^[4]. Based on a profound understanding of the concept of industry-education integration, applied undergraduate universities in various regions are actively carrying out new practices such as school-enterprise cooperation, building on-campus industrial classes, and establishing practical training and internship bases. Some universities are also deepening the practice of industry-education integration by establishing new organizational forms such as industry colleges and engineering colleges in typical industries. The current promotion of industry-education integration in application-oriented undergraduate universities presents the following characteristics: firstly, the policy-driven and top-level leading features are more obvious. The process and coverage effectiveness of the integration of industry and education in universities have strong policy dependence. Although it provides sufficient guarantees for the integration of industry and education, it is, to some extent, not conducive to the formation of endogenous driving forces in relevant universities. Secondly, the school-enterprise cooperation model presents diversified characteristics. Local universities are based on the actual development of regional industries and the organizational layout of enterprises, fully exploring and expanding the scale of school-enterprise cooperation. The integration of industry and education has diverse organizational forms. Some universities have also implemented college-run enterprises and school-enterprise joint construction of physical teaching organizations (such as BYD Industrial College), jointly developing courses, building laboratories, and setting up internship positions. The third is the deep correlation between the integration of industry and education and the level of regional economic

development. There are significant differences in the level, depth, and emphasis on industrial fields in the integration of industry and education in applied universities in economic regions with different gradients, and the regional characteristics are distinct.

2.2. Development status of ideological and political education in applied undergraduate universities

As a specialized platform for cultivating composite and applied talents, applied undergraduate universities have gradually formed a development pattern of ideological and political education with policy strengthening as the leading factor, model innovation as the driving force, and practical exploration as the goal, adhering to the fundamental task of cultivating morality and talents in China in recent years^[5]. Firstly, relevant universities implement a construction mechanism of ideological and political courses and a dual wheel drive of curriculum ideology and politics, taking courses and classrooms as the primary entry point for ideological and political education, and then constructing a teaching syllabus and curriculum system rich in ideological and political connotations, fully following the requirements of the construction of new engineering and humanities, and incorporating the spirit of craftsmanship, professional ethics, etc. into the framework of ideological and political education. Secondly, application-oriented universities combine practical teaching with ideological and political education, setting up ideological and political scenarios for practical education through active participation of college students in corporate internships and industrial projects, emphasizing the educational philosophy of “professional skills & professional ethics & social responsibility.” In addition, some universities focus on collaboration and cooperation between schools, enterprises, and local areas, relying on local characteristic industries to explore the space for ideological and political education linkage from regional development, such as injecting patriotism and grassroots service awareness into students’ career development through rural revitalization, green development, and practicing the “Two Mountains” concept, cultivating national confidence and enthusiasm for participating in local construction.

3. Mechanism of integration of industry and education and collaboration of ideological and political education in applied undergraduate universities

Applied undergraduate universities focus on cultivating practical talents, but as an important component of cultivating Chinese socialist builders, promoting the integration of industry and education and carrying out ideological and political education are not in conflict, and the ultimate goal of synergistic education between the two should be achieved. Essentially, the collaborative education of industry-education integration and ideological and political education is a deep coupling between the education chain and the industry chain in terms of value guidance, resource integration, and process interaction. The two have a profound collaborative development logic in the four dimensions of goals, processes, resources, and evaluation, which is also an important guarantee for their transformation from theoretical collaboration to practical collaboration.

3.1. The synergy of industry-education integration and ideological and political education goals

For application-oriented undergraduate colleges and universities, the ultimate educational goals of industry-education integration and ideological and political education are the same. The two aims to actively cultivate “morality and technology” composite talents for Chinese path to modernization, and achieve the unity of “talent” and “adult,” which is the basic premise and fundamental guarantee for application-oriented undergraduate

colleges and universities to integrate ideological and political education into the process of performing skills development. In the practice of integrating industry and education with the coordinated development of ideological and political education, their respective educational goals will be mapped and transformed into each other, thus achieving the common value goal of “combining morality and technology” as the core.

3.2. The process synergy between industry-education integration and ideological and political education

From the specific process of implementing industry-education integration and ideological and political education in applied undergraduate universities, there is a high degree of interaction and symbiosis between the two in terms of teaching scenarios and faculty matching, ensuring that the two can achieve the penetration of ideological and political values in production practice education through the setting of target integration scenarios and the complementary matching of dual mentor mechanisms, as well as the teaching of professional spirit practice by enterprise mentors and the focus on value theory interpretation by on-campus teachers. In the process of collaboration, the integration of teaching scenarios is mainly achieved through bidirectional reconstruction of curriculum design, that is, the mutual implantation and feedback between ideological and political elements and professional courses. Teacher collaboration relies on the complementary abilities under the dual mentor system to achieve the joint development of industry-education and ideological and political education programs.

3.3. Resource synergy between industry-education integration and ideological and political education

The so-called resource collaboration mainly refers to the gradual formation of a collaborative education ecosystem between applied undergraduate universities and enterprises in the process of practicing the integration of industry and education and ideological and political education. From the perspective of resource connotation and types, it mainly involves enterprise resources and ideological and political resources. Based on the integration of industry and education, ideological and political education is a vivid process in which universities actively promote the ideological and political transformation of enterprise resources and the industrialization of ideological and political resources. The former focuses on incorporating standardized production, standardized management, and responsible business behavior into the ideological and political element system, while the latter transforms craftsmanship, struggle culture, team spirit, and other aspects into enterprise training content and professional practice guidelines.

4. The dilemma of industry-education integration and ideological and political education synergy in applied undergraduate universities

4.1. Misalignment of goals between the integration of industry and education and ideological and political education

The so-called goal misalignment refers to the lack of a high degree of consistency between industrial demand and educational value goals in practice, and the traditional integration of industry and education with ideological and political education still presents a “two-skin” feature. Given the basic positioning of application-oriented undergraduate universities, the skill-oriented education goal is more prominent, and the integration of industry and education overly focuses on the cultivation of “hard skills,” resulting in the ideological and political education goal remaining to a certain extent in form and unable to achieve the concretization of ideological and

political education.

4.2. Separated integration of industry and education and the process of ideological and political education

Some application-oriented undergraduate universities, based on the basic positioning of skill orientation, present a certain dual-track education pattern in implementing the integration of industry and education and ideological and political education. This is manifested in the rigid and mechanical process of curriculum ideological and political education, and the implementation of “label-based” ideological, political, and educational design for various professional courses, without fully embedding industrialization scenarios and professional ethics standards. When promoting the integration of industry and education in teaching, the focus is on developing internship programs that mainly focus on skill development, with insufficient design of application scenarios for ideological and political education.

4.3. Resource imbalance between the integration of industry and education and ideological and political education

The so-called resource imbalance is mainly manifested in the fact that some application-oriented undergraduate universities, in the process of promoting the integration of industry and education and the coordinated development of ideological and political education, have paid attention to the mutual transformation and integration of enterprise resources and ideological and political elements. However, due to the subjective enthusiasm and ability of different entities such as enterprises, schools, students, and third parties, the ability to transform ideological and political resources in the practice of industry-education integration is weak, which restricts the degree of achievement of the goals of industry-education integration and ideological and political education coordination.

5. Innovative development strategies for ideological and political education in applied undergraduate universities

5.1. Anchoring the ideological and political goals of school-enterprise collaboration

Applied undergraduate universities must first clarify the ideological and political goals of school-enterprise collaboration in the process of industry-education integration, fully integrate industry capabilities with the goal of cultivating students' morality, and actively develop a value realization system with collaborative education as the goal. To this end, relevant universities can establish a special committee for school-enterprise collaborative ideological and political education, with enterprise management personnel, technical backbones, ideological and political teachers, student representatives, third-party representatives, etc. as core members, to approve the school's ideological and political education goals, supervise the implementation process of collaborative education, dynamically evaluate the effectiveness of education, and continuously promote the integration of industry and education with ideological and political education.

5.2. Building an integrated ideological and political education module for production and education

In order to achieve the integration of industry and education and the deep coupling of ideological and political education, on the one hand, relevant majors in applied undergraduate universities will be restructured, and a three-stage progressive curriculum system will be established based on general ideological and political courses,

with professional ideological and political courses as the core, and school-enterprise jointly built courses as the expansion, to ensure that ideological and political education runs through the entire process of industry capacity cultivation. On the other hand, based on school-enterprise research, we actively develop project-based ideological and political teaching packages suitable for applied undergraduate universities, deeply decompose enterprise cases and industrial projects, clarify the skill tasks and ideological and political core, and carry out integrated teaching with division of labor and emphasis on collaboration.

5.3. Establishing a closed-loop collaborative education evaluation feedback mechanism

In response to the dilemma of the integration of industry and education and the inability to evaluate ideological and political education in application-oriented undergraduate universities, it is suggested to optimize the collaborative education evaluation mechanism and establish a closed-loop collaborative education evaluation feedback mechanism. One is to construct a diversified evaluation matrix, including enterprises, teachers, students, third parties, etc., and integrate theoretical knowledge, professional skills, values, etc., into the evaluation content, scientifically setting different subjects and content weights. Secondly, develop an “industry education & ideological and political” information system to achieve real-time collection and process evaluation of collaborative education data, complete dynamic monitoring, and continuous improvement.

5.4. Constructing a “dual teacher and dual ability” teacher training mechanism

Teachers are the core driving force for implementing the integration of industry and education and the coordinated development of ideological and political education. It is suggested that application-oriented undergraduate universities accelerate the construction of a “dual teacher and dual ability” teacher training mechanism. On the one hand, setting up professional teachers to participate in enterprise “ideological and political research” projects, deeply exploring ideological and political education elements and vivid cases in real industrial scenarios, and guiding the establishment of a case library for the transformation of achievements. On the other hand, hiring enterprise mentors to enter campuses and classrooms, and regularly conducting special training and exchange programs on the “value guidance” of enterprise mentors, to enhance their understanding of the connotation of ideological and political education and strengthen their ability to transmit values in the process of school-enterprise cooperation.

6. Conclusion

Based on the macro background of multiple challenges facing China’s higher education ecosystem, application-oriented undergraduate universities are playing an increasingly important role in the deep promotion of industry-education integration, while also undertaking the mission of cultivating morality and nurturing socialist builders in the era. The integration of industry and education and the coordinated development of ideological and political education still face practical difficulties. It is necessary to accelerate the exploration and innovation of the organic unity of the education chain, industry chain, and talent chain, break down the barriers to their integration and parallel development, and fully leverage and demonstrate the educational advantages of application-oriented undergraduate universities in cultivating both professional skills and pillars of socialist values.

Funding

The 2023 Guangdong University of Science and Technology Teaching, Science and Technology Innovation, Teaching and Learning Enhancement Project Team (GKJXXZ2023018)

Disclosure statement

The authors declare no conflict of interest.

References

- [1] Zhong X, 2025, Research on the “Three Directions and Three Forces” Reform Model of Practical Teaching of Ideological and Political Courses in Applied Undergraduate Universities under the Background of Industry Education Integration, *Economic Review*, March 26, 2025, (006).
- [2] Li M, 2024, Research on the Construction of Ideological and Political Courses in Applied Universities from the Perspective of Industry Education Integration. *Journal of Jilin Radio and Television University*, (5): 64–66.
- [3] Li M, 2024, Research on the Reform of Practical Teaching of Ideological and Political Courses in Applied Universities from the Perspective of Industry Education Integration. *Talent*, (10): 57–60.
- [4] Zhang Y, Li X, Zhu Q, 2021, The Problems and Strategies of Curriculum Ideology and Politics Construction in Applied Universities from the Perspective of Industry Education Integration. *Education and Career*, (11): 77–82.
- [5] Hou Y, 2018, Exploration of Optimization Measures for Ideological and Political Education in the “Integration of Industry and Education” Talent Training Model of Applied Universities. *Journal of Shangqiu Vocational and Technical College*, 17(6): 59–62.

Publisher’s note

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

Research on the Teaching Reform Path of Digital Empowerment for Business Model Innovation from the Perspective of Ideological and Political Education in Courses

Ling Peng, Xiong Deng*, Zhenfeng Zhu, Lina Peng

School of Management, Guangdong University of Science and Technology, Dongguan 523083, Guangdong, China

**Author to whom correspondence should be addressed.*

Copyright: © 2025 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 dual impetus of the fundamental task of “cultivating virtue and nurturing talent” and the national strategy of digitalizing education, promoting the deep integration of ideological and political education in courses with digital technology has become a core issue in the curriculum reform of colleges and universities. This paper takes the course “Business Model Innovation” as the research object and focuses on the problems existing in the current course, such as lagging content update, superficial application of digital tools, and weakening elements of ideological and political education. This paper proposes a teaching reform path that is supported by digital means and centered on value guidance, and focuses on how to systematically optimize teaching content design, interactive teaching scenarios, evaluation and feedback mechanisms, and teacher collaboration systems through specific tools such as “Rain Classroom,” “Enterprise Sand Table,” and “Smart Classroom Platform.” We aim to build a digital model of ideological and political education in the curriculum that integrates knowledge imparting, ability training, and value shaping, and to provide practical reference and path support for the cultivation of high-quality business talents in the new era.

Keywords: Course-based ideological and political education; Business model innovation; Digital empowerment; Teaching reform; Blended learning

Online publication: June 30, 2025

1. Introduction

In recent years, higher education has faced unprecedented structural changes as the country continues to push forward the digitalization of education. From the 18th to the 20th National Congress of the Communist Party of China, and the release of a series of policy documents such as the 2024 Government Work Report and the Strategic Action Plan for Education Digitalization, it is evident that education digitalization has been officially established as a national strategy and has become a key support for building an education power^[1,2].

For colleges and universities, this means not only a transformation of teaching methods but also an indication that educational concepts and curriculum structures must be updated simultaneously. In today's era, where the digital economy and value co-construction have become the themes of the times, relying solely on the imparting of knowledge clearly cannot meet the complex needs of talent cultivation in the new era ^[3]. Today, the values and perceptions of college students have changed in many ways. If teaching is still confined to traditional classrooms and standardized cases, it will not only fail to resonate with students but also fail to fulfill the educational mission of fostering virtue and nurturing talent ^[4]. Therefore, the ideological and political teaching reform of the "Business Model Innovation" course should take digitalization as the starting point and use intelligent platforms to reshape the value logic of the course content, so as to shift to a new teaching model that is student-centered, value-oriented, and driven by social issues. This is not only a direct response to the national strategy, but also a realistic choice to promote the comprehensive development of talent cultivation in colleges and universities.

2. Current situation and problems of digitalization empowering ideological and political education in the Business Model Innovation course

In the context of the comprehensive promotion of ideological and political education in higher education, digital technology is regarded as a key means to promote the integration of ideological and political education into professional courses ^[5]. Business Model Innovation, as a core applied course in the field of management, is theoretical, instrumental, and practical, covering multiple dimensions such as value creation, strategic innovation, and business ethics, and has a natural channel of integration with the core socialist values. However, judging from the current implementation of the course, the role of digital technology in the construction of ideological and political education in the course has not been fully exerted, and there are multiple problems, such as the fragmentation of the use of digital tools and the superficial integration of ideological and political education.

2.1. The use of digital tools is more focused on teaching management, with insufficient embedding of ideological and political functions

At present, most colleges and universities have introduced teaching tools such as Rain Classroom, Learning Pass, and Chaoxing Platform in the "Business Model Innovation" course, but their application is mostly focused on management functions such as pre-class push, sign-in, and material distribution, and digital tools have not effectively served the realization of the ideological and political goals of the course ^[6]. For instance, the digital tool Rain Classroom, which could have been used for red case materials and policy guidance, has functions such as pop-up guidance, topic discussion, and online testing. In practical use, it has been simplified into a knowledge point review tool and has failed to effectively build an interactive teaching logic oriented towards ideological and political education ^[7]. Although many teachers have attempted to introduce ideological and political elements, such as patriotic enterprise cases and social responsibility issues, through digital platforms in their teaching, there is still a problem of formalized introduction. The ideological and political content only appears in the course introduction, conclusion, or special topic insertion, lacking deep integration with the core theories of the course, making it difficult for students to convert the ideological and political information they receive into value recognition.

2.2. Digital virtual simulation and ideological and political education are misaligned, and there is a lack of value-guided decision-making scenarios

In the design of the “Business Model Innovation” training course, many colleges and universities have introduced digital training tools such as business sand table systems and entrepreneurship simulation platforms to enhance students’ practical skills ^[8]. But these systems are mainly oriented towards business indicators and lack embedded value judgment scenarios. For example, when students choose customer relationship models or profit paths, they do not consider integrating moral decision-making content such as “whether it conforms to green development” and “whether there are data ethics issues” into the digital practice process, resulting in the disconnection between virtual teaching and ideological and political goals and the inability to achieve value guidance through “learning by doing” and “thinking through creation.”

2.3. The platform data has not been transformed into an ideological and political feedback mechanism, and process-oriented education is absent

In the digital reform teaching process of the “Business Model Innovation” course, some teachers merely used the digital platform for daily course attendance or teaching management, and did not actually use it to analyze students’ growth trajectories in terms of value perception and responsibility awareness, etc. ^[9]. For example, in case studies and project assignments, digital tools were not effectively utilized to establish value-oriented assessment labels, and there was a lack of visual records and personalized guidance mechanisms for students’ ideological and political literacy performance ^[10]. These problems have made it difficult for the “Business Model Innovation” course to achieve the digital reform goal of “all-round and whole-process education.”

2.4. Teachers’ ability to integrate digitalization with ideological and political education is insufficient, and there is a lack of a collaborative mechanism in teaching design

Since the teachers of the “Business Model Innovation” course mainly come from professional fields such as management and economics, many teachers have obvious technical anxiety when facing digital tools such as Rain Classroom, smart teaching platform and enterprise sand table, and often only stay at the basic function application of uploading courseware and issuing notifications ^[11]. They are unable to design teaching structures, build interactive scenarios, or analyze data feedback through the platform, thus weakening the teaching transformation effectiveness that digital technology should have. Some teachers’ understanding of ideological and political education in the curriculum remains at the theoretical propaganda level, and they are unable to organically integrate socialist core values with digital technology to form teaching design ideas. For instance, when teaching about value proposition design, teachers often only emphasize how enterprises make profits, but fail to design digital interactive tasks to trigger students’ discussions on business ethics, making it difficult for ideological and political elements to promote students’ behavioral cognition.

3. The urgency of digitalization empowering the ideological and political teaching reform of the “Business Model Innovation” course

In the context of the digital transformation of education and the deepening of ideological and political education in the curriculum in the new era, the course “Business Model Innovation” is confronted with the dual challenges of upgrading educational goals and reforming digital teaching methods ^[12]. Digitalization is not only a tool for improving teaching efficiency, but also a strategic fulcrum for value guidance. There is an urgent need to empower the ideological and political teaching reform of “Business Model Innovation” course through

digitalization to respond to students' needs, social changes, and national strategies.

3.1. The contradiction between the transformation of modern college students' learning methods and traditional teaching has become prominent

With the widespread use of digital technology and social media, modern college students' ways of accessing information, cognitive structures, and learning preferences have undergone profound changes. Contemporary college students have become proficient in using AI tools such as DeepSeek and GPT-4 Design assistant to assist with innovative thinking and business analysis ^[13]. However, outdated knowledge is still being taught in the classroom, and there is a lack of guidance on the combination of these new tools with business practice, making it difficult to stimulate students' deep learning motivation. Many students expressed obvious dissatisfaction with the classroom format of this course, arguing that the knowledge learned in college is difficult to meet the challenges of the future workplace, further widening the gap in students' perception of the uselessness of the teaching content. Therefore, there is an urgent need to activate the innovation of classrooms and teaching models through digital teaching methods.

3.2. The transformation of digital teaching models has become a key means to enhance the practical value and social guidance of the curriculum

With the rapid development of the digital economy and the widespread application of cutting-edge technologies such as artificial intelligence, business practices have entered a new stage of deep integration and rapid evolution ^[14]. Under the traditional teaching paradigm, the content of the "Business Model Innovation" course often deviates from the context of the times and fails to guide students to form concepts of sustainable development, strategic judgment ability, and social responsibility awareness, resulting in limited impact of the course on students' social cognition and value judgment, and the teaching effect falling into the predicament of "armchair theorizing." Therefore, there is an urgent need to rebuild the connection between the course content and real business practice through digital curriculum reform to enhance the effectiveness of the course.

3.3. The deepening of the digital education strategy urgently requires the construction of replicable models for integrating ideological and political education

The report of the 20th National Congress of the Communist Party of China explicitly proposed to "accelerate the building of a strong education country and a digital China," elevating education digitalization to a national strategy. Business Model Innovation, as a course with strong application and high educational value, should serve as a model for the digital reform of ideological and political education in courses ^[15]. However, there is a widespread disconnection between digital technology and ideological and political integration at present. On the one hand, the implementation of ideological and political education in the curriculum mainly relies on teachers' experience and subjective consciousness, lacking unified standards and technical support; On the other hand, although schools have built digital teaching platforms and tools, they have not been effectively integrated into the functional modules of ideological and political education, and the reform lacks replicable paths. Therefore, there is an urgent need to establish a standardized, procedural, and traceable implementation system of ideological and political education in courses based on digital tools to achieve the dual implementation of concept integration and technology integration.

4. Digital empowerment of the teaching reform path design for Business Model Innovation course ideological and political education

With the development of digital teaching tools and the improvement of the educational informatization environment, digital empowerment provides a more efficient and sustainable implementation path for the ideological and political reform of the Business Model Innovation course. This study proposes implementation paths for the ideological and political reform of the “Business Model Innovation” course in a digital environment from three aspects: digital teaching scenarios, digital ideological and political practice system of the course, and digital lesson preparation system.

4.1. Expanding teaching scenarios with intelligent teaching tools to achieve immersive experiences of ideological and political elements

The use of smart teaching tools in the “Business Model Innovation” course is not for showing off skills, but to make ideological and political content, which was originally prone to being superficial, discussable, controversial, and reflective. Digital teaching tools provide an immersive experience for course-based ideological and political education. With the help of smart teaching platforms (such as Rain Classroom, Chaoxing, Tencent Classroom) and virtual simulation experimental environments, teachers can create situational teaching processes, transforming abstract ideological and political elements into concrete business challenges and moral dilemmas, guiding students in the formation of business values and ethics. For example, when teaching the “Enterprise Business Model Building” module, teachers can set up virtual enterprise cases through the platform, design group discussions and role-playing sessions around decision-making nodes such as “whether to adopt a high-profit but environmentally polluting business path” and “whether to sacrifice workers’ rights for capital efficiency,” and guide students to experience business ethics conflicts in simulated confrontations. Through reflection, develop a sense of responsibility. Through digital empowerment, value judgments are no longer one-sided indoctrination by teachers, but rather an internal identity gradually formed by students through multiple rounds of interaction with the help of digital tools, enabling the classroom teaching to truly shift from emphasizing ideological and political education to building scenarios.

4.2. Introducing diverse digital teaching tools based on the three links of “before class-during class-after class” to build an integrated digital course-based ideological and political practice system

The realization of ideological and political education in courses should not rely solely on classroom instruction, but should run through the entire process of pre-class preparation, in-class teaching, and post-class feedback.

In the pre-class session, teachers can use platforms such as Rain Classroom and Learning Pass to release preview videos and micro-lessons on ideological and political themes, and push topics related to red enterprise cases in advance to help students enter the classroom with questions and thoughts. At the same time, through Questionnaire Star or the interactive questionnaire system of Rain Classroom, it prompts students to start thinking about social responsibility and ethical boundaries in business activities, helping them build a basic awareness of identifying business phenomena based on values before class.

When entering the classroom stage, teachers can incorporate ideological and political guiding questions such as “Is the value proposition of this enterprise socially fair?” in conjunction with the bullet-screen interaction and in-class answering functions of Rain Classroom when teaching core knowledge, such as the nine elements of the business model; “Is its source of income sustainable?” Such as guiding students to express their opinions in real time, enhancing their sense of participation in the class and their ability to analyze values. At

the same time, use the enterprise sand table simulation platform to set up business decision-making scenarios with ethical conflicts, such as whether to sacrifice employee benefits to reduce costs, to guide students to make decisions in the simulation, and organize online debates or reflective discussions after the simulation to help students feel the social responsibility of value trade-offs from business decisions. Through position statements and other means, inspire students to integrate socialist core values into the expression and construction of business logic.

In the after-class session, teachers can use the data analysis system of Learning Pass or Smart Classroom to automatically summarize behavioral data such as the accuracy rate of students' answers, the frequency of interaction, and the number of comments to form a profile of each student's ideological and political performance, providing a basis for subsequent value guidance and personalized feedback. Through the Chaoxing platform assignment, students write a business logic and reasons they do not agree with based on the class content, guiding ideological and political reflection in the course and further promoting the formation of a stable value perception structure and social empathy ability among students.

4.3. Utilizing digital tools to build a multi-party joint lesson preparation system and jointly design modular ideological and political scenarios

Given the current fragmentation of the application of digital tools in the course "Business Model Innovation," the shallow embedding of ideological and political elements, and the lack of a teacher collaboration mechanism, there is still considerable room for improvement. Colleges and universities should systematically advance the digital reform path of ideological and political education in courses from the dimensions of instructional design, platform construction, and multi-party collaboration. Establish a multi-party joint lesson preparation mechanism by leveraging cloud collaborative teaching platforms such as Chaoxing Course Center, DingTalk teaching Group, WPS Cloud Document, etc. Ideological and political teachers provide value-oriented design, business teachers determine the core logic of teaching, and educational technology experts are responsible for digital embedding point suggestions. Through this system, a modular library of ideological and political units is generated for teachers to freely invoke by theme, section, or teaching objective, enabling iterative co-construction and cross-school reuse of teaching resources, thereby promoting the breaking of professional barriers and organizational boundaries in college courses and building a co-construction and sharing mechanism of ideological and political design in courses supported by digital platforms.

5. Conclusion

Business Model Innovation, as a core part of business education, not only carries the teaching goal of cultivating students' innovative ability and strategic thinking, but also shoulders the important educational mission of guiding students to form correct values and a sense of social responsibility. With the deepening of the digital transformation of education, the integration of ideological and political education into the curriculum urgently needs to shift from traditional indoctrination to a systematic reconstruction driven by technology. Based on the current teaching situation of the "Business Model Innovation" course, this paper focuses on the core question of "how to implement the goals of ideological and political education in the curriculum through digital means," and proposes a teaching reform path supported by digital tools such as Rain Classroom and Learning Pass Smart Class, in order to effectively implement the collaborative education model of "knowledge-ability-value." Therefore, colleges and universities should continue to deepen the integration mechanism of digital tools and education, promote the collaborative interaction of multiple disciplines and departments, and form replicable

and scalable models of ideological and political education in courses to provide solid support and practical paths for the cultivation of high-quality business talents in the new era.

Acknowledgments

The author would like to express sincere gratitude to Guangdong University of Science and Technology for supporting this research. Special thanks go to the team members and students who actively participated in the teaching practice and provided valuable feedback throughout the course development and implementation.

Funding

The 2024 Higher Education Teaching Reform Project of Guangdong University of Science and Technology “Teaching Practice of Human Resource Management Course Based on SPOC+FC Hybrid Teaching Mode” (GKZLGC2024024)

Disclosure statement

The authors declare no conflict of interest.

Author contributions

Instructional design: Ling Peng

Conceptualization: Xiong Deng, Zhenfeng Zhu

Literature review: Lina Peng

Supervision: Xiong Deng, Zhenfeng Zhu

Writing – original draft: Lina Peng

Writing – review & editing: Xiong Deng, Zhenfeng Zhu, Lina Peng

References

- [1] Okunlaya RO, Syed Abdullah N, Alias RA, 2022, Artificial Intelligence (AI) Library Services Innovative Conceptual Framework for the Digital Transformation of University Education. *Library Hi Tech*, 40(6): 1869–1892.
- [2] Zhang A, Sheng L, Wang J, 2024, Empirical Research on Curriculum-based Ideological and Political Teaching of Universities. *Int. J. Educ. Humanit*, 13: 34–38.
- [3] Liu Z, Luo L, 2024, Using Artificial Intelligence for Intelligent Ideological and Political Education Teaching, 2024 International Conference on Interactive Intelligent Systems and Techniques (IIST), IEEE, 137–144.
- [4] Xu C, Wu L, 2024, The Application of Artificial Intelligence Technology in Ideological and Political Education. *International Journal of Advanced Computer Science & Applications*, 15(1): 1–4.
- [5] Zhang W, 2025, The Quality Evaluation and Development of University Ideological and Political Teaching Based on Wireless Network Artificial Intelligence. *J. Combin. Math. Combin. Comput*, 125(185): 195–198.
- [6] Guo L, 2024, Digital Empowerment of the Innovation of Ideological and Political Education Methods, SHS Web of Conferences, Vol. 209, EDP Sciences, 01014.

- [7] Guo Y, Zhai L, 2024, Digital Empowerment and Ideological and Political Integration: Innovation Exploration of Computer Network Courses in Secondary Vocational Schools under the Background of the New Era, 2024 14th International Conference on Information Technology in Medicine and Education (ITME), IEEE, 529–533.
- [8] Aramburuzabala P, Culcasi I, Cerrillo R, 2024, Service-Learning and Digital Empowerment: The Potential for the Digital Education Transition in Higher Education. *Sustainability*, 16(6): 2448.
- [9] Shi J, Song Y, Li L, et al., 2023, Research on the Teaching Quality Evaluation System and Improvement Path of Ideological and Political for Online and Offline Blended Learning in Universities. *International Journal of New Developments in Education*, 5(24): 64–73.
- [10] Lv F, 2025, Research on Optimization Strategies of University Ideological and Political Parenting Models under the Empowerment of Digital Intelligence. *Scientific Reports*, 15(1): 8680.
- [11] Tang Y, 2024, Exploration on Innovative Models of Ideological and Political Education and Employment Guidance in Higher Vocational Colleges in the New Era Context. *Advances in Vocational and Technical Education*, 6(2): 84–89.
- [12] Zhu C, Chen J, Guo C, et al., 2025, Exploring the Intelligent Transformation Path of Party Building Leading Financial Aid Education Evaluation from the Perspective of Digital Empowerment. *International Journal of Social Science and Education Research*, 8(6): 312–321.
- [13] Kollerup JB, Li M, Yuan T, 2025, (Re) Imagining the Future of Education: A Critical Discourse Analysis of Digital Transformation Policies in China and Denmark, *Comparative Education*, 1–21.
- [14] Yang D, Wu J, Tan W, 2024, Effectiveness, Challenges, and Innovative Pathways of Digital Teaching in College Ideological and Political Courses, 4th International Conference on New Media Development and Modernized Education (NMDME 2024), Atlantis Press, 493–500.
- [15] Li Y, 2024, Research on the Reform of Ideological and Political Education of English Courses in Higher Vocational Colleges Empowered by ChatGPT. *Creative Education*, 15(6): 993–1002.

Publisher's note

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

Research on the Influencing Mechanism of College Students' Reliance on AI Tools and Weakened Learning Ability and Educational Coping Strategies

Xiang Yuan, Ling Peng*

School of Management, Guangdong University of Science and Technology, Dongguan 523083, Guangdong, China

**Author to whom correspondence should be addressed.*

Copyright: © 2025 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: With the rapid popularization of artificial intelligence technology in the field of higher education, college students are increasingly dependent on AI tools such as ChatGPT, automatic writing assistants, and intelligent translators. Behind the convenience and efficiency, a decline trend in students' core learning abilities such as autonomous learning ability, critical thinking ability, and knowledge construction ability has gradually emerged. This study aims to explore the interactive logical mechanism between college students' reliance on AI tools and the weakening of their learning abilities, and on this basis, propose practical and feasible educational intervention strategies. Research has found that while AI tools lower the learning threshold, they also weaken students' cognitive investment and independent thinking abilities, further intensifying their reliance on technology. In this regard, this paper proposes a three-dimensional intervention path based on guided usage, ability compensation, and value reconstruction to achieve the collaborative improvement of students' technical usage ability and learning ability. This research has certain theoretical value and practical enlightenment significance for solving the structural predicament of higher education in the intelligent era.

Keywords: Reliance on AI tools; Learning ability; Coping strategy; Interactive logic

Online publication: June 30, 2025

1. Introduction

Artificial intelligence (AI) is reshaping the higher education ecosystem at an unprecedented speed and depth. From teaching assistance to knowledge construction, AI tools (such as ChatGPT, automatic translation, intelligent writing assistants, etc.) have demonstrated strong advantages in enhancing students' learning efficiency and expanding learning resources. However, behind the technological dividends, the excessive reliance of college students on AI tools and the consequent degradation of their core learning abilities have also

been exposed ^[1,2]. Students tend to use AI to generate answers, write or translate automatically in their studies, thereby weakening their abilities such as critical thinking, independent exploration, and logical reasoning. Current research mostly focuses on the positive effects of AI technology, such as the improvement of teaching efficiency and the transformation of teachers' roles, but pays less attention to its impact on the deep structure of students' learning behaviors, especially how tool dependence affects students' core learning abilities ^[3,4]. The mechanism is still unclear. This study reveals the interaction mechanism between AI tool dependence and weakened learning ability, and explores feasible coping strategies for colleges and universities in educational practice, providing a theoretical basis and practical guidance for constructing a path of "dual improvement of technical literacy and learning ability" for students.

2. Literature review

With the rapid penetration of generative artificial intelligence technologies (such as ChatGPT, writing assistance systems, language translation models, etc.) in the higher education system, the issue of students' reliance on AI tools has gradually drawn widespread attention from the academic community. In recent years, a number of studies have begun to explore the potential impact of AI usage on students' learning abilities from multiple dimensions, such as cognition, ethics, and instructional design.

Zhai *et al.* found through a systematic review that over-reliance on AI dialogue systems can improve task completion efficiency in the initial stage, but at the same time, weaken students' cognitive processing ability, problem-solving ability, and reflective awareness ^[1]. This conclusion was also confirmed in the research of Szmyd and Mitera, who pointed out that AI, to a certain extent, weakens students' initiative in developing critical thinking, especially when facing complex concepts and open-ended questions, students are more inclined to accept the answers generated by AI rather than actively solve them ^[2]. Specifically for college students, Li *et al.* proposed at the ISEMSS conference that the boundless use of AI writing tools such as ChatGPT by college students is changing their learning behavior structure, manifested as "shifting from problem-solving to relying on tools to cope" ^[3]. However, Putri found in the context of foreign language learning that when students use AI for English writing, there are problems such as weakened semantic understanding and decreased language transfer ability, further demonstrating the substitution effect of AI on the construction of deep learning ^[4]. Further research has also revealed the interaction mechanism between AI dependence and weakened capabilities. Miranda *et al.* found in their empirical research on universities in many countries that AI dependence is gradually eroding students' critical reading, writing logic, and metacognitive regulatory ability. This "hidden degradation" process is often difficult to detect in a timely manner in the traditional teaching evaluation system ^[5]. Athar pointed out from the perspective of personality psychology that students who overly rely on AI tools often have characteristics such as avoidant learning tendencies, low self-efficacy, and ambiguous moral judgment, which may further intensify their behavioral inertia of avoiding complex tasks during the learning process ^[6].

However, there are also studies demonstrating the positive potential of AI tools. Zhao *et al.* pointed out that in a well-designed teaching context, generative AI can stimulate students' deeper thinking processes and strengthen their critical thinking ability, provided that teachers guide students to compare, question, and reconstruct the content of AI ^[7]. Gawlik-Kobylińska believed that AI has obvious advantages in promoting scientific research collaboration, information retrieval, and interdisciplinary learning, but the prerequisite is that students have a clear sense of purpose and the ability to reflect ^[8].

In short, the current research has basically confirmed that there is a complex two-way interaction mechanism between the use of AI tools and students' learning abilities: On the one hand, while AI improves efficiency, it may cause cognitive degradation. On the other hand, if used scientifically and guided, it can also become an effective tool for activating higher-order thinking. However, at present, most studies still focus on qualitative descriptions or local empirical evidence, lacking theoretical construction at the system mechanism level and research on intervention paths. Therefore, it is necessary to further reveal how AI dependence affects the entire process of students' ability development at the micro cognitive mechanism and propose targeted educational countermeasures. This research is precisely carried out under this background, attempting to clarify the interaction logic among “dependence–substitution–weakening” from the perspective of cognitive behavior and construct a systematic intervention model.

3. Influence mechanism

The reliance of college students on AI tools during the learning process, ostensibly a pursuit of learning efficiency, may, in essence, induce a series of deep-seated ability degradation problems. From the perspective of cognitive behavior, there is a funnel-like process between AI tool dependence and the weakening of students' learning ability, involving multiple mechanisms such as “tool induction–ability substitution–deepening dependence–weakening ability” (see **Figure 1**).

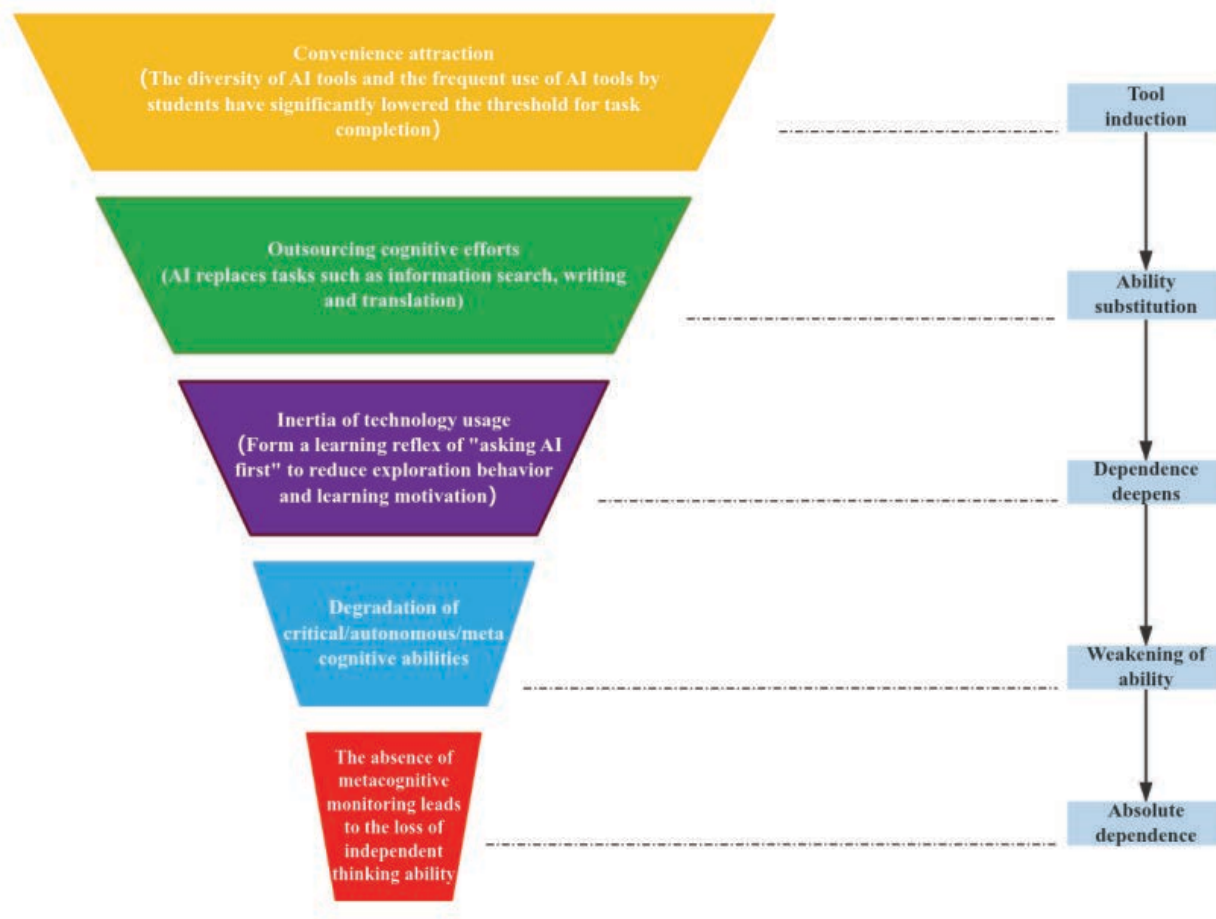


Figure 1. Influence mechanism model

First of all, AI tools, with their fast, convenient, and intelligent technological features, greatly reduce the threshold for students to obtain information and complete tasks, especially in specific tasks such as writing, translation, calculation, and answering questions. Students can use AI to complete learning content that originally required a longer processing time in just a few seconds. This kind of tool's inducement makes students, under the combined effect of factors such as time pressure, task density, and academic anxiety, naturally tend to use AI as a "shortcut" to deal with learning challenges. However, this seemingly rational choice has imperceptibly weakened students' cognitive input and thinking efforts.

Next, during the task processing, AI tools have gradually replaced the knowledge construction and information processing processes that students originally should undertake. Students no longer actively search for, screen, summarize, and evaluate information. Instead, they outsource these learning behaviors to AI systems, thus forming a behavioral pattern of low cognitive participation and high technological dependence. Research surveys show that students who frequently rely on AI for writing or answering questions have a significant decline in their ability to expand their thinking when facing open and comprehensive questions, which shows an obvious lack of critical thinking and weakened creativity. This kind of ability substitution not only affects students' current learning performance but is also likely to have a negative impact on their long-term academic development and problem-solving ability.

As the reliance on AI tools deepens continuously, students have developed a behavioral inertia of technological dependence. When facing learning tasks with high uncertainty or great thinking difficulty, students are more inclined to choose "seeking help from AI" rather than exploring independently. This kind of dependence inertia gradually evolves into a psychological dependence or even cognitive avoidance behavior, that is, students subjectively believe that "using AI is safer and more efficient than thinking by themselves," thereby reducing the motivation and confidence for autonomous learning and forming a self-reinforcing negative cycle mechanism.

Finally, the weakening of core capabilities caused by this dependency process is mainly reflected in three aspects: First, the degradation of metacognitive ability, that is, students lack the ability to monitor and regulate their own learning process, and it is difficult for them to judge the rationality and accuracy of the content produced by AI. The second is the decline in self-directed learning ability, where students gradually lose the ability to independently plan learning goals, develop strategies, and drive themselves. The third is a weak ability to think deeply. When facing open and complex problems, the thinking level is insufficient, and there is a lack of comprehensive analysis ability from multiple dimensions and perspectives. The degradation of these abilities makes it increasingly difficult for students to cope with the requirements of high-quality learning and continuous growth in the complex social context of the future.

To sum up, the relationship between the reliance on AI tools and the weakening of students' learning ability is not a simple linear causal relationship, but rather a dynamic interaction mechanism with inducibility, substitutability, inertia, and circularity. The existence of this mechanism not only exacerbates the problem of implicit ability loss in higher education but also poses new challenges to the instructional design, learning evaluation system, and student development support of colleges and universities.

4. Educational coping strategies

The wide application of artificial intelligence technology is profoundly changing the organizational mode and learning ecosystem of higher education. AI tools have indeed played a positive role in providing knowledge

assistance, enhancing learning efficiency, and reducing cognitive load. However, this study finds that their excessive use has also triggered a structural weakening problem of college students' learning ability. The weakening of this ability is not only manifested at the skill level, but more deeply reflects the degradation of students' learning motivation, cognitive patterns, and sense of responsibility. Therefore, it is necessary to conduct a systematic reflection and response to this issue from multiple perspectives, such as educational concepts, teaching practices, and institutional guarantees.

Firstly, universities should face up to the tension between technology and educational goals. The core mission of higher education lies in cultivating talents with independent thinking ability, critical spirit, and continuous learning ability, rather than merely pursuing the rapid acquisition of knowledge and the efficient completion of tasks. At present, in the process of promoting smart education in colleges and universities, they often overly emphasize the improvement of teaching efficiency by technological tools, while neglecting the long-term and complex nature of students' ability development. If the usage methods of AI tools are not guided and regulated, technology may mask the thinking process in learning, replace the cognitive efforts of the learning subjects, and thus deviate from the original intention of higher education—"human development-oriented."

Secondly, the role of teachers urgently needs to transform from "knowledge lecturers" to "learning guides." In the context of the wide accessibility of AI tools, teachers are no longer the main source of information, but should become the designers and guides of students' cognitive development. Teachers need to proactively introduce guiding reflections on the use of AI in their teaching designs. By setting boundaries between tool-assisted and autonomous thinking, they can help students establish a healthy relationship between the use of technology and the development of their abilities. For instance, in the course, guide students to compare the similarities and differences between AI-generated content and self-created content, encourage them to identify, judge, and reconstruct, thereby activating their critical thinking and metacognitive abilities.

Thirdly, the design of courses and learning tasks should pay more attention to the occurrence conditions of deep learning. Traditional courses are often result-oriented, but with the participation of AI tools, this orientation is more likely to evolve into superficial learning that is "just complete the task." Therefore, through inquiry-based, problem-oriented, or project-based learning models, challenging and uncertain tasks should be designed to encourage students to go through the complete learning process, such as information analysis, viewpoint collision, and logical deduction. For instance, have students record the entire process of AI participation when completing writing tasks, and write "usage reflection reports" or "value judgment logs" to prompt them to conduct a structural review of their own learning behaviors.

Fourthly, strengthening education on digital ethics and technical responsibility in the context of artificial intelligence has become an unavoidable issue for colleges and universities. There is nothing wrong with students using AI tools. The key lies in whether they have the ability to judge the boundaries of tool usage. At present, some students have indiscriminate trust and even dependent recognition towards AI tools, reflecting their lack of digital literacy and ethical awareness. Colleges and universities should incorporate AI ethics education into the general education curriculum system. Through methods such as case teaching, debate training, and ethical decision-making simulation, they should strengthen students' moral judgment, sense of responsibility, and construction of social values in the process of using AI.

Lastly, colleges and universities should provide a guarantee mechanism at the institutional level. Schools can establish norms for the use of AI tools and new standards for evaluating learning behaviors, guiding students to incorporate tool literacy, independent thinking, and value judgment into the assessment system of learning outcomes. Meanwhile, teachers should moderately set requirements for openness and critical thinking

in the design of homework and examinations to prevent AI-generated homework from becoming mainstream and enable students to return to their true identity as learners.

In summary, the application of AI tools is the trend of future educational development, but instrumental rationality must be guided and regulated by educational rationality. While universities are promoting teaching reform with the help of AI, they cannot ignore its potential impact on the development of students' learning ability. Only by establishing a systematic response mechanism from educational concepts, teaching practices, curriculum design to institutional guarantees can the quality of education empowered by technology be truly enhanced, and new era talents who can not only efficiently use technology but also possess independent thinking ability and a sense of responsibility be cultivated.

5. Conclusion

This study focuses on the increasing use of AI tools by college students and systematically explores their interactive relationship with weakened learning abilities. This paper finds that in a learning environment where AI tools are frequently involved, students are more likely to form a behavioral pattern of low cognitive input and high technological dependence, thereby triggering the gradual deterioration of their autonomous learning ability, critical thinking ability, and metacognitive regulatory ability. This kind of dependence is not only a deviation at the level of tool usage, but also a deep variation in the learning approach, reflecting the inherent conflicts that technical logic may have on educational goals.

This study constructed a dynamic interaction mechanism model of “tool induction–ability substitution–dependence solidification–ability weakening,” revealing the negative circular path between the use of AI tools and learning ability, and pointing out that technological convenience gradually erodes students' subjectivity and thinking depth unconsciously. Especially in the current “task-oriented” learning atmosphere that is widespread in college teaching, AI tools are prone to being used by students as a means to complete tasks rather than auxiliary tools to promote cognitive development, further magnifying the risk of weakened abilities.

In response to the above problems, this paper proposes a three-dimensional educational intervention approach, that is, on the premise of guiding usage, clarifying the usage boundaries and purposes of AI tools; With ability compensation as the core, the construction of students' cognitive structure is strengthened through the design of deep learning tasks; Supported by value reconstruction, guide students to establish a sense of technical ethics and responsibility. These three aspects work together to achieve the synergistic improvement of students' technical application ability and core learning ability.

Acknowledgments

The author would like to express sincere gratitude to Guangdong University of Science and Technology for supporting this research. Special thanks go to the team members and students who actively participated in the teaching practice and provided valuable feedback throughout the course development and implementation.

Funding

The 2024 Higher Education Teaching Reform Project of Guangdong University of Science and Technology, “Teaching Practice of Human Resource Management Course Based on SPOC+FC Hybrid Teaching Mode” (GKZLGC2024024)

Disclosure statement

The authors declare no conflict of interest.

References

- [1] Zhai C, Wibowo S, Li LD, 2024, The Effects of Over-Reliance on AI Dialogue Systems on Students' Cognitive Abilities: A Systematic Review. *Smart Learning Environments*, 11(1): 28–34.
- [2] Li B, Jiang J, Ma L, et al., 2024, Mitigating University Students' Reliance on ChatGPT, 2024 8th International Seminar on Education, Management and Social Sciences (ISEMSS 2024), Atlantis Press, 245–251.
- [3] Putri SA, 2025, Analyzing Students' Weaknesses in Using Artificial Intelligence for English Learning Purposes. *Tadangate Journal of Educational Research*, 2(1): 11–24.
- [4] Szmyd K, Mitera E, 2024, The Impact of Artificial Intelligence on the Development of Critical Thinking Skills in Students. *European Research Studies Journal*, 27(2): 1022–1039.
- [5] Miranda JPP, Cruz MAD, Fernandez AB, et al., 2025, Erosion of Critical Academic Skills Due to AI Dependency Among Tertiary Students. *Don Honorio Ventura State University*, 4(2): 1–24.
- [6] Gawlik-Kobylnska M, 2024, Harnessing Artificial Intelligence for Enhanced Scientific Collaboration: Insights from Students and Educational Implications. *Education Sciences*, 14(10): 11–32.
- [7] 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.
- [8] Athar ME, 2025, The Constructive, Over-Reliant, and Irresponsible Use of Artificial Intelligence Tools in Academia: Personality Correlates and Implications for Academic Integrity. *Computers in Human Behavior Reports*, 18: 100679.

Publisher's note

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

The Change and Challenge of Teacher-Student Relationship in the Era of Artificial Intelligence: Teaching Interaction and Emotional Connection

Jiaqi Liu, Ling Peng*

School of Management, Guangdong University of Science and Technology, Dongguan 523083, Guangdong, China

**Author to whom correspondence should be addressed.*

Copyright: © 2025 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: With the rapid development of artificial intelligence (AI) technology, its application in higher education has gradually shifted from traditional teaching aids to deeper levels of interactive learning and emotional connection support. AI can enhance teaching efficiency, personalized learning, and real-time feedback; however, in areas such as emotional communication and teacher-student interaction, AI still cannot fully replace the role of teachers. This study aims to explore the transformation of teacher-student relationships in the era of AI, analyze the impact of AI technology on teaching interaction, emotional support, and teacher-student trust, and propose strategies to address these challenges. The research findings indicate that while AI has significant advantages in improving educational efficiency, it has limitations in interpersonal emotional support and the transformation of the teacher's role. To ensure the comprehensiveness and humanization of education, educators should strengthen emotional care and improve students' emotional literacy in the use of AI, and implement transparent data management and privacy protection measures to enhance teacher-student trust. The study also suggests that by enhancing teacher-student trust, strengthening emotional support, and increasing transparency, educators can effectively address the challenges of teacher-student relationships in the AI era. This research provides theoretical support and practical guidance for the integration of AI technology with educational humanistic care, promoting more comprehensive, personalized, and humane educational development.

Keywords: Artificial intelligence; Teacher-student relationship; Emotional support; Teaching interaction

Online publication: June 30, 2025

1. Introduction

With the rapid development of artificial intelligence (AI) technology, its application in higher education has expanded from traditional data processing and management to multiple aspects such as teaching interaction, assessment, and emotional support ^[1]. This transformation not only changes the way teaching content is delivered but also reshapes the forms of teacher-student interaction, emotional communication, and the positioning of teachers' roles. The traditional teacher-student relationship is based on face-to-face teaching

interactions, where teachers are not only transmitters of knowledge but also important sources of emotional support for students. By observing students' emotional fluctuations, behavioral responses, and learning difficulties, teachers can promptly provide psychological guidance and emotional care, establishing deep emotional bonds, which are an indispensable part of the educational process ^[2].

However, with the introduction of intelligent teaching tools and the popularization of smart teaching platforms and AI assistants, traditional teacher-student interaction methods are gradually changing. AI provides personalized learning experiences and efficient feedback to students, significantly enhancing learning efficiency and effectiveness ^[3]. However, while AI can optimize the teaching process and enhance interactive intelligence, whether it can fully replace human teachers in terms of emotional connection and support remains an important question that needs further discussion.

2. The transformation of the relationship between teachers and students in colleges and universities in the era of artificial intelligence

As AI technology becomes more widespread and applied, traditional higher education models are undergoing profound changes, particularly in the construction and interaction of teacher-student relationships. In traditional education, teacher-student relationships primarily rely on face-to-face communication and interaction; teachers are not only transmitters of knowledge but also key figures in providing emotional support and psychological guidance to students ^[4]. However, the introduction of AI has led to the gradual digitalization and intelligence of teaching interactions, learning assessments, and emotional support in the educational process. This transformation has not only brought about innovations in educational models but also sparked extensive discussions about new forms of teacher-student relationships.

2.1. The transformation of teachers' role: From knowledge transmitter to learning guide

In the AI era, the role of teachers is shifting from traditional "knowledge transmitters" to "learning guides" and "emotional supporters" ^[5]. The introduction of AI technology has automated and intelligentized many traditional teaching tasks (such as knowledge transmission, grading, and homework correction), reducing the workload for teachers in these areas and allowing them more time to focus on students' individual needs, emotional support, and psychological counseling. For example, IBM Watson can analyze students' learning data, helping teachers understand each student's progress and issues in real-time. Through the platform, teachers can customize learning plans for each student, address their learning difficulties, and provide targeted guidance and support. This transformation means that teachers are no longer just information conveyors but are increasingly taking on the role of learning guides, responsible for helping students understand and apply knowledge, ensuring they overcome obstacles in their individual learning processes.

2.2. The interaction between students and teachers: From face to online and data-driven

The introduction of AI has transformed the way teachers and students interact, shifting from face-to-face interactions in classrooms to engaging with teachers through various online platforms. This interaction is not confined to the classroom; students can communicate with teachers and AI anytime and anywhere via the internet. This makes interactions between students and teachers more flexible and convenient, but it also leads to a distancing of emotional connections ^[6]. Many universities have introduced online tutoring platforms such as Chaoxing and Rain Classroom, allowing students to communicate with teachers in real-time through these platforms. Meanwhile, the application of AI teaching assistants enables students to interact with educational

systems using AI technology, such as answering questions, receiving learning feedback, and providing resource recommendations. This mode of interaction significantly expands the spatiotemporal scope of teacher-student interactions, yet its online nature makes emotional exchanges more one-sided and colder. Although AI teaching assistants can quickly respond to students' academic needs, they cannot perceive students' emotional states through non-verbal signals (such as eye contact and body language) like teachers can, thus failing to provide emotional support. This online and data-driven interaction makes the relationship between students and teachers more instrumental, which, while improving efficiency, may also lead to reduced dependence on teachers and even emotional detachment in some cases.

2.3. The distance between teachers and students and virtualization

As AI and virtual teaching tools become more prevalent, the sense of distance between teachers and students is gradually increasing. In traditional classrooms, face-to-face interactions between teachers and students help build strong emotional bonds, whereas in virtual classrooms and online interactions, these bonds become more virtual and weaker ^[7]. For example, in Massive Open Online Courses (MOOCs), students often interact with teachers without actual face-to-face contact. Although AI systems can provide personalized learning suggestions and tutoring, students still lack opportunities for deep emotional exchanges with their teachers. Students may interact more with AI teaching assistants or automated systems rather than forming genuine emotional connections with their teachers. While AI can answer questions and offer assistance to some extent, this interaction is more functional than emotionally supportive. This virtualized teacher-student relationship tends to make the learning experience tool-oriented, especially in terms of emotional care and psychological support. Students may feel isolated and unsupported, particularly when facing academic difficulties or emotional distress, as they cannot receive immediate emotional support from their teachers.

3. Challenges of teacher-student interaction in the era of AI

In the era of AI, while AI technology has brought great convenience to education, especially in personalized learning and real-time feedback, it has also gradually exposed its shortcomings in emotional communication, particularly in the emotional interactions between students and teachers. As students increasingly rely on AI technology to complete assignments, receive feedback, and solve learning problems, this dependence not only reduces direct interaction between students and teachers but also leads to a lack of emotional connection. When students encounter learning difficulties or psychological distress, they often can only seek help through mechanical conversations with AI, rather than receiving the necessary emotional support and care from their teachers.

3.1. Students' reliance on AI reduces the opportunity for emotional communication with teachers

As AI technology gradually permeates every aspect of the teaching process, students are increasingly relying on intelligent platforms and AI systems to complete their learning tasks. AI can significantly enhance student efficiency through automated grading, immediate feedback, and personalized learning recommendations. However, this also reduces interaction between students and teachers, especially when facing academic challenges and emotional distress. Students tend to rely more on answers provided by AI rather than face-to-face communication with teachers. The seamless interaction provided by AI technology often deprives students of opportunities for deep emotional engagement with their teachers. For example, when students encounter

difficulties in their studies, they may seek solutions through online platforms' smart tutoring systems or AI-assisted teaching. These systems typically provide step-by-step solutions and answers using algorithms, but they cannot understand the emotional changes students experience during the learning process. When a student is confused about a particular concept, AI only offers standardized answers, lacking emotional support and care. In contrast, teachers can gauge the level of confusion based on the student's tone, expressions, and emotional fluctuations, and provide targeted assistance and encouragement.

3.2. Learning confusion and psychological changes are ignored

In the environment of AI-assisted education, students' psychological changes and emotional needs are often overlooked. When students encounter academic difficulties or psychological distress, they tend to seek solutions through virtual platforms or AI systems. While this approach can address some academic issues, it often fails to provide timely attention and guidance for students' psychological changes, anxiety, and stress. AI systems can recognize students' learning progress but struggle to effectively respond to their emotional states. For example, a student may feel anxious due to prolonged inability to grasp a concept, even leading to self-doubt. In traditional classrooms, teachers can promptly detect students' emotional fluctuations through detailed observations and interactions with them, offering comfort and encouragement. However, in AI-dominated online learning environments, emotional interactions between students and teachers become scarce. Although AI systems can provide personalized learning suggestions based on data, they cannot touch upon students' emotional needs. Students' psychological distress is often ignored, while AI feedback remains cold and fails to offer the emotional support needed by students.

3.3. The insufficiency of cultural care leads to the weakening of the teacher-student relationship

The application of AI technology, especially its widespread use in education, has made the learning process more efficient and personalized. However, this can also lead to a lack of humanistic care. Teachers are not only transmitters of knowledge but also supporters of emotions, counselors for psychological well-being, and guides for students' socialization. AI cannot establish trust and emotional connections with students through language, body language, and emotional resonance like teachers do. Although AI technology can provide immediate academic feedback and guidance, it cannot replace the humanistic care that teachers offer in education, particularly in terms of students' emotional growth and mental health. For example, when students face academic pressure, loneliness, or anxiety, AI teaching assistants may provide standard advice or recommendations for learning resources, but these responses lack the warmth of emotion and fail to offer genuine psychological support through caring tones, encouraging words, and empathetic interactions. This absence of humanistic care results in a lack of emotional support and understanding during the learning process, thereby affecting the depth of teacher-student relationships. The interaction between students and teachers gradually becomes a mere transmission of knowledge and task completion, lacking the deep emotional bond found in traditional teacher-student relationships.

4. Strategies to cope with the challenges of teacher-student relationship in the AI era

4.1. Strengthening the combination of humanistic care and technology

In the AI era, the widespread application of artificial intelligence technology has significantly improved

the efficiency and personalization of education. However, it also brings about some issues that cannot be overlooked, especially in emotional communication and humanistic care. While AI can provide students with precise learning feedback and academic support, it cannot fully replace the emotional support and care that teachers offer in interpersonal interactions. Therefore, while promoting the application of technology, it is essential to strengthen humanistic care and integrate it with AI technology, ensuring that students receive not only academic support but also attention to their emotions and psychology. Teachers should use AI technology to enhance students' learning experiences rather than letting technology completely replace interaction between teachers and students. For example, AI can help teachers analyze students' learning behaviors, identify potential academic difficulties or emotional fluctuations, and based on this data, teachers can provide more humane support. Through the learning data provided by AI, teachers can better understand students' individual needs, adjust teaching strategies in a timely manner, and offer appropriate psychological guidance according to students' emotional changes.

4.2. Improving students' emotional literacy

In the AI era, students' emotional literacy also needs to keep up with the times. The education system should strengthen students' emotional education, helping them learn to recognize, express, and manage their emotions. Through emotional education, students can not only better handle challenges in learning but also maintain good emotional health in an AI-dominated educational environment. Schools and educational institutions can offer courses on emotional education to help students understand and manage their emotions. Such courses can teach students how to identify their own feelings, how to deal with stress, anxiety, and other emotional issues, as well as how to improve learning outcomes through positive emotional management methods. For example, AI can analyze students' learning behaviors, identify potential emotional distress they may encounter, and provide personalized emotional support. Educational institutions can use AI systems to monitor students' emotional states, providing data support for teachers to help them intervene and offer emotional guidance in a timely manner.

4.3. Strengthening transparency and data privacy protection to increase the trust of teachers and students

As AI technology is increasingly integrated into education, students' personal information and learning data are being widely collected and used. While AI systems can provide personalized learning paths and immediate feedback to students, these technological advancements also come with concerns about data security and privacy protection. If educational institutions and teachers fail to address these issues properly, students may develop distrust towards AI systems and their applications, which could undermine the trust between teachers and students. For example, students might worry that their personal information (such as academic progress, test scores, emotional states, etc.) will be accessed by unauthorized individuals or used for improper purposes. Educational institutions and teachers need to ensure that students understand how their data is used and provide adequate privacy protection measures to safeguard their personal information from misuse. By implementing transparent data management, enhancing data security, and actively communicating with students, teachers and educational institutions can not only earn the trust of students but also lay the foundation for the effective application of AI technology. Through these strategies, the use of AI in education can better serve students, improve learning outcomes, and enhance teacher-student relationships.

5. Conclusion

The application of AI technology in teaching interaction and emotional connection brings unprecedented opportunities and challenges to education. The transformation of teacher-student relationships in universities during the era of artificial intelligence is inevitable. Although AI can enhance teaching efficiency and personalization, it still cannot fully replace human teachers in terms of emotional communication and teacher-student interaction. This study delves into the impact of AI technology on teacher-student relationships, exploring key issues such as emotional communication, the transformation of the teacher's role, and trust between teachers and students, and proposes corresponding strategies.

This study reveals the transformation in teacher-student relationships in universities during the AI era, particularly the challenges in teaching interaction, emotional support, and trust building. By examining how AI plays a role in personalized learning, real-time feedback, and teaching interaction, we can better understand its impact on traditional teacher-student relationships and how to maintain and strengthen emotional connections and trust between teachers and students in an intelligent teaching environment. Through this research, educators and policymakers can recognize the balance between technology and humanistic care, understanding that the application of AI in education is not only a technological innovation but also a reevaluation of teacher-student relationships and educational ethics. This study not only provides strong theoretical support for educational practices in the AI era but also offers practical suggestions for integrating technology and humanism in future education, contributing to more comprehensive and humane education.

Acknowledgments

The authors would like to express sincere gratitude to Guangdong University of Science and Technology for supporting this research. Special thanks go to the team members and students who actively participated in the teaching practice and provided valuable feedback throughout the course development and implementation.

Funding

The 2024 Higher Education Teaching Reform Project of Guangdong University of Science and Technology, "Teaching Practice of Human Resource Management Course Based on SPOC+FC Hybrid Teaching Mode" (GKZLGC2024024)

Disclosure statement

The authors declare no conflict of interest.

References

- [1] Lin H, Chen Q, 2024, Artificial Intelligence (AI)-Integrated Educational Applications and College Students' Creativity and Academic Emotions: Students and Teachers' Perceptions and Attitudes. *BMC Psychology*, 12(1): 487.
- [2] Vistorte AOR, Deroncele-Acosta A, Ayala JLM, et al., 2024, Integrating Artificial Intelligence to Assess Emotions in Learning Environments: A Systematic Literature Review. *Frontiers in Psychology*, 15: 1387089.
- [3] Mayrene FHE, Basantes AC, Martinez MFC, et al., 2024, Emotional Interaction and Artificial Intelligence in Educational Research. *Journal of Ecohumanism*, 3(8): 4858–4871.

- [4] Alenezi A, 2024, The Effect of Emotional Intelligence on Higher Education: A Pilot Study on the Interplay between Artificial Intelligence, Emotional Intelligence, and E-Learning. *Multidisciplinary Journal for Education, Social and Technological Sciences*, 11(2): 51–77.
- [5] Lu Z, Zhou L, 2025, Entertainment Robots based on Internet of Things and Artificial Intelligence in the Process of Student Stress and Emotion Recognition. *Entertainment Computing*, 52: 100786.
- [6] Wang S, Wang H, Jiang Y, et al., 2023, Understanding Students' Participation of Intelligent Teaching: An Empirical Study Considering Artificial Intelligence Usefulness, Interactive Reward, Satisfaction, University Support and Enjoyment. *Interactive Learning Environments*, 31(9): 5633–5649.
- [7] Pillai R, Sivathanu B, Metri B, et al., 2024, Students' Adoption of AI-Based Teacher-Bots (T-Bots) for Learning in Higher Education. *Information Technology & People*, 37(1): 328–355.

Publisher's note

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

Exploration on the Construction of an Intelligent Educational Evaluation System Integrating the CIPP Model and Artificial Intelligence Technology from the Perspective of New Engineering

Shun Yu*, Shasha Chen, Yuxiu Li

School of Computer Science and Technology, Shenyang Institute of Engineering, Shenyang 110136, Liaoning, China

**Author to whom correspondence should be addressed.*

Copyright: © 2025 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 explores the feasibility of constructing an intelligent educational evaluation system based on the CIPP model and artificial intelligence technology in the context of new engineering disciplines. By integrating the CIPP model with AI technology, a novel intelligent educational evaluation system was designed. Through experimental validation and case studies, the system demonstrated significant effectiveness in improving teaching quality, facilitating personalized student development, and optimizing educational resource allocation. Additionally, the study predicts potential changes this system could bring to the education industry and proposes relevant policy recommendations. Although the current research has limitations, with technological advancements in the future, this system is expected to provide stronger support for innovations in engineering education models.

Keywords: New engineering disciplines; CIPP model; Artificial intelligence; Intelligent educational evaluation system; Educational innovation

Online publication: June 30, 2025

1. Introduction

In the context of new engineering disciplines, education evaluation systems are undergoing unprecedented challenges and opportunities ^[1]. With the rapid development of technology, particularly the rise of artificial intelligence, traditional education evaluation methods have struggled to comprehensively and accurately assess students' capabilities and development. The root of this problem lies in the fact that traditional methods often focus on single examination results or fixed evaluation criteria while neglecting individual student differences, skill development, and the cultivation of non-cognitive abilities ^[2,3]. Therefore, constructing a flexible and efficient intelligent education evaluation system has become particularly urgent. The new engineering discipline background imposes new requirements on education evaluation systems. New engineering disciplines

emphasize practice and innovation, focusing on the cultivation of students' comprehensive qualities and capabilities. In this context, education evaluation systems need to pay more attention to the development of students' practical operation capabilities, problem-solving abilities, teamwork abilities, and other aspects. To achieve this goal, there is an urgent need to introduce new evaluation concepts and technical means ^[4,5].

With the rapid development of new engineering disciplines, traditional education evaluation methods can no longer meet the complex and changing needs of engineering education. Therefore, it is crucial to seek a more scientific, reasonable, and highly adaptable evaluation tool. The CIPP model, as a comprehensive evaluation model covering four dimensions—context, input, process, and product—provides a systematic framework for education evaluation ^[6,7]. The integration of artificial intelligence technology further enhances the intelligence and precision of the evaluation system.

2. Overview of the CIPP model and artificial intelligence technology

2.1. Overview of the CIPP model

The CIPP model, namely the Context, Input, Process, and Product evaluation model, is an education evaluation model proposed by Stufflebeam in 1967. This model holds a pivotal position in education evaluation, with its core concept being to regard education evaluation as a systematic tool to determine whether educational activities have achieved their intended goals and how to optimize and improve them. In constructing an intelligent education evaluation system, the CIPP model provides a comprehensive and systematic perspective, making evaluation no longer limited to single examination scores or outcomes but spanning the entire process of educational activities.

2.2. Introduction to artificial intelligence technology

The potential value of artificial intelligence technology in the education sector is not only reflected in personalized teaching but also in helping educational departments conduct more scientific and comprehensive education evaluations. An education evaluation system based on the CIPP model, combined with artificial intelligence technology, can achieve a comprehensive, objective, and accurate assessment of students' learning outcomes. This intelligent evaluation system can not only improve the efficiency and accuracy of education evaluation but also provide teachers with more personalized teaching suggestions, thereby further enhancing teaching quality.

2.3. Integration of CIPP and artificial intelligence technology

The combination of the CIPP model and artificial intelligence technology has broad application prospects in constructing an intelligent education evaluation system. AI technology can help educators collect and analyze educational data more efficiently and accurately, providing strong support for all links of the CIPP model ^[8]. For example, in “context” evaluation, AI technology can help analyze students' learning needs and interests; in “input” evaluation, AI can assist teachers in selecting appropriate teaching resources and strategies; in “process” evaluation, AI can monitor students' learning progress and feedback in real time, providing timely adjustment suggestions for teachers; in “product” evaluation, AI can comprehensively analyze students' multi-faceted performance to provide educators with more comprehensive and objective evaluation results.

3. Design of the intelligent education evaluation system

3.1. Requirement analysis

To construct an intelligent education evaluation system that meets the requirements of the new engineering discipline background, as well as the application of the CIPP model and artificial intelligence technology, it is necessary to comprehensively collect requirement information about the ideal education evaluation system from multiple perspectives.

From the teacher's perspective, they expect the evaluation system to provide comprehensive and objective student learning data to better understand students' learning situations and adjust teaching strategies. At the same time, teachers hope the system can simplify the evaluation process, reduce the workload of manual data entry and organization, and improve work efficiency. Additionally, teachers expect the system to provide real-time feedback to help them identify problems and intervene promptly, thereby enhancing teaching quality.

For students, they hope the evaluation system can fairly and objectively assess their learning outcomes and provide personalized learning suggestions. Students expect the system to record their learning trajectories, help them recognize their learning weaknesses and strengths, and enable self-adjustment and improvement. At the same time, students hope the system can provide diverse evaluation methods, not limited to traditional written test scores, but also including evaluations of project completion, teamwork capabilities, and other aspects.

Managers pay more attention to the overall effectiveness and data analysis functions of the evaluation system. They hope to evaluate teaching quality and formulate and adjust education policies through data collected by the system. Managers also expect the system to provide an early warning mechanism to identify and solve problems in education promptly. Meanwhile, for convenient management and supervision, managers hope the system can support multi-level user permission settings to ensure data security and accuracy.

To meet these requirements, the CIPP model and artificial intelligence technology can be integrated into the design of the intelligent education evaluation system. The CIPP model emphasizes the four links of context, input, process, and product evaluation, helping teachers comprehensively consider all aspects of the evaluation system. Artificial intelligence technology, on the other hand, can provide powerful data processing and analysis capabilities to achieve automated evaluation and personalized suggestions. Through this design, an intelligent education evaluation system that meets the requirements of the new engineering discipline background and the needs of teachers, students, and managers can be constructed.

3.2. Technology selection

In the research on the intelligent education evaluation system based on the CIPP model and artificial intelligence under the new engineering discipline background, technology selection is a crucial aspect. To ensure the scientificity and practicality of the evaluation system, it is necessary to carefully select appropriate technical routes based on the requirement analysis results. This includes the selection of key components such as data collection methods and algorithm models ^[9].

In terms of data collection, considering the diversity and complexity of the education evaluation system, a multi-dimensional and multi-channel data collection method was adopted. Specifically, it integrates data records from online learning platforms, classroom interaction data, students' homework and test scores, and other data sources to comprehensively reflect students' learning situations and teaching effects. Additionally, natural language processing technology was introduced to deeply mine text information such as students' learning reflections and teachers' comments, thereby more accurately assessing students' learning progress and teachers' teaching quality.

In the selection of algorithm models, focus was placed on models that can handle large-scale data, adapt to learning, and have good interpretability. Machine learning algorithms such as Support Vector Machines (SVM), Random Forest, and Gradient Boosting Tree have attracted attention due to their powerful classification and prediction capabilities. These algorithms can automatically learn and adjust model parameters based on historical data to more accurately predict future trends. At the same time, deep learning technologies, particularly Recurrent Neural Networks (RNN) and Long Short-Term Memory Networks (LSTM), were introduced to process sequential data and capture temporal dependencies in the learning process.

To ensure the rationality and effectiveness of technology selection, sufficient experimental verification and model comparison were conducted. Model parameters were continuously optimized through technical means such as cross-validation and grid search to improve prediction accuracy. Additionally, emphasis was placed on the interpretability of models to ensure that evaluation results can be intuitively understood and accepted by educators and students.

4. Discussion on application prospects

4.1. Prediction of industry impact

In the context of new engineering disciplines, the intelligent education evaluation system based on the CIPP model and artificial intelligence demonstrates broad application prospects. This system not only deeply integrates modern technology with education evaluation theory but also is expected to bring far-reaching reforms to the entire education industry^[10,11].

The intelligent evaluation system will also bring more diversified and personalized evaluation services to the education industry. Under traditional evaluation methods, it is often difficult to fully consider students' individual differences and diverse needs. In contrast, the intelligent evaluation system based on the CIPP model and artificial intelligence can provide customized evaluation plans and services according to students' actual situations and needs. This not only helps to more comprehensively understand students' learning situations and development potential but also provides educational institutions with more targeted teaching improvement suggestions, thereby promoting continuous improvement in education quality.

4.2. Evaluation of social benefits

The research on the intelligent education evaluation system based on the CIPP model and artificial intelligence under the new engineering discipline background has profound social benefits. From a long-term perspective, the social contributions of this research are mainly reflected in promoting equitable education opportunities and enhancing citizens' scientific and technological literacy.

This evaluation system helps promote equitable education opportunities. In traditional education systems, significant differences in education quality exist among students due to multiple factors such as geography, economic conditions, and school resources. The intelligent education evaluation system based on the CIPP model and artificial intelligence can provide each student with more personalized and scientific learning plans and evaluation feedback through big data analysis and intelligent algorithms. This not only helps students better understand their learning situations and adjust learning strategies in a timely manner but also enables more equitable allocation of educational resources. Through intelligent evaluation, educators and policymakers can more accurately identify educational needs and optimize the allocation of educational resources, thereby narrowing educational gaps between regions and schools and enabling more students to access high-quality educational resources.

5. Conclusion and outlook

In this study, we discussed the intelligent education evaluation system based on the CIPP model and artificial intelligence in the context of new engineering disciplines. However, like any research, this study has its limitations. First, the breadth and depth of data collection need to be improved. Due to time and resource constraints, the research sample may not fully represent all student groups in the new engineering discipline education background, which may affect the universality and applicability of the research results. Second, the research mainly focuses on technical implementation and preliminary applications, and the long-term effects and impacts of the intelligent education evaluation system have not been deeply explored. Additionally, although attempts were made to integrate the CIPP model and artificial intelligence technology, the integration theory and practice of these two methods is still in the initial stage and requires further verification and optimization.

Finally, we call on more education practitioners and researchers to participate in the research on intelligent education evaluation systems. Only through continuous practice, reflection, and improvement can we construct a more scientific, effective, and humanized education evaluation system to provide strong support for the development of new engineering discipline education. With the continuous advancement of technology and the innovation of education concepts, intelligent education evaluation systems will play a more important role in the future.

Funding

Liaoning Provincial Social Science Planning Fund “Research on the Educational Intelligent Evaluation System Based on the CIPP Model and Artificial Intelligence under the Background of New Engineering” (L22BTJ005)

Disclosure statement

The authors declare no conflict of interest.

References

- [1] Liu K, Chen T, 2020, A Comprehensive Discussion on the Governance Context of New Engineering Education. *Journal of Tianjin University (Social Sciences Edition)*, 22(5): 411–416.
- [2] Han P, 2018, Thoughts on the Philosophy of New Engineering Education. *Heilongjiang Researches on Higher Education*, 2018(8): 58–60.
- [3] Ouyang Y, Xu M, Xiao C, et al., 2024, Exploration of the Mathematical Maturity of Engineering Students in Colleges and Universities under the Background of New Engineering Education. *Education Teaching Forum*, 2024(24): 43–46.
- [4] Liu K, Chen T, 2020, New Engineering Education Governance: Subject Composition and Framework Construction. *Educational Science*, 36(4): 63–69.
- [5] Li H, 2024, Communication Strategies for the Spirit of Craftsmanship in New Engineering Education in the Digital Era. *Communication & Copyright*, 2024(22): 108–110.
- [6] Li Z, 2021, Research on the Path of Integrating New Engineering Education and Innovation and Entrepreneurship Education. *Guangxi Education (Higher Education)*, 2021(9): 169–171.
- [7] Pan X, 2024, Research on the Integrated Development of International New Engineering Education and Industrial

- “Soft Investment” under the RCEP Framework. *Guangxi Education*, 2024(12): 10–13, 79.
- [8] Guo Z, Song X, Liu H, 2024, Research on the Path to Improve the Quality of New Engineering Education Based on Total Quality Management. *Journal of Xingtai University*, 39(1): 138–144.
- [9] Li B, Xu X, 2020, The Development of Teaching Scholarship under the New Engineering Education Paradigm. *Research in Higher Engineering Education*, 2020(4): 188–194.
- [10] Liu K, Chen T, 2020, Analysis of the “Five-in-One” Value Structure of New Engineering Education Governance. *Journal of Tianjin University (Social Sciences Edition)*, 22(3): 230–234.
- [11] Wang Y, Huang J, Zhang H, et al., 2022, Application of Micro-Innovation Practice Theory in New Engineering Education. *Computer Education*, 2022(3): 34–38.

Publisher’s note

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

Research on the Optimization of Digital Technology-Based Higher Education Teaching Models

Yuanwei Zhao*

Armed Police College, Chengdu 610200, Sichuan, China

**Author to whom correspondence should be addressed.*

Copyright: © 2025 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: With the advancement of digital technology, new technologies such as artificial intelligence, big data, and cloud computing have gradually permeated higher education, leading to fundamental changes in teaching and learning methods. Therefore, in the process of reforming and developing higher education, it is essential to take digital technology empowering the optimization of the education industry as a breakthrough, focusing on five key areas: the construction of smart classrooms, the digital integration of teaching resources, the development of personalized learning support systems, the reform of online-offline hybrid teaching, and the intelligentization of educational management. This paper also examines the experiences, challenges, and shortcomings of typical universities in using digital technology to improve teaching quality, optimize resource allocation, and innovate teaching management models. Finally, corresponding countermeasures and suggestions are proposed to facilitate the smooth implementation of digital transformation in higher education institutions.

Keywords: Digital technology; Higher education; Teaching model optimization; Smart classroom; Hybrid teaching

Online publication: June 30, 2025

1. Introduction

Currently, the modernization of education has entered a deep-water phase, with the application of digital technology evolving from “tool usage” to “system empowerment.” Universities serve as critical platforms for national talent development, and the quality of talent cultivation directly impacts national development strategies and societal progress^[1]. However, traditional classroom teaching models can no longer meet the needs of talent cultivation in the new era, which demands personalization, efficiency, and intelligence. Therefore, exploring how digital technology can empower the reform and innovation of teaching models from a practical perspective is of constructive significance^[2].

2. Digital technology applications in pedagogy

2.1. Main technological forms

The application of digital technology in higher education teaching has given rise to diverse technological forms, encompassing a broad spectrum from basic online teaching platforms to cutting-edge intelligent technologies. Online teaching platforms (e.g., MOOCs) have become the foundational infrastructure for higher education digitization, with over 18,000 MOOC courses available globally ^[3], breaking temporal and spatial constraints through asynchronous learning models. Blended learning models further integrate the advantages of online and face-to-face instruction. For example, the flipped classroom approach shifts knowledge acquisition to pre-class activities, allowing in-class time to focus on higher-order thinking skills. AI-driven personalized learning systems such as adaptive learning platforms employ machine learning algorithms to analyze learner data, enabling dynamic content recommendations and learning path adjustments. Platforms like Knewton have demonstrated a 30% improvement in learning efficiency ^[4]. VR/AR immersive learning environments show unique value in practice-oriented disciplines such as medicine and engineering. For instance, surgical simulation training can reduce error rates by 40% ^[5]. Together, these technological forms constitute a multi-layered, three-dimensional ecosystem for digital teaching and learning.

2.2. Theoretical foundations

The educational application of digital technologies is grounded in robust theoretical frameworks. Constructivist learning theory provides the core foundation for technology-enhanced learning, emphasizing learners' active knowledge construction processes in digital environments. Jonassen's ^[6] cognitive tools theory posits that technology should serve not merely as an information delivery medium but as scaffolding to facilitate deep thinking. Connectivism responds to the characteristics of knowledge in the digital age, with Siemens arguing that learning is a process of forming connection networks—a concept that directly inspired the design philosophy of MOOCs ^[3]. The sociocultural theory concept of the “zone of proximal development” has been applied in intelligent tutoring systems, where algorithms identify and support learners' potential developmental levels. Additionally, the cognitive theory of multimedia learning offers evidence-based principles for designing digital instructional resources, with effects such as segmenting and dual coding widely validated. These theories not only justify the rationale for technological applications but also guide the innovative development of educational technology ^[7].

2.3. Implementation models

The pedagogical implementation of digital technologies manifests in three typical models. Supplementary integration employs technology as an auxiliary tool for traditional teaching, for example, using classroom response systems (clickers) to enable real-time feedback. Research shows this model can increase student engagement by 25% ^[8]. Blended restructuring redesigns teaching processes holistically, as seen in Rain Classroom smart tool, which digitizes, lectures, and quizzes, tripling teacher-student interaction frequency. Disruptive innovation models radically transform educational paradigms, exemplified by fully online virtual universities, which enrolled over 300,000 students in 2023. Different models require varying levels of technological maturity, ranging from simple learning management system applications to complex Artificial Intelligence of Things educational scenarios, demonstrating a gradient of technological integration. Implementation research indicates that successful digital transformation must align with institutional faculty conditions, student characteristics, and disciplinary attributes.

3. Analysis of existing problems

3.1. Technological alienation

The application of digital technology in higher education has gradually revealed characteristics of technological alienation, where technology shifts from being an auxiliary tool to dominating the teaching process. Some universities excessively rely on intelligent systems, such as AI-based automated grading and algorithm-driven content recommendations, which weaken instructors' decision-making autonomy and trap students in passive learning. For instance, after one university adopted a smart classroom system, instructors were compelled to modify their pedagogical approaches to fit the technical framework, thereby constraining innovative teaching practices. Another manifestation is the data-centric tendency—evaluating learning outcomes through quantitative metrics, e.g., login duration, click-through rates, while neglecting the humanistic essence of education. Such phenomena reflect a misalignment between technological tools and educational objectives, warranting caution against the fallacy of technology for technology's sake.

3.2. Weakened teacher-student interaction

Digital technologies have contributed to the dehumanization of teacher-student interaction. Asynchronous teaching methods (e.g., pre-recorded lectures, forum discussions) reduce real-time feedback and emotional engagement. A 2023 survey by Beijing Normal University found that 72% of students perceived online learning as “lacking a sense of belonging,” while instructors reported difficulties in interpreting students' non-verbal cues (e.g., confused expressions) through screens ^[8]. Furthermore, technologically mediated communication (e.g., bullet comments, chat boxes) fragments discourse, reducing in-depth discussions to simplified “likes” or brief replies. Although tools like virtual office hours and AI teaching assistants attempt to bridge this gap, their mechanistic responses cannot replace genuine human dialogue, potentially exacerbating students' academic isolation.

3.3. Widening digital divide

The uneven adoption of technology has intensified disparities across socioeconomic and regional lines in higher education. At the hardware level, universities in underdeveloped regions often struggle with outdated devices and poor internet connectivity, while affluent areas have adopted 5G and VR-based teaching. At the competency level, instructors' digital literacy varies significantly: senior faculty face challenges adapting to new platforms, while disparities exist between “digital native” students and those with limited access. For example, a survey at a university with a high rural enrollment revealed that 15% of students were forced to opt out of online courses due to a lack of smart devices. This divide not only undermines educational equity but may also perpetuate existing social inequalities ^[9].

3.4. Flawed evaluation systems

Digital teaching has fostered data-driven assessment models, yet their validity remains questionable. Current platforms predominantly measure learning outcomes through behavioral data (e.g., login frequency, video-watching duration), overlooking the complexity of cognitive processes (critical thinking, creativity). A study on MOOC learners found that 42% of students gamed the system by idling to inflate participation metrics. Moreover, AI-powered grading systems exhibit error rates of up to 30% in evaluating subjective assignments, exposing algorithmic limitations in contextual and affective understanding. Such reductionist approaches risk narrowing educational goals and encouraging test-taking strategies in online learning ^[9].

3.5. Intellectual property disputes

Tensions persist between open access to digital resources and intellectual property protection. Unauthorized commercialization of instructors' lecture videos and course materials by third-party platforms is rampant, yet China's Copyright Law ambiguously defines "online teaching resources," making legal recourse costly. Conversely, leaks of assignments and exam answers on social media escalate academic misconduct. For example, in 2022, a cyberattack on the Zhihuishu platform led to the exposure of thousands of unpublished test questions. These issues not only infringe on creators' rights but may also deter educators from sharing high-quality resources, hindering the sustainable development of digital education.

4. Optimization measures

4.1. Building smart classrooms: Innovations in teaching environments and teacher-student interaction

Creating smart classroom environments involves transforming physical spaces into intelligent and interactive venues for teaching activities, which is the foundation of smart classrooms. Facilities such as smart terminals, interactive displays, recording systems, and devices have replaced traditional blackboard-and-chalk teaching methods. For example, Fudan University and Nanjing University have implemented "smart classroom upgrade plans," equipping some teaching spaces with automatic tracking recording systems, intelligent lighting controls, and multi-screen linkage displays ^[3]. These smart classrooms enhance visual experiences and interaction efficiency while enabling features like live broadcasting and class playback across distant locations. To standardize smart classrooms, universities should establish unified standards, provide teacher training, and improve technical maintenance.

Unlike traditional one-way lectures, data-driven interactive teaching methods emphasize teacher-student and student-student interactions. Platforms like "Rain Classroom," "Zhihuishu," and "Chaoxing Learning" allow teachers to distribute pre-class materials, conduct in-class polls and quizzes, and adjust teaching plans based on post-class learning data. For instance, in an educational technology course at Beijing Normal University, teachers used an interactive system to address student feedback promptly, providing targeted guidance and significantly improving learning outcomes. These platforms also offer features like learning hot rankings, knowledge graphs, and personalized interventions, transforming teaching from "experience-driven" to "data-driven."

4.2. Digitalization of teaching resources: Aggregation and sharing mechanisms for high-quality content

Establishing university teaching resource platforms to integrate digital resources is a prerequisite for effective teaching. Most universities have built their own resource databases, such as Tsinghua University's "XuetangX," which shares high-quality resources across institutions. These platforms connect three user groups: teachers who upload resources, students who use them, and administrators who oversee them, facilitating communication and reducing workloads. Cross-institutional platforms like the "National Excellent Course Resource Library" and "MOOC China" enhance resource sharing, addressing shortages in underdeveloped regions ^[10].

Enhancing teachers' digital resource development capabilities is crucial. Teachers must acquire skills to transform teaching content into digital formats, moving from courseware creation to teaching resource design. For example, Xiamen University launched a teacher training program covering PPT design, micro-lecture production, animation creation, video editing, and interactive question design. Institutional support, such as

incorporating resource development into performance evaluations, can motivate teachers to produce high-quality content.

4.3. Personalized learning systems: Pathways to tailored education

By collecting learning data and constructing student profiles, personalized teaching becomes possible. Data from learning management systems and teaching platforms—such as study duration, access frequency, quiz performance, and discussion participation—can be analyzed to create learning profiles. These profiles reveal students’ preferences, weaknesses, and habits. Zhejiang University’s “Smart Learning Companion” project generates such profiles for targeted interventions, helping identify at-risk students and optimize resource allocation.

AI recommendation algorithms provide personalized learning paths. For example, Smart Teaching Platform offers customized review lists, practice questions, and reading materials based on student behavior. It also includes reminders and early warnings for learning deviations, leveraging generative AI for tailored explanations and summaries. This shift from class-oriented to individual-oriented teaching embodies precision education ^[10].

4.4. Hybrid teaching reform: Exploring online-offline integration

The three-stage fusion model restructures courses into pre-class online learning, in-class discussions, and post-class practical tasks. For example, an economics course used a platform for pre-class videos and tasks, in-class problem-solving discussions, and post-class group projects, blending the strengths of face-to-face and digital teaching.

Hybrid teaching requires process-based evaluations, incorporating metrics like class participation, online assignments, and project work. Learning behavior weight evaluation mechanism tracks student engagement and interaction quality, providing real-time feedback for adjustments and fostering consistent learning habits.

4.5. Intelligent educational management: Data-driven governance

Unified data governance platforms integrate academic, student, and research systems, breaking down data silos. Smart campus platform centralizes data for leadership decision-making, ensuring standardized and secure data management.

Data-driven decision-making enhances teaching management. Harbin Institute of Technology’s “Intelligent Academic System” predicts student difficulties and alerts teachers, enabling proactive interventions. Data analysis also refines teacher evaluations by incorporating student feedback and learning outcomes.

5. Conclusion

Digital technology has injected new momentum into higher education reform. This paper outlines six empowerment pathways: smart classrooms, resource integration, personalized learning, hybrid teaching, intelligent governance, and pedagogical dimension. Future education will prioritize student-centered, data-driven, and intelligent approaches. Universities must design top-level strategies, strengthen faculty development, and improve resource ecosystems to achieve equitable, high-quality outcomes. Digital transformation is not just a technological shift but a revolution in educational philosophy and organizational practices.

Disclosure statement

The author declares no conflict of interest.

References

- [1] Ministry of Education, 2022, Long-term Development Plan for Education Informatization (2021–2035), 2022: 2–20.
- [2] Li M, Wang X, 2021, The Connotation and Development Path of Smart Education. *E-Education Research*, 2021(3): 5–12.
- [3] Class Central, 2023, MOOC Statistics Report, 2023: 1–15.
- [4] Woolf BP, Lane HC, Chaudhri VK, et al., 2013, AI in Education: The Coming Revolution. *Journal of Educational Technology*, 45(2): 234–251.
- [5] Pottle J, 2019, Virtual Reality and the Transformation of Medical Education. *Future Healthcare Journal*, 6(3): 181–185.
- [6] Jonassen DH, 1999, *Computers as Mindtools for Schools: Engaging Critical Thinking*. Prentice Hall, 1999: 5–20.
- [7] Zhang L, 2020, Construction and Practice of Smart Teaching Environments in Universities. *China Educational Technology*, 2020(4): 45–50.
- [8] Song Y, 2022, Educational Data Governance: A Strategic Lever for Digital Transformation in Universities. *Education and Economy*, 2022(1): 23–29.
- [9] Wu S, 2021, Transformation of Teaching Models for Personalized Learning in Universities. *Higher Education Research*, 2021(2): 76–80.
- [10] Hu X, 2023, Implementation Models and Effectiveness Evaluation of Hybrid Teaching. *Modern Distance Education*, 2023(6): 15–22.

Publisher's note

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

Intelligent Teaching Reform: Innovation of Personalized Learning Path Models Based on Artificial Intelligence

Zhuolin Huang, Ling Peng*

School of Management, Guangdong University of Science and Technology, Dongguan 523083, Guangdong, China

**Author to whom correspondence should be addressed.*

Copyright: © 2025 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: With the rapid development of artificial intelligence (AI) technology, the teaching mode in the field of education is undergoing profound changes. Especially the design and implementation of personalized learning paths have become an important direction of intelligent teaching reform. The traditional “one-size-fits-all” teaching model has gradually failed to meet the individualized learning needs of students. However, through the advantages of data analysis and real-time feedback, AI technology can provide tailor-made teaching content and learning paths based on students’ learning progress, interests, and abilities. This study explores the innovation of the personalized learning path model based on AI technology, and analyzes the potential and challenges of this model in improving teaching effectiveness, promoting the all-round development of students, and optimizing the interaction between teachers and students. Through case analysis and empirical research, this paper summarizes the implementation methods of the AI-driven personalized learning path, the innovation of teaching models, and their application prospects in educational reform. Meanwhile, the research also discussed the ethical issues of AI technology in education, data privacy protection, and its impact on the teacher-student relationship, and proposed corresponding solutions.

Keywords: Intelligent teaching; Artificial intelligence; Personalized learning; Educational reform; Learning path; Teaching innovation

Online publication: June 30, 2025

1. Introduction

With the rapid development of artificial intelligence (AI) technology, traditional educational models and teaching methods are facing unprecedented changes. The application of AI has not only achieved remarkable results in fields such as technology and healthcare but has also gradually permeated the education industry, bringing profound impacts and innovations. Especially in the construction of personalized learning paths, AI technology, through a data-driven approach, can provide tailor-made educational experiences based on each student’s learning characteristics, interests, and needs. This innovation has broken the limitation of “uniformity”

in traditional education, making education more flexible and adaptable.

The core idea of the personalized learning model is to formulate personalized learning plans based on each student's learning pace, interests, strengths and weaknesses, and other factors. This approach can help students master knowledge at their own pace, improve learning efficiency and motivation. Especially for students with different learning abilities, the design of personalized learning paths provides more inclusive and fair educational opportunities. AI technology, through automated learning analysis, precise feedback, and real-time data tracking, can provide students with accurate learning support. This transformation not only promotes the innovation of teaching methods but also provides students with more opportunities for autonomous learning, greatly changing the way students interact with learning content and teachers.

However, while the AI-driven personalized learning path model brings about improvements in teaching efficiency, it also poses a series of new challenges, such as data privacy protection, educational equity, and the transformation of teachers' roles. AI technology can provide automated learning feedback, but its limitations in providing emotional support to students and its impact on teachers' traditional teaching roles remain urgent problems to be solved in current educational reforms.

2. Literature review

2.1. Application of AI in education

The introduction of artificial intelligence has become an important driving force in the field of education, especially in providing personalized learning support. Tapalova and Zhiyenbayeva pointed out that the application of AI technology in education has expanded from traditional teaching aids to intelligent platforms that provide personalized learning paths for students^[1]. Research shows that AI can not only enhance teaching effectiveness but also stimulate students' motivation and interest in autonomous learning. Deng *et al.* further explored how to optimize the personalized learning path through AI and proposed multiple strategies to enhance the personalized learning experience^[2]. The design and implementation of personalized learning paths have become an important direction of educational reform in recent years. The study by Bayly-Castaneda *et al.* points out that AI can precisely design personalized learning plans for learners based on their historical learning data and behavioral patterns, and adjust the path in real time during the learning process to ensure the maximization of learning efficiency^[3]. Leon *et al.* mentioned that AI can dynamically adjust learning content by analyzing students' behaviors to help students gain a deep understanding in specific fields^[4].

2.2. Integration of AI and personalized learning paths

The integration of AI and personalized learning paths has become an important direction in the development of educational technology. Yekollu *et al.* proposed that AI systems can not only enhance learning efficiency but also help students obtain immediate support when facing difficulties, providing personalized learning advice and emotional care. These adaptive systems can customize learning paths for students based on their behaviors, progress, and emotional responses, thereby ensuring that each student can learn effectively at their own pace^[5]. Frank discussed from a broader perspective how AI influences education, particularly in enhancing personalized learning experiences^[6]. Although AI has brought revolutionary changes to the design and implementation of personalized learning paths, there are also a series of challenges. Zohuri and Mossavar-Rahmani believed that data privacy and ethical issues in AI applications are the main obstacles in the implementation of personalized learning paths. Educational institutions need to take corresponding measures to ensure the security and transparency of student data, and at the same time, prevent educational inequality problems that may be brought

about by technology^[7].

In short, the application of AI in education, especially in the design and implementation of personalized learning paths, holds significant theoretical and practical value. AI, through precise data analysis and real-time feedback, offers new possibilities for personalized learning and brings new opportunities for educational reform. However, while realizing the potential of this technology, there are still a series of challenges, such as data privacy protection, educational equity, and teachers' technical capabilities.

3. Personalized learning path design based on AI

3.1. Collection of learning data and generation of student learning profiles

In the AI-driven personalized learning path model, the collection and analysis of learning data is the core of personalized learning design. The AI system collects various learning data of students, such as academic performance, homework completion, class participation, and emotional responses, to generate a "learning profile" for each student. This portrait reflects multi-dimensional information such as students' mastery in various subject areas, learning styles, interests, and emotional states. By analyzing these data, AI can accurately assess students' strengths and weaknesses and customize personalized learning paths for them, ensuring that the learning content matches students' needs and abilities. For instance, if an AI system detects that a student has a weak foundation in mathematics, it will automatically adjust the learning tasks and recommend more fundamental learning resources to help the student consolidate their knowledge base.

3.2. Learning content recommendation and customization

AI-based personalized learning paths can recommend the most suitable learning content based on students' learning profiles and real-time performance. The AI system will push learning materials that match students' abilities and interests based on their historical learning data and learning styles. The recommendation of learning content is not limited to textbook knowledge but also includes various forms such as supplementary textbooks, video explanations, and online exercises, ensuring that students study with comprehensive resource support. Meanwhile, AI can also adjust the difficulty and depth of the recommended content based on students' feedback and their learning progress. For instance, if a student encounters difficulties when learning a certain mathematical concept, the AI will automatically recommend basic review materials and adjust the task difficulty in a timely manner to ensure that the student can maintain a continuous interest in learning during the process of gradually accumulating knowledge.

3.3. Real-time feedback and adjustment of learning progress

An important feature of the AI personalized learning path model is real-time feedback and progress adjustment. Whenever students complete tasks or take exams, the AI system will provide immediate feedback based on their performance, pointing out the correct and incorrect parts and offering detailed error analysis. This kind of feedback can help students correct mistakes quickly and improve their comprehension and memory. Meanwhile, AI dynamically adjusts the learning path by monitoring students' real-time performance to ensure the adaptability of the learning content. If students repeatedly make mistakes on a certain knowledge point, the AI will push more review questions or explanatory materials to help students further consolidate the knowledge point. For the content that has already been mastered, AI will timely push more challenging learning resources to prevent the learning progress from being too slow and maintain students' enthusiasm and motivation for learning.

4. Implementation strategies of AI personalized learning paths

Artificial intelligence technology can provide support at all stages of the course, helping students obtain tailor-made learning paths during the learning process. The AI-based personalized learning path not only covers pre-class preparation, in-class interaction, and the learning process, but also can provide targeted review and feedback after class. Through continuous data collection and analysis, AI ensures that students remain in the most suitable learning state throughout the entire learning process.

4.1. Before class: Preparation and preview of personalized learning paths

In the pre-class stage, AI mainly provides personalized learning preparations for students based on their historical data, learning habits, and interest preferences. The focus of this stage is to help students make adequate preparations for their studies in advance based on their knowledge level, learning goals, and personal needs, ensuring that they can enter the classroom learning efficiently. For example, before starting to learn a new course unit, the AI system can set goals for students. These goals will help students clearly understand the key points of the upcoming study and provide them with a clear learning direction at the same time.

4.2. During class: Dynamic adjustment and personalized learning support

During the classroom learning process, AI provides dynamic and personalized learning support for students by real-time analysis of their learning behaviors, participation, and feedback. AI not only focuses on students' mastery of new knowledge but also provides targeted guidance based on their real-time performance, ensuring that each student can keep up with the course progress and receive additional support when needed. For instance, if a student fails to answer a question correctly during classroom interaction, the AI system will analyze the error in real time and recommend relevant learning resources to the student, such as videos, practice questions, or explanations, to help the student better understand the problem and consolidate the knowledge points.

4.3. After class: Review and extension of personalized learning paths

After class, AI regularly assesses students' learning outcomes, analyzes their progress in review, and optimizes the learning path based on the assessment results. Assessment is not limited only to test scores, but also includes factors such as students' mastery of knowledge and the efficiency of their review. The AI system adjusts the study plan based on these assessment results, recommends new study materials, and ensures that students can continue to progress along the path that suits them. If students still have a poor grasp of a certain concept during their review after class, the AI will adjust their learning path based on the assessment results and recommend more supplementary materials, such as e-books, videos, and exercise books, to help students understand the relevant content more deeply. After class, AI can generate a detailed learning report, informing students in which areas they have performed outstandingly and where they still need to improve, and suggesting suitable learning resources and review strategies to help students optimize their learning process.

5. Conclusion

With the continuous advancement of artificial intelligence technology, personalized learning paths have become an important driving force for modern educational reform. Through AI-driven personalized learning, students can obtain tailor-made educational experiences based on their own learning needs, interests, and abilities. This not only enhances learning efficiency but also stimulates students' learning motivation and sense of participation. The comprehensive application of AI before, during, and after class ensures that students

can receive appropriate support and feedback at each learning stage, thereby better mastering knowledge, overcoming difficulties, and achieving a balance between academic and personal growth. In conclusion, the personalized learning path model based on AI is not only an inevitable trend in the development of educational technology, but also provides a brand-new perspective for the future of education. By making rational use of AI technology, educators can better understand and meet the individual needs of students, promote the improvement of educational quality, and provide a broader space for the all-round development of students.

Acknowledgments

The authors would like to express sincere gratitude to Guangdong University of Science and Technology for supporting this research. Special thanks go to the team members and students who actively participated in the teaching practice and provided valuable feedback throughout the course development and implementation.

Funding

The 2024 Guangdong University of Science and Technology Teaching, Science and Innovation Project (GKJXXZ2024028)

Disclosure statement

The authors declare no conflict of interest.

References

- [1] Tapalova O, Zhiyenbayeva N, 2022, Artificial Intelligence in Education: AIED for Personalised Learning Pathways. *Electronic Journal of e-Learning*, 20(5): 639–653.
- [2] Deng W, Wang L, Deng X, 2024, Strategies for Optimizing Personalized Learning Pathways with Artificial Intelligence Assistance. *International Journal of Advanced Computer Science & Applications*, 15(6): 1–5.
- [3] Bayly-Castaneda K, Ramirez-Montoya MS, Morita-Alexander A, 2024, Crafting Personalized Learning Paths with AI for Lifelong Learning: A Systematic Literature Review. *Frontiers in Education*, 9: 1424386.
- [4] Leon RD, Ortiz A, Diaz MDMA, et al., 2024, Using AI for Developing Personalized Learning Paths. *International Journal of Advanced Statistics and IT&C for Economics and Life Sciences*, 14(1): 20–25.
- [5] Yekollu RK, Bhimraj Ghuge T, Sunil Biradar S, et al., 2024, AI-Driven Personalized Learning Paths: Enhancing Education through Adaptive Systems. *International Conference on Smart Data Intelligence*, Springer Nature Singapore, Singapore, 507–517.
- [6] Frank E, 2024, The Influence of Artificial Intelligence on Education: Enhancing Personalized Learning Experiences, *EasyChair Preprint*, 14675.
- [7] Zohuri B, Mossavar-Rahmani F, 2024, Revolutionizing Education: The Dynamic Synergy of Personalized Learning and Artificial Intelligence. *International Journal of Advanced Engineering and Management Research*, 9(1): 143–153.

Publisher's note

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

Exploring a Hybrid Teaching Quality Evaluation System Based on the CIPP Model Construction in Higher Education

Lin Chen^{1,2*}

¹Postdoctoral Research Work Station, Beijing Yinghua Online Technology Co., Ltd., Beijing 102600, China

²College of Education, Capital Normal University, Beijing 100048, China

**Author to whom correspondence should be addressed.*

Copyright: © 2025 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: Hybrid teaching has become an essential direction of the teaching reform and innovation of higher education, and puts forward new requirements for the evaluation system of teaching quality. The background of hybrid teaching, the CIPP model, and teaching quality evaluation system, and the necessity of constructing a hybrid teaching quality evaluation system are further discussed. This paper also discusses the evaluation focus of the CIPP model and its applicability in the hybrid teaching quality evaluation and believes that the CIPP model can reflect the concept innovation, target diversity, process advancement, and subject participation; the evaluation indicator system of hybrid teaching quality is designed based on the CIPP model, which provides a reference for the hybrid teaching quality evaluation and teaching reform.

Keywords: Hybrid teaching; Evaluation; CIPP; Higher education; Quality

Online publication: June 30, 2025

1. Introduction

Teaching quality is the core of higher education quality. As an essential part of the national implementation of undergraduate teaching level evaluation, evaluating teaching quality in higher education is vital for deepening the teaching reform, strengthening the connotation construction, and improving the quality of talent training. Constructing a teaching quality evaluation system in higher education is essential to enhance the management level of education and teaching and realize the connotation development. With the development of big data, the Internet, artificial intelligence, and other electronic information technologies, digital education has gradually entered the teaching field, and hybrid teaching has received significant attention. Hybrid teaching is an organic system of online and offline teaching. Hybrid teaching has developed with the popularization of “Internet + education.” It has become the mainstream mode of teaching reform in colleges and universities, and the teaching focus has also changed from technology integration to teaching content and teaching mode. Hybrid teaching

can break the limitations of time and space, improve efficiency, enhance teachers' and students' interests, and provide psychological satisfaction. However, hybrid teaching still has problems in specific teaching practice activities. The CIPP evaluation model, proposed by American evaluation scholar Daniel L. Stufflebeam, combines diagnostic evaluation, formative evaluation, and summative evaluation with context evaluation, input evaluation, process evaluation, and product evaluation as the evaluation steps. Its primary purpose is evaluation, and the most essential purpose is not to prove but to improve. Due to the traditional teaching quality evaluation system fails to assess a comprehensive evaluation of hybrid teaching quality, this study considers the characteristics of hybrid teaching using the CIPP evaluation model, sets the corresponding evaluation standard and evaluation method, builds the whole process of hybrid teaching quality evaluation indicator system, to achieve a multi-angle, diversified evaluation of teaching quality and provide reference to improve the teaching quality and level.

2. Literature review

2.1. Hybrid teaching

With the popularization of information technology and the rapid development of various MOOC platforms, the field of education is undergoing unprecedented changes. New teaching methods, such as online and offline hybrid teaching, have gradually become the mainstream teaching methods of higher education and have become the new normal of higher education teaching ^[1].

2.1.1. Definition of hybrid teaching

Hybrid teaching is a learning model that combines face-to-face learning with computers, TV, and other learning ^[2]. Hybrid teaching is a combination of multiple teaching methods without regard to limiting the techniques used ^[3]. According to Hidayah, hybrid teaching is an innovation in education, using cutting-edge technology or the Internet for offline and online teaching ^[4]. The author combines the definition of hybrid teaching as a teaching model where hybrid teaching combines face-to-face teaching with online teaching.

2.1.2. Benefits of hybrid teaching

First, hybrid teaching is more flexible, allowing students to study according to their schedule. Second, hybrid teaching is more in line with personalized learning experiences. Using various tools and data analysis, teachers can more accurately understand students' learning habits, interests, and abilities and thus provide more appropriate teaching content and methods. This personalized teaching method can enhance learning effects and increase students' participation in courses. Third, hybrid teaching can help students improve interaction, communication skills, confidence, and self-awareness, and it encourages discussion and collaboration with lecturers and classmates, and course materials to obtain an overall positive student reporting experience ^[5].

2.1.3. Limitations of hybrid teaching

However, hybrid teaching has some drawbacks. Hybrid teaching is time-consuming and demanding in creating materials, preparing, and evaluating. In addition, students and teachers sometimes need more knowledge of the use of technology, and technical failures can occur at any time. Besides, students' learning skills must be fully developed to maximize their benefit from hybrid learning ^[6]. Finally, students' learning interactivity will decrease. Across the computer screen, students often neglect to give feedback or delay giving feedback. The interaction between students and teachers could be timelier ^[7].

2.2. CIPP model

The CIPP model originated in the 1960s and was founded by Professor Daniel L. Stufflebeam from Purdue University in the United States. The CIPP model is a comprehensive formative, project, personnel, product, institutional, systematic, and summative assessment framework^[8]. Today, it is widely recognized as one of the most complete scientific evaluation theory systems^[9]. The CIPP model includes context, input, process, and product evaluation. Context evaluation mainly analyzes and evaluates the educational environment and checks and assesses the program of academic activities. Input evaluation primarily evaluates the resources and conditions needed to achieve the goal and the program's feasibility. Process evaluation mainly supervises the implementation of the program, checks the implementation of the program, and provides timely feedback on the existing problems to adjust and optimize. The product evaluation mainly evaluates the program's effect and the achievement of the goal^[10]. The CIPP model is shown in **Figure 1**.

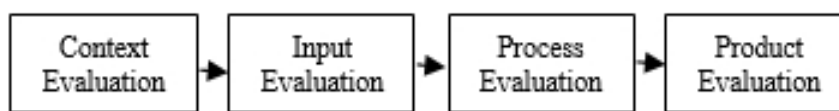


Figure 1. CIPP model

2.3. Teaching quality evaluation system

Evaluating teaching quality is vital to ensure quality education, teaching, and talent training in colleges and universities. Still, it is also an essential channel for teaching reflection and improving teachers' teaching levels. Teaching evaluation is an objective, scientific, fair, and value judgment on the teaching state, process, and results according to the corresponding evaluation standard^[11]. Teaching quality evaluation is based on the classroom teaching quality evaluation standard, objective, scientific, fair, and fair to "teach" the "learning" state, process, and the result to make a value judgment is to help students grow, spur teachers constantly learning and essential means of improving the quality of classroom teaching, and judge the value of specific classroom teaching activities, mining and promotion process^[12].

3. The necessity of a hybrid teaching quality evaluation construction

3.1. Complying with the requirements of the era

It is the era of the Internet, real-time, convenient, and efficient. Hybrid teaching is a combination of online and offline teaching. Using digital teaching platforms enables teachers and students to connect and communicate in two ways. Still, it also realizes the organic integration of the natural and virtual worlds and improves teaching and learning efficiency. Hybrid teaching makes the traditional teaching process flexible and convenient; colleges and universities need to combine their operational situation and teaching characteristics to build a hybrid teaching quality monitoring and evaluation system to better adapt to the requirements of the times and the characteristics of hybrid teaching.

3.2. Meeting the needs of the teaching model change

Online and offline hybrid teaching modes have become an important starting point for reforming the current teaching mode in colleges and universities, which can enrich the teaching content and optimize the teaching model. In hybrid teaching, students can use the network to obtain learning resources, and teachers can expand

the classroom teaching paths to ensure the realization of teaching objectives and the completion of teaching tasks. Not only that, the teaching model also focuses on establishing an excellent teacher-student relationship and tries to break the restrictions of traditional education in time and space through the convenience of online education resource retrieval, and strengthens the information exchange between teachers and students. Therefore, to adapt to the development of a hybrid teaching model, colleges and universities must continuously enhance the evaluation of hybrid teaching quality to maximize the educational value.

3.3. Meeting the need to improve the quality of teaching

Teaching quality evaluation is very important in higher education, and it is the primary way to ensure that the student training effect meets the teaching expectations. In the hybrid teaching, it is more important. Constructing a scientific and reasonable teaching quality monitoring and evaluation system can effectively improve the quality of hybrid teaching. The hybrid teaching quality evaluation in colleges and universities is not only an inevitable requirement to ensure the pertinence and sustainability of their teaching but also an internal requirement to improve their teaching quality.

Although the construction of the teaching quality evaluation system has been studied, there are few studies on hybrid teaching, mainly based on the CIPP model ^[13,14]. Hence, this study is conducted to fill the gap and allow specialists to voice their opinions in a hybrid teaching quality evaluation system. Besides, based on the literature review and the necessity of hybrid teaching quality evaluation construction, here are two research questions:

- (1) What are the issues of the traditional teaching quality evaluation system?
- (2) How can the hybrid teaching quality evaluation system be constructed under the CIPP model, and what indicators should be included?

4. Methodology

A qualitative methodology was considered the most appropriate for this study because the researcher explored specialists' insights in-depth ^[15]. This study adopted a case study design to explore potential qualitative data missed by previous research. Participants of this study are six specialists from three universities who often use and are familiar with hybrid teaching and have good experience in teaching evaluation to solicit their opinions on the second and third-level indicators of hybrid teaching quality evaluation based on the CIPP model. The participants were interviewed both online and offline three times, and each interview lasted around 60 minutes and was conducted separately.

All the data were recorded and transferred manually. Content analysis was used for data analysis by NVivo 12. Participation in this study was voluntary, and participants were free to withdraw at any time and did not need to specify their reasons. All recorded interviews were stored in the researcher's password-protected computer. To achieve internal validity for the study, the interview protocol was reviewed by other researchers with experience in the field. In addition, either participant involved in the interviews practiced the procedure or ensured that their methods were consistent. In data analysis, the emerging themes were communicated to the participants to eliminate potential bias in the content analysis process. After the results indicated data saturation, the data were deemed reliable or consistent, accomplished by simultaneously running the analysis and data collection.

5. RQ1: What are the issues of the traditional teaching quality evaluation system (Figure 2)

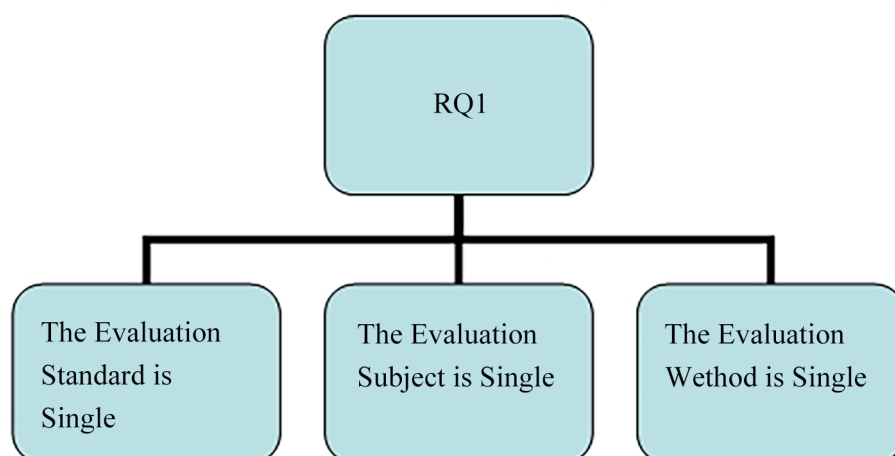


Figure 2. Themes of RQ1

5.1. The evaluation standard is single

The traditional teaching quality evaluation model is mainly based on the final evaluation, and the evaluation model is rigid, blind to students' efforts and progress in the learning process, and cannot fully and genuinely reflect students' learning effect and ability improvement. It is mainly reflected in the evaluation of examination results, excessive emphasis and reliance on quantitative indicators and students' mastery of theoretical knowledge, and in the measurement of students' practical operation ability, innovative thinking, teamwork, and other aspects, which fail to fully reflect the importance of students' practical skills.

5.2. The evaluation subject is single

The main aspects of evaluation are students, teachers, and society. Among them, student teaching evaluation is the most essential part of evaluating the quality of teaching in colleges and universities. Students are the direct evaluators of teaching quality in colleges and universities, but are also the most critical evaluators. Due to the influence of traditional ideas, the current students' evaluation of teaching accounts for a large proportion of teaching quality evaluation, and students' evaluation of teaching has a particular subjectivity, so its authenticity and objectivity cannot be guaranteed. Teachers are the prominent teacher leaders, but in the actual teaching process, teachers' participation in evaluating teaching quality is low due to the influence of various factors. Society is an indispensable part of the development of teaching quality evaluation in colleges and universities. Still, the current society has a certain degree of distrust and incomprehension regarding evaluating the quality of education of college graduates, employers, parents, and other stakeholders. In addition, all walks of life pay great attention to the quality of college education and teaching. Still, the need for a more necessary and objective understanding of the evaluation of education and teaching quality in colleges and universities has also, to a certain extent, affected the evaluation of education and teaching quality in colleges and universities.

5.3. The evaluation method is single

Under the hybrid teaching model, the ways and means of course teaching have profoundly changed. However, the reform of the teaching quality evaluation method is not synchronized with it, resulting in the evaluation

results not fully reflecting the students' learning and ability improvement. The traditional teaching quality evaluation system is complex in effectively evaluating students' independent online learning ability. The lack of diversified, modern evaluation methods cannot comprehensively assess the student's ability and quality. At the same time, the evaluation tools did not keep pace with the times, and digital tools and platforms were not used for data collection and analysis.

6. RQ2: How can the hybrid teaching quality evaluation system be constructed under the CIPP model, and what indicators should be included (Figure 3)

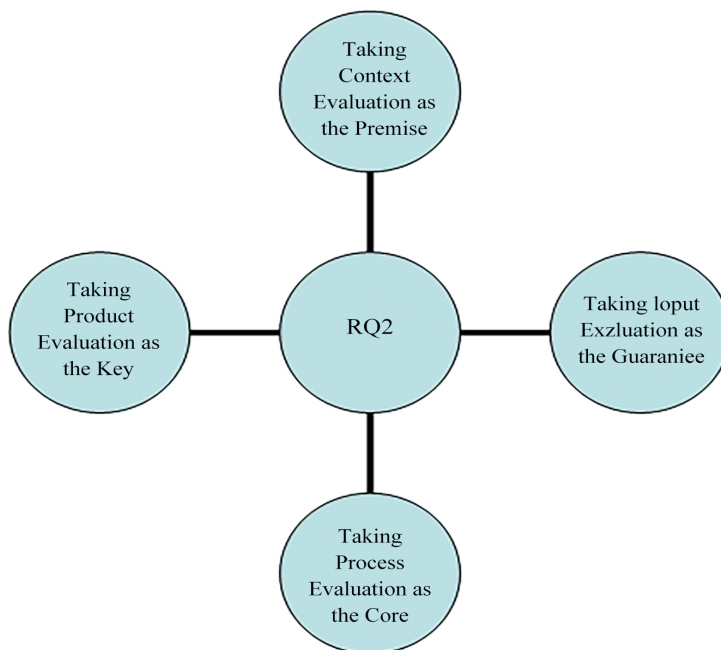


Figure 3. Themes of RQ2

According to the characteristics of the CIPP model, it can solve the existing problems of the hybrid teaching quality evaluation system, which conforms to the basic principles of the construction of the hybrid teaching quality evaluation system. Therefore, this model can be used for reference, and the four different dimensions of evaluation indicators include context, input, process, and product evaluation in the framework of the hybrid teaching quality evaluation system. In each dimension, straightforward, specific evaluation indicators explore the construction of a hybrid teaching quality evaluation system.

First of all, according to the evaluation content of the CIPP model and the teaching process of hybrid teaching, the specific contents of the four first-level indicators of hybrid teaching, including content evaluation, input evaluation, process evaluation, and product evaluation, were summarized. The interview outline of the hybrid teaching quality evaluation index system based on the CIPP model was formed. Secondly, according to the data collection and participants' views, the scope of the second and third levels of the hybrid teaching quality evaluation indicator system based on the CIPP model was formulated, and the first draft was formed. This study finally formed a hybrid teaching quality evaluation indicator system including four first-level indicators, 11 second-level indicators, and 32 third-level indicators, as shown in **Table 1**.

Table 1. Hybrid teaching quality evaluation indicator system

Level 1 indicators	Level 2 indicators	Level 3 indicators
Context evaluation	Target setting	The compatibility of national hybrid teaching laws, policies, and regulations.
		Social talent demands a good degree.
		School development positioning fits the degree.
		The fit of professional training objectives.
	Facility configuration	Hybrid teaching hardware and software facilities configuration degree.
		The degree of safeguard measures for the allocation of facilities.
	Teachers' level	Teachers have a knowledge reserve and mastery of hybrid teaching facilities and teaching methods.
	Students' level	Students already have a knowledge reserve and mastery of the hybrid teaching facilities, learning methods, etc.
Input evaluation	Teaching materials	Rationale of the teaching plan.
		The rationality of the online resources, textbook content, and courseware.
	Teaching management	Hybrid teaching organization and structure are guaranteed.
		The completeness of hybrid teaching resources.
	Teachers' strength	Hybrid learning platform completeness.
		The number of teachers.
Process evaluation	Teachers' level	Teachers' degree.
		Teachers' title.
		Organization and management of hybrid teaching activities.
		Classroom interaction between teachers and students.
	Students' level	Rational performance of the teaching schedule.
		Teachers' classroom and after-school guidance, personalized guidance.
Product evaluation	Teacher development	Students' recognition of hybrid teaching.
		Student engagement in the hybrid teaching system.
		Students' cooperation with hybrid teaching.
		The number of awards for teaching.
	Student development	Number of scientific research awards.
		The number of scientific research papers.
		Evaluation of teaching scores.
		Quality improvement in Internet use.
		Competition award.
		Achievement improvement.
		Improvement of independent learning ability.
		Quality improvement in Internet use.

6.1. Taking context evaluation as the premise

Context evaluation mainly investigates what needs to be done before implementing hybrid teaching, that is, the

preparation of external factors, including four aspects: target setting, facility configuration, teachers' level, and students' level. The apparent target of hybrid teaching should be based on the relevant requirements of laws, policies, regulations, and other documents, and follow the overall principle of integrated construction. The demand for social talents is mainly reflected in whether the hybrid teaching training meets the requirements of society for talents and whether it participates in local social services, resulting in teaching, social, and economic benefits. The development orientation of the college and university is based on their orientation. They should highlight the orientation and characteristics of the college and university when carrying out hybrid teaching. The fit of professional training objectives means that hybrid teaching should help students develop good professional qualities.

6.2. Taking input evaluation as the guarantee

The input evaluation focuses on the hybrid teaching plan and discusses how to implement it. The internal factor preparation of hybrid teaching is mainly evaluated from teaching materials, teaching management, and teachers' strengths. Teaching resources include the preparation of teaching resources. Before teaching, we should fully consider whether the teaching plan is reasonable. Teaching resources include technical tools and online resources used to support hybrid teaching, such as electronic textbooks, interactive exercises, video lectures, etc., and offline teaching resources related to teaching materials, such as courseware, teaching content, etc. Teaching management focuses on whether the college and university have set up an organization of hybrid teaching management, including a hybrid teaching team and management team. Also, it focuses on whether the college and university have complete hybrid teaching resources and whether it has built an interactive platform for hybrid teaching. Teachers' strengths mainly include the number of teachers, teachers' degrees, and titles.

6.3. Taking process evaluation as the core

Process evaluation is mainly a formative evaluation of the implementation process of hybrid teaching. It solves the problem of being done, including the teacher and student level participation in the hybrid teaching process. The teachers' level includes the organization and management of hybrid teaching activities, whether the hybrid management and organization are orderly, whether the teaching methods are practical, whether the teaching methods are targeted and applicable, and whether the teaching methods are interactive, mainly role play, group discussion, or the establishment of online teacher-student interaction platform and social media groups. For classroom interaction, special attention should be paid to the continuity and fundamental frequency of interaction, that is, the length and frequency of communication between teachers and students in the classroom; The depth and quality of interaction, that is, the depth, inquiry and thinking, and the improvement of students' critical thinking and cross-cultural communication ability; to analyze the specific ways and diversity of interaction, such as group discussion, role play, and debate. The interactive atmosphere and equality should be evaluated, whether the interaction between the two sides is based on mutual equality, whether the classroom atmosphere is relaxed and harmonious, whether students are encouraged to express their ideas boldly, whether they respect their views and ideas, etc. Teachers' classroom and after-class and personalized guidance mainly investigate teachers' mastery and follow-up degree of students' learning in hybrid teaching. The students' level includes students' recognition of hybrid teaching, student engagement in the hybrid teaching system, and students' cooperation with hybrid teaching. It mainly focuses on the performance of classroom interaction, after-class learning, cooperative learning, and other aspects, such as whether to speak and ask questions in class, whether to complete homework on time after class, actively participate in extracurricular activities, preview

new content, etc.

6.4. Taking product evaluation as the key

Achievement evaluation directly measures teachers' teaching and students' learning results. The evaluation content of hybrid teaching should be centered on teachers' development and students' growth. The purpose of reflection and improvement is achieved through the factors that positively affect the development of teachers and students in implementing the curriculum. Among them, teacher development includes the number of awards for teaching, the number of scientific research awards, the number of scientific research papers, the evaluation of teaching scores, and quality improvement in Internet use. Student growth includes competition awards, achievement improvement, improvement of independent learning ability, and quality improvement in Internet use.

7. Empirical analysis

Two representative private universities were selected for empirical analysis to validate the rationality and practicality of the proposed teaching quality evaluation system for hybrid learning in private higher education institutions. These universities were chosen based on their differences in teaching modes, faculty quality, student demographics, and teaching resources, allowing for a comprehensive evaluation of the adaptability and applicability of the evaluation system.

7.1. Research methodology and data collection

A mixed-methods approach was employed, combining questionnaire surveys, in-depth interviews, and classroom observations to collect feedback from teachers, students, and teaching administrators. Additionally, quantitative data was gathered to analyze student performance, classroom interactions, assignment quality, and independent learning activities. These data provided a solid empirical foundation to assess the rationality of the hybrid learning quality evaluation system.

The key evaluation indicators included:

Student learning outcomes: Mastery of academic knowledge, innovation capacity, and interdisciplinary practical skills.

Teaching process: Classroom interaction frequency and use of online learning platforms.

Teacher-student interaction: Student engagement in class discussions and the timeliness of teacher feedback.

Student autonomous learning ability: Completion of assignments, participation in self-directed learning projects, and development of critical thinking skills.

7.2. Case study 1: University A

University A is a private institution focusing on applied talent cultivation, and it has actively adopted blended learning since the pandemic. In the survey, we found that the university had made notable progress with its blended learning initiatives, but there were discrepancies in the teaching quality evaluation system.

Student learning outcomes: University A demonstrated strong performance in academic knowledge acquisition, especially in understanding course content. However, the development of students' innovation capacity and interdisciplinary skills was relatively weak. Students reported that "the courses are theoretical and lack cross-disciplinary practical projects."

Teaching process: Although online courses were rich in content, survey data showed low student engagement in online interactive sessions. Many students viewed online learning as supplementary and neglected its interactive and self-learning components.

Teacher-student interaction: The frequency of teacher-student interaction was relatively high, but most occurred in the classroom in real-time. Online interactions were insufficient to stimulate student participation.

Student autonomous learning ability: Students spent limited time on autonomous learning, and the design of learning tasks was ineffective, leading to low-quality independent learning.

Based on the analysis, the teaching quality evaluation system at University A effectively assessed academic knowledge acquisition and the teaching process. Still, it lacked sufficient emphasis on innovation capacity and interdisciplinary practical skills. More comprehensive assessments of cross-disciplinary projects and practical abilities in the evaluation system are recommended.

7.3. Case study 2: University B

University B is a private university with a strong emphasis on vocational training and practical skills. Hybrid learning is widely adopted, integrating extensive online practical courses with in-person internships. Through surveys and interviews, the following data were gathered:

Student learning outcomes: University B excelled in developing students' practical and innovative abilities, particularly in interdisciplinary projects and team-based collaboration, demonstrating strong hands-on skills.

Teaching process: The teaching process at University B heavily relied on online practical platforms, where students engaged in simulations and exercises. However, student feedback indicated that some online platforms lacked technical support, with poor functionality and limited learning resources.

Teacher-student interaction: There was frequent teacher-student interaction, especially in practical courses, with timely feedback. However, some students pointed out that the online feedback mechanism was inadequate, with delays in grading assignments and answering questions.

Student autonomous learning ability: Students generally completed their autonomous learning tasks on time and displayed strong practical skills in hands-on assignments. However, some students reported that the online self-learning content was too essential and lacked depth and critical thinking exercises.

The hybrid learning quality evaluation system at University B was comprehensive in assessing practical abilities and innovation skills, but it highlighted shortcomings in technological support and online feedback mechanisms. The system should be improved by addressing the technological limitations of online platforms and enhancing the feedback mechanisms for better learning outcomes.

7.4. Discussion

The empirical analysis of University A and University B validated the applicability and rationality of the proposed hybrid learning teaching quality evaluation system. Overall, the evaluation system demonstrated strong adaptability in assessing student learning outcomes, teaching processes, and teacher-student interactions. However, specific adjustments are needed based on the unique characteristics of each institution.

For University A, the evaluation system should emphasize innovation capacity and interdisciplinary practical skills, which are critical to the institution's educational goals. For University B, the system needs to address the limitations in online platform functionality and improve feedback mechanisms to better support student learning.

8. Conclusion

Taking the characteristics of hybrid teaching as the starting point and based on the CIPP evaluation model, the hybrid teaching quality evaluation indicator system is constructed from four evaluation stages: context evaluation, input evaluation, process evaluation, and product evaluation, including four first-level indicators, 11 second-level indicators, and 32 third-level indicators observation points. This evaluation system determines the evaluation dimension according to the relevant national policy requirements and has strong operability. More precise and detailed guidance is needed to improve the quality of hybrid teaching, which is conducive to the long-term development of students, teachers, schools, and society. Follow-up research can be continuously optimized and improved on this basis, forming a quantitative evaluation tool that enhances the hybrid teaching quality in colleges and universities and provides a strong guarantee for the training of excellent engineering and technical talents in China.

Acknowledgments

Appreciation is given to the six specialists who participated in this study; with their assistance, the second and third-level indicators of hybrid teaching quality evaluation based on the CIPP model were designed initially. The completion of the article is inseparable from the three universities.

Funding

The 2025 Beijing Postdoctoral Research Activity Funding Project “Exploring Hybrid Teaching Quality Evaluation System Based on the CIPP Model Construction in Higher Education” (2025114)

Disclosure statement

The author declares no conflict of interest.

References

- [1] Zhou Q, Jiang L, Liu Z, 2024, Research on College Students' Learning Investment and Learning Satisfaction Under the Background of New Normal of Mixed Teaching. *Science, Education, and Literature*, 18: 180–183.
- [2] Verawat D, 2019, Solusi Pembelajaran 4.0: Hybrid Learning. *Seminar Nasional Pendidikan*, 1183–1192.
- [3] Margaret D, 2002, On Certain Integrals of Lipschitz-Hankel Type Involving Products of Bessel Functions. *E-Learning and Digital Media*, 3: 999–1015.
- [4] Hidayah SN, 2019, Hybrid Model-based Learning in Welcome Era Industrial Revolution 4.0. *The Innovation of Social Studies Journal*, 1: 46–54. <https://doi.org/10.20527/iis.v1i1.1262>
- [5] Chan YF, Narasuman S, Dalim SF, et al., 2016, Blended Learning as A Conduit for Inquiry-based Instruction, Active Learning, Formative Assessment, and Its Impact on Students' Learning Outcomes in Higher Education, 74–78.
- [6] Klimova BF, Kacetl J, 2015, Hybrid Learning and Its Current Role in the Teaching of Foreign Languages. *Procedia - Social and Behavioral Sciences*, 182: 477–481. <https://doi.org/10.1016/j.sbspro.2015.04.830>
- [7] Syafril S, Latifah S, Engkizar E, et al., 2021, Hybrid Learning on Problem-solving Abilities in Physics Learning: A Literature Review. *Journal of Physics: Conference Series*, 1796: 012–021. <https://doi.org/10.1088/1742->

- [8] Mathison S, 2004, Encyclopedia of Evaluation, Sage Publications, London.
- [9] Zhong J, 2024, Construction of Teaching Quality Evaluation System Based on CIPP Model. Chinese Journal of Multimedia and Network Teaching, 6: 120–123.
- [10] Singh MD, 2024, Evaluation Framework for Nursing Education Programs: Application of the CIPP Model. International Journal of Nursing Education Scholarship, 1: 120–123. <https://doi.org/10.2202/1548-923X.1023>
- [11] Yi S, 2022, Digital Thinking: An Innovative Framework in the Process of Fashion Sustainability. Art and Design Research, 2: 17–22.
- [12] Yan J, An J, Sun G, 2023, Reconstruction of Classroom Teaching Quality Evaluation Index System. China University Teaching, 12: 74–78, 91.
- [13] Feistauer D, Richter T, 2016, How Reliable are Students' Evaluations of Teaching Quality? A Variance Components Approach. Assessment & Evaluation in Higher Education, 8: 1263–1279. <https://doi.org/10.1080/02602938.2016.1261083>
- [14] Goos M, Salomons A, 2017, Measuring Teaching Quality in Higher Education: Assessing Selection Bias in Course Evaluations. Research in Higher Education, 8: 341–364. <https://doi.org/10.1007/s11162-016-9429-8>
- [15] Denzin NK, Lincoln YS, 1996, Handbook of Qualitative Research. Journal of Leisure Research, 2: 132.

Publisher's note

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

Intelligent Educational Administration Management System Based on Data Mining Technology

Xiaofei Yang*

Police Skills and Tactics Training Department, Criminal Investigation Police University of China, Shenyang 110035, Liaoning, China

**Author to whom correspondence should be addressed.*

Copyright: © 2025 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: With the gradual acceleration of information construction in colleges and universities, digital campus and smart campus have gradually become important means for colleges and universities to scientifically manage the campus. They have been applied to teaching, scientific research, student management, and other fields, improving the quality and efficiency of management. This paper mainly studies the intelligent educational administration management system based on data mining technology. Firstly, this paper introduces the application process of data mining technology, and builds an intelligent educational administration management system based on data mining technology. Then, this paper optimizes the application of the Apriori algorithm in educational administration management through transaction compression and frequent sampling. Compared with the traditional Apriori algorithm, the optimized Apriori algorithm in this paper has a shorter execution time under the same minimum support.

Keywords: Data mining; Educational administration management; System construction; Apriori algorithm

Online publication: June 30, 2025

1. Introduction

With the development of information technology and emerging technology, technology businesses in various fields have been greatly promoted ^[1]. As far as the vast majority of current fields are concerned, the development of their business will rely on computer technology. For the management of schools, we can also use computer technology to improve the efficiency and level of management work, and to process control data, which can improve the security level of data. Computers also have faster efficiency and accuracy in processing complex and huge amounts of data. At present, there are many kinds of intelligent educational administration management systems in various schools in China. At the same time, primary and secondary schools have also begun to apply the intelligent educational administration management system ^[2,3]. However, in the process of practical work, especially in the primary and secondary schools in poor areas in Western China, due to the lagging development of their social environment, the needs of related technology, software, and hardware cannot be met, so it is difficult to realize the research and development of intelligent educational administration

management system. With the gradual deepening of the basic concept of teaching informatization construction, management also began to gradually change from a manual management mode to an information management mode ^[4]. Thanks to the rapid development of network technology, data technology, and social economy, the achievements of campus data construction are more and more obvious, and the school can complete its daily management with the help of information technology. Most schools have begun to apply an intelligent educational administration management system, but there are still many practical problems. In order to effectively solve these problems, the relevant research and analysis work should be more in-depth ^[5].

Foreign universities have always attached great importance to educational administration. Most of them have established their own educational administration management system, and increased the adaptability to mobile clients on the basis of the traditional educational administration management system, so as to build a set of complete campus Internet of Things ^[6]. This way makes the educational administration management mode more scientific, stable, and easier to manage, and builds a communication bridge between schools and students, teachers and students ^[7]. At the same time, the research on data mining technology has a history of many years abroad. Data mining technology has brought many benefits to the FMCG industry, the financial industry, and many other traditional industries. Major supermarkets in Europe and the United States have used data mining technology to process hundreds of millions of data, analyze each consumer's consumption habits and purchase tendencies, obtain effective information, and match the consumer's purchase history with relevant goods. It has provided consumers with more valuable, targeted consumption recommendations ^[8]. Now, more and more colleges and universities are also investing a lot of energy in combining data mining technology with college educational administration management systems to mine and deeply study valuable teaching data to serve educational administration management ^[9,10].

This paper designs an intelligent educational administration management system based on a mining algorithm. After applying this system in the school, it can help the school realize the standardized management objectives and improve the work efficiency of managers to a great extent.

2. Development of an educational administration system based on data mining

2.1. Data mining process

Generally, a complete data mining process includes three stages: data preprocessing, data mining, and result analysis and representation. It is mainly divided into the following steps: the first step is data preprocessing, which mainly includes data cleaning, data integration, data selection, data transformation, and data reduction. The second step is data mining, which uses intelligent methods to extract and discover patterns from a large amount of preprocessed data. The last step is to analyze and present the results, and evaluate whether the found patterns are interesting and can bring value to users according to a certain degree of interest measurement. At the same time, the mined knowledge or laws are presented to users with effective, novel, potentially useful, and easy-to-understand knowledge by relying on visualization or knowledge representation technology.

- (1) Data preprocessing: In the data preprocessing stage, it can be divided into data cleaning, data integration, data selection, data reduction, data transformation, and data discretization. In practice, it is usually found that the workload of data preprocessing accounts for about 80% of the workload of the whole data mining project. Therefore, data preprocessing is a very important step in the whole process of data mining, which determines the upper limit of data mining effect. Moreover, many works in the field of data mining are based on high-quality data, and the data collected in real life often has missing or abnormal data, which needs to be cleaned to get high-quality data. Data integration, as the name

suggests, because data is often stored in multiple files, databases, or other storage systems, and the data is gathered together to facilitate processing. Data selection involves selecting the required data from many types of data according to the mining target. Data transformation makes the mined patterns easier to understand by people. At the same time, it also enables the mining process to learn the patterns in the data more effectively. For example, when the data distribution presents the characteristics of a long and short tail effect, the logarithmic transformation is used to transform its distribution into a normal distribution, so that the regression algorithm can obtain a better prediction effect. Data discretization, which is also a way of data transformation, divides continuous attributes into multiple intervals, or carries out box division and layered operation.

- (2) Data mining: Data mining stage is a key link in the whole process of data mining. After preprocessing the original data, according to the task and purpose of data mining, select appropriate intelligent methods to extract knowledge and discover data patterns. Among them, intelligent methods mainly include frequent pattern mining, association rule analysis, correlation mining, classification and regression algorithms, cluster analysis, outlier analysis, and time series analysis.
- (3) Result analysis and representation: After a series of data preprocessing and data mining, the knowledge, patterns, or laws extracted from a large amount of data need pattern evaluation. The main purpose of pattern evaluation is to identify the really interesting patterns. Because the data mining results contain a large number of non-user purpose patterns or a few worthless patterns below the interest threshold, it is necessary to filter and extract data patterns from these mining analysis results. Finally, the obtained data pattern is compared with the user's purpose, and the mined knowledge is presented to the user by using visualization and knowledge representation technology.

2.2. Overall system design

The new generation of educational administration management system designed in this paper is essentially an extended information management system, which stores a large amount of information. The most important information includes student information, faculty information, course information, achievement, and teacher evaluation. For this data information, the generation process is as follows:

After the school starts, the school counselors will input the basic information of students in the designated major into the teacher management system. The basic information of students includes students' names, labels, majors, places of origin, admission results, and so on. Teachers will distribute course information according to the training plan in the educational administration management system, and then students log in to the system as students to choose courses. Counselors can add and modify a lot of information for students, and students can also view their own relevant information. At the end of the semester, the teacher will publish the test results to the educational administration management system. Students can view their results and evaluate the teacher at the same time. A large amount of data information is generated every day, which serves for the data mining subsystem. Although there is a lot of data, not all the information is useful for data mining. For example, the student's name can be directly replaced by the student's label.

The educational administration management system designed in this paper adopts the widely used C/S mode system, which can give full play to all the functions of the two subsystems. C/S mode naturally has many advantages: first, the system is simple. The system assigns corresponding tasks to the server and client, which can give full play to the respective advantages of the server and client. Second, the system adapts to a variety of system layouts and meets the requirements of most systems. Third, the system stores a large amount of data, which is safe and effective. The architecture of the educational administration management system designed in

this paper is shown in **Figure 1**.

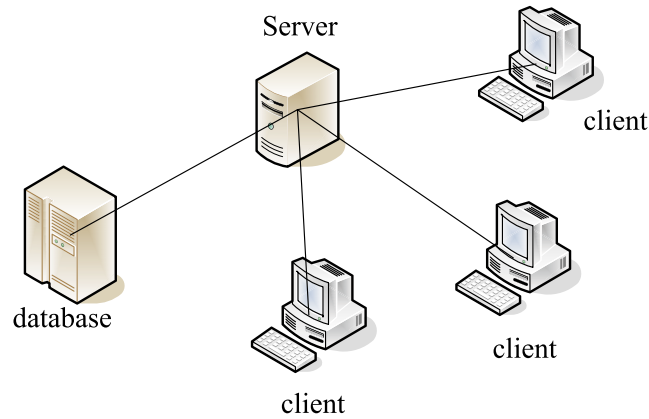


Figure 1. Architecture of educational administration management system

Based on the above analysis, the functional modules of the system can be divided into two categories: the first is the functional module of the daily affairs and educational administration subsystem, and the second is the functional module of the data mining subsystem. The daily educational administration subsystem has five functional modules, and the data mining subsystem also has four functional modules.

The five modules of the daily educational administration subsystem are: student curriculum management, student achievement management, teacher information management, student information management and system setting.

The data mining subsystem is divided into two modules: system setting and data mining. Among them, the data mining module includes data preprocessing, advanced analysis, data statistics, data warehouse, and other functions. The data preprocessing function mainly carries out the operations of data concept stratification, data sample sampling, data digitization, data cleaning, data discretization, and so on.

3. Optimization of data mining algorithm in educational administration system

3.1. Data preprocessing

Before data mining, we first preprocess the data. In the pretreatment stage, our primary purpose is to minimize errors and errors, especially those caused by human factors. Then we sort out the data and delete the errors and redundant data found in the sorting. Thirdly, we fuse the data. After preprocessing, it can minimize the pressure on the database during subsequent operations.

3.2. Optimized association rule mining algorithm

Association rules are defined as assuming that formula (1) is a collection of items

$$I = \{i_1, i_2, \dots, i_m\} \quad (1)$$

The set related to all items is:

$$D = \{t_1, t_2, \dots, t_m\} \quad (2)$$

Association rules are the implication of $a \Rightarrow B$, where $a, B \in I$ and $a \cap B$ are not equal to \emptyset . A and B are called the forerunner and successor of association rules, respectively. The interesting relationship between items

is measured by support and reliability. The so-called support refers to the percentage of one or more items in the item set, that is, probability $p(a \cup b)$. Credibility refers to the percentage of one item including another, that is, probability $p(B | a)$.

The main problem in the operation of association rules is the generation of candidate frequent itemsets. Based on this property, we can do the following optimization:

- (1) Transaction compression: Since the Apriori algorithm needs to scan the database frequently, in order to reduce the size of frequent itemsets of future scanned transactions.
- (2) Frequent sampling: We can reduce the consumption of the algorithm by sacrificing the accuracy of the algorithm and reducing the frequency of sampling.

4. Analysis and comparison of data before and after optimization of association rule algorithm

In this paper, the classical Apriori algorithm and the improved Apriori algorithm are used to analyze and compare the score database of our school. The classical Apriori algorithm and the improved Apriori algorithm are used to change the data size of the database under the same support. The data volume is 3000, 5000, 20000, 30000, respectively. The test results are shown in **Table 1**.

Table 1. Execution time of different data volumes with the same support

	3000	5000	10000	20000	30000
Classic APRIORI	47	52	59	75	97
Improved APRIORI	39	41	47	64	89

As shown in **Figure 2**, under the same minimum support, the execution time also changes with the change of the data capacity of the database, but the execution time of the improved Apriori algorithm is always short.

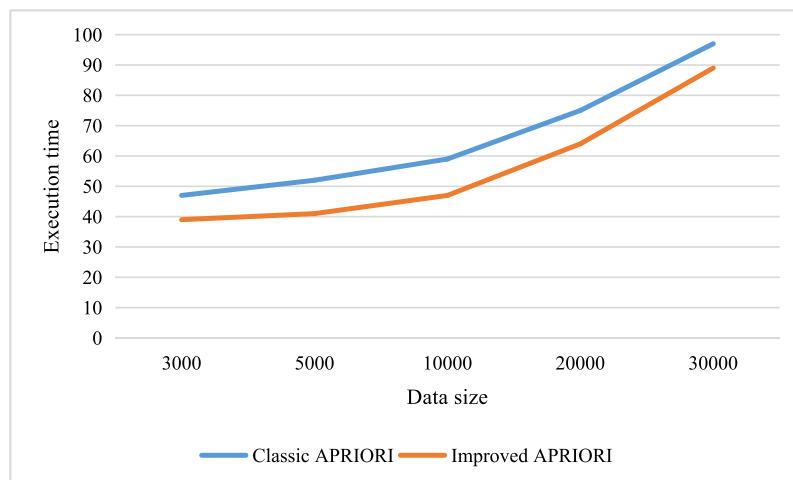


Figure 2. Execution time of different data volumes with the same support

5. Conclusion

This paper designs and shows an educational administration management system in line with the new situation and technology. This paper makes a detailed demand analysis and research on the functional modules of the

university educational administration management system, uses the system to standardize the operation process between the various businesses of the educational administration management, improves the transparency of the educational administration management information, and strengthens the exchange and sharing of information among various departments of the university and departments, so that all departments of the university can quickly and conveniently obtain the teaching operation, teaching quality, and talent training of the school. Because of the limited ability, there are many places that need to be further studied and improved in both system analysis and system framework design: we can combine mobile Internet technology to strengthen the development and application of the educational administration system on mobile Internet, so as to provide a convenient use experience for teachers and students.

Disclosure statement

The author declares no conflict of interest.

References

- [1] Bellibas MS, Gumus S, 2019, A Systematic Review of Educational Leadership and Management Research in Turkey: Content Analysis of Topics, Conceptual Models, and Methods. *Journal of Educational Administration*, 57(6): 731–747.
- [2] Salvioni DM, Raffaella C, 2017, School Governance, Accountability and Performance Management. *International Journal of Financial Research*, 8(2): 176.
- [3] Araque KA, Kadayakkara DK, Gigauri N, et al., 2018, Reducing Severe Hypoglycaemia in Hospitalised Patients with Diabetes: Early Outcomes of Standardised Reporting and Management. *BMJ Open Quality*, 7(2): e000120.
- [4] Abrahamyan G, Atayan A, Sharabaeva L, et al., 2021, The Model of an Online Digital Competencies Development System for the Management Personnel of the Arctic Region. *IOP Conference Series: Earth and Environmental Science*, 678(1): 012027.
- [5] Antoniou P, Lu M, 2017, Evaluating the Measuring Properties of the Principal Instructional Management Rating Scale in the Chinese Educational System: Implications for Measuring School Leadership. *Educational Management Administration & Leadership*, 46(4): 624–641.
- [6] Almarashdeh I, Alsmadi MK, Althuni Ba TGJA, et al., 2018, Looking Inside and Outside the System: Examining the Factors Influencing Distance Learners Satisfaction in Learning Management System. *Journal of Computer Sciences*, 14(4): 453–465.
- [7] Fanoos A, He Y, 2021, Curriculum Analysis of Educational Leadership Master’s Programs in the University System of Maryland. *Educational Management Administration & Leadership*, 49(5): 841–858.
- [8] Tapenova G, Bugubayeva R, 2018, State Management of the Education System in the Conditions of Knowledge Economy Formations. *Journal of Applied Economic Sciences*, 13(6): 1791–1801.
- [9] Holloway J, Keddle A, 2019, Competing Locals in an Autonomous Schooling System: The Fracturing of the ‘Social’ in Social Justice. *Educational Management Administration & Leadership*, 48(1): 174114321983668.
- [10] Khan M, Naz T, 2019, A Multi-Layered Security Model for Learning Management System. *International Journal of Advanced Computer Science and Applications*, 10(12): 207–211.

Publisher’s note

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

Connotation and Value of Study Travel Education in the Temple of Heaven from the Perspective of Ritual and Music Civilization

Qianzhu Zhou*

Beijing Jiaotong Vocational Technical College, Beijing 102200, China

**Author to whom correspondence should be addressed.*

Copyright: © 2025 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: From the perspective of ritual and music civilization, various study travel activities are currently being organized in different stages of teaching, leading students to experience traditional ritual and music culture in various places and fostering a strong cultural foundation in education. This article mainly analyzes the connotation of ritual and music civilization in the study travel teaching of the Temple of Heaven, clarifies the value of study travel education in the Temple of Heaven, explores the inheritance of traditional culture and students' personal development, and finally proposes practical strategies for study travel education to improve its effectiveness.

Keywords: Ritual and music civilization; Study travel education in the Temple of Heaven; Connotation; Value; Practical strategies

Online publication: June 30, 2025

1. Introduction

Ritual and music civilization is an important component of traditional Chinese culture. However, under the impact of modern civilization, many elements of ritual and music civilization have gradually faded, and modern youth have a limited or even complete lack of understanding of it, leading to the risk of traditional culture being lost^[1]. Therefore, in recent years, education has begun to focus more on ritual and music civilization, providing students with opportunities to encounter and understand it through daily teaching and study travel activities. The Temple of Heaven is an important carrier of ritual and music civilization in China, and a significant way for students to understand it. Therefore, it is necessary to fully utilize the opportunities of study travel in the Temple of Heaven to promote the inheritance of ritual and music civilization and enhance students' personal development.

2. Connotations of ritual and music civilization

Ritual and music civilization originally emerged in the sacrificial rituals and life norms of Chinese civilization. With the passage of time and changes in society, ritual and music gradually evolved into a civilized system ^[2]. In primitive society, people expressed their gratitude for nature's bounty and awe through sacrificial singing and dancing activities, which formed the foundation of ritual and music culture. As society changed, ritual and music civilization further developed during the Xia and Shang dynasties, incorporating politics, social norms, various etiquette, and daily life regulations into two systems: "ritual" mainly served to regulate behavior, while "music" was a system of emotional expression. Later, ritual and music became important bases for national governance and social norms. During the Spring and Autumn and Warring States periods, Confucianism became the dominant social ideology, and ritual and music civilization became the core value guiding society, exerting a significant influence on Chinese civilization ^[3]. In ritual and music civilization, "ritual" regulates citizens' behavior and can be applied to various social fields as a behavioral norm for social interaction and personal conduct, helping to maintain good social order and promoting civilized social development. "Music," on the other hand, achieves the effect of cultivating sentiment through emotional expression. The combined development of ritual and music forms a dual norm from both internal and external aspects, enabling individuals not only to exercise self-control in their behavior but also to cultivate good moral character internally.

3. Values of study and educational tours in the Temple of Heaven from the perspective of ritual and musical civilization

Study and educational tours in the Temple of Heaven from the perspective of ritual and musical civilization enable students to have close encounters with the architecture of the Temple of Heaven, understand China's traditional sacrificial culture, appreciate the architectural aesthetics of the Temple of Heaven, and experience the charm of China as a land of etiquette and the profound sense of history. These tours play an important role in cultivating students' cultural confidence, building moral literacy, enhancing aesthetic abilities, and recognizing historical development ^[4].

3.1. Inheriting traditional culture

The Temple of Heaven, completed in the 18th year of Yongle's reign in the Ming Dynasty and adopting a double-walled architectural structure, has a history of more than 600 years. It was a royal building for worshipping the heavens during the Ming and Qing dynasties, carrying rich ritual and musical civilization. Firstly, from the analysis of the architectural structure of the Temple of Heaven, the structure, decoration, and sacrificial etiquette all embody ritual and musical civilization. During the study tour, students can visit the buildings and observe the sacrificial ceremony process, which is conducive to understanding the significance of ancient ritual and musical civilization. For example, the Circular Mound Altar of the Temple of Heaven adopts a three-tiered circular design based on the Ming Dynasty people's belief in the "round sky and square earth" ^[5]. The Hall of Prayer for Good Harvests, as the core building of the Temple of Heaven and an important site for sacrificial ceremonies, highlights ancient prayers for good weather in its architectural decoration. Students can more intuitively experience the charm of culture during the study tour, which is beneficial for their understanding of ritual and musical civilization and promotes the inheritance of traditional culture.

3.2. Strengthening moral training

Ritual and musical civilization includes content on human behavior and moral norms, which are reflected in

the sacrificial etiquette and decorative patterns of the Temple of Heaven's architecture. Through the study tour, students can observe various etiquette systems of the sacrificial ceremony from a close distance. These systems are not only ritual actions and processes but also encompass respect, integrity, and awe for nature. All participants in the ceremony need to fast, bathe, and change clothes beforehand to ensure the solemnity of the etiquette. Observing these rituals can help students establish correct moral concepts, learn to obey rules and respect others, and enhance their moral cultivation.

3.3. Enhancing aesthetic value

The environment, buildings, and various decorations of the Temple of Heaven are embodiments of traditional Chinese cultural and artistic aesthetics. As a royal sacrificial site, the technical crafts and decorative crafts applied there represent the highest specifications in traditional cultural aesthetics. Although there are certain differences between these aesthetic elements and contemporary aesthetics, they still possess strong aesthetic value^[6]. The Hall of Prayer for Good Harvests adopts a circular pointed roof structure, and the entire building is decorated with various colored paintings. In the landscaping of the entire garden, careful consideration is given to the seasonal changes and needs of the scenery, resulting in an exquisite layout. By admiring these buildings and landscapes during the study tour, students can appreciate the exquisite craftsmanship of traditional Chinese architecture, which plays an important role in cultivating their aesthetic abilities and artistic accomplishments.

3.4. Improving historical cognition

The Temple of Heaven, built in the Ming Dynasty and having witnessed more than 600 years of historical vicissitudes, reflects the changes in different eras of political, economic, and cultural development. During the study tour, students can learn about the historical changes of the Temple of Heaven, form a more intuitive perception of history, and develop an interest in exploring history^[7].

4. Practical strategies for study and educational tours at the Temple of Heaven from the perspective of ritual and music civilization

4.1. Creating a theme of ritual and music civilization to optimize the study and educational tour model at the Temple of Heaven

Under the development of ritual and music civilization, study and educational tour work at the Temple of Heaven should focus on the theme of ritual and music civilization, optimizing the research model. Firstly, a curriculum system on "Exploring the Mysteries of the Temple of Heaven" can be developed. Teachers can design story-based and experiential exploration tales for students ahead of the study tour. The architectural structures of the Temple of Heaven can be personified, with each building containing a story about ritual and music. Students can learn about the norms and procedures of sacrificial rituals through advanced research and on-site teacher explanations^[8]. At the same time, using knowledge of scale, students can measure the buildings of the Temple of Heaven and analyze the concept of ritual and music culture presented there from a mathematical perspective, such as the embodiment of the nine heavens culture. During the tour, students can record and photograph the actual scenes of the Temple of Heaven, and then create short videos under the guidance of teachers and parents to promote the ritual and music civilization of the Temple of Heaven, cultivating students' sense of responsibility for cultural dissemination. Secondly, after the study tour activities, a diversified evaluation system can be constructed based on the students' performance during the tour, their absorption of knowledge, and the completion of assignments. Evaluation can enhance students' focus during the

study tour and promote the transformation of learned knowledge into their own reserves and guiding thinking. On the other hand, it can test the results of the study tour, laying a foundation for future improvements and optimizing the study and educational tour model at the Temple of Heaven.

4.2. Constructing immersive teaching scenes to enhance students' learning experience

During the study tour at the Temple of Heaven, students may be unable to watch the entire process of the Heaven Worship Ceremony due to time and crowd restrictions, affecting their perception and understanding of ritual and music civilization. To address this, students can be led to participate in holographic imaging activities. Holographic images can be used to recreate scenes of the emperor worshipping the heavens, allowing students to fully participate using VR glasses and experience the royal demeanor and the ritual and music atmosphere created by the sacrificial team. This viewing method effectively compensates for the limitations of on-site viewing, is not restricted by space, and provides a more comprehensive and three-dimensional experience for students, facilitating their connection with the Heaven Worship Ceremony at the Temple of Heaven. Moreover, the time for study travel is limited, and most visits are conducted during the daytime. However, the Temple of Heaven at night actually has a unique charm. Students can also utilize information technology to experience the grandeur of the Temple of Heaven at night. Through the interaction of architecture and lighting, as well as the combination of folk music and etiquette, the etiquette civilization in the Temple of Heaven can be further reproduced, deepening students' understanding of etiquette civilization. After the tour, teachers can assign a project for students to design their own cultural and creative products based on their perceptions of the Temple of Heaven's architecture, ritual and music culture, decorations, and celebration procedures. Students can design stationery, magnets, clothing decorations, and more through drawing. Students with average drawing skills can adopt group collaboration, using software to complete digital cultural and creative product creation through collective wisdom. Furthermore, a training program for explainers of the ritual and music culture at the Temple of Heaven can be launched. Students can combine information obtained through their own visits and additional research to provide explanations to teachers and students who have not participated in the study tour through community training and the use of image resources. Alternatively, students can be encouraged to participate in volunteer explanation activities at the Temple of Heaven, promoting their learning, expression, and dissemination of the ritual and music culture there.

4.3. Constructing a collaborative education model to achieve multi-party resource integration

During the study activities at the Temple of Heaven, in order to promote students' better understanding of ritual and music culture, attempts can be made to collaborate with the management unit of the Temple of Heaven to construct a dual-teacher classroom for students. Currently, there are many records about the Temple of Heaven and ritual and music culture on the internet and in various materials, but there is still a certain gap compared to scholars who study the management of the Temple of Heaven and ritual and music culture. To ensure the comprehensiveness of learning about ritual and music civilization during the study, a combination of teaching instructors and guides can be used to provide students with more exciting study courses. Besides collaborating with the management unit of the Temple of Heaven, extensions can also be made from the ritual and music culture of the Temple of Heaven. Thematic activities on ritual and music civilization can be formed by combining the ritual and music cultural content of cultural museums such as the Forbidden City. Through visits to various exhibits and cultural relics, the effect of linking ritual and music civilization can be achieved. In

addition, students can be led to participate in the experience of colored drawing, wood carving, and mortise and tenon craft activities, divided into groups to make models of the Temple of Heaven, experience the production process of the Temple of Heaven, and have close contact with ritual and music culture. To deepen the study process at the Temple of Heaven, teachers can use the study APP to show students the full picture of the Temple of Heaven and the various ritual and music cultural content involved once again after the study. Then, the study content can be divided into different modules, including sacrificial activities, architectural art, and ritual and music culture. Students can communicate with each other about each module and share their experiences and insights.

4.4. Strengthening teacher training and improving teaching ability for study

In the traditional study of ritual and music civilization at the Temple of Heaven, teachers need to have rich knowledge of ritual and music civilization and a deep understanding of the architectural structure, culture, and environment of the Temple of Heaven to better explain it to students and enhance their understanding of culture. Therefore, to ensure the smooth development of the study, it is necessary to strengthen the construction of the teacher team. Firstly, before the study begins, historians, ritual and music culture experts, and architectural experts can be invited to provide training for teachers, which can be conducted in both online and offline formats depending on specific resource conditions ^[9]. Enrich teachers' knowledge of history and ritual and music civilization so that they can flexibly explain it to students in combination with the construction and sacrificial procedures of the Temple of Heaven during the study. At the same time, teachers should actively participate in relevant academic research activities and conduct field visits ahead of time to effectively combine ritual and music civilization with the structure and layout of the Temple of Heaven, avoiding omissions in subsequent studies. Active communication can also be established with teachers who have completed their studies to enrich the experience of subject research and development. Teachers also need to keep a study log during the teaching and research process, recording the study process and students' performance, and clarifying the highlights and shortcomings of the study to lay a foundation for subsequent teaching and research activities. To stimulate teachers' research enthusiasm, competition activities such as on-site teaching and curriculum design can be organized to enhance teachers' comprehensive skills. Corresponding rewards can also be set for teachers who perform well in the competition.

4.5. Emphasizing the transformation of research learning outcomes and expanding the influence of ritual and music culture

After conducting research and learning at the Temple of Heaven, students gain a deep understanding of its ritual and music culture. Through various activities, they are able to deepen their impression and produce numerous works and achievements. These achievements encompass students' harvest from research learning, their cognition of ritual and music culture, and their insights from visiting the Temple of Heaven. To expand the influence of ritual and music civilization and deepen students' perception, teachers can organize activities to transform research learning outcomes after the completion of research learning. These activities can include exhibiting students' cultural and creative works, paintings, and architectural models themed around the ritual and music culture of the Temple of Heaven. By inviting parents and other students to visit and experience these research learning outcomes, the influence of ritual and music culture can be strengthened, and the role and value of research learning activities can be extended ^[10]. Furthermore, students' completed research works can also be taken off campus and applied to more cultural venues, providing reference for the dissemination and protection

of the ritual and music culture of the Temple of Heaven. For instance, collaborations can be established with cultural propaganda departments or media outlets to provide materials for the dissemination of ritual and music culture. This encourages students to apply their research findings and ideas to social practices, attracting more people to pay attention to ritual and music culture and promoting its inheritance and development.

5. Conclusion

In summary, study travel education at the Temple of Heaven, viewed through the lens of ritual and music civilization, needs to explore the content of ritual and music civilization by combining various aspects such as history, culture, sacrificial ceremonies, and architectural decoration in the Temple of Heaven. Through explanations, immersive experiences, and the creation of immersive scenes, students are led to have close contact with ritual and music culture and experience the grandeur it brings. This enhances students' comprehensive abilities such as cultural perception, moral accomplishment, aesthetic judgment, and historical understanding, ensuring the effectiveness of study travel teaching. After the study travel activities are completed, teachers also need to sort out the process, summarize the achievements made during the study, provide secondary inspiration to students, and expand the effectiveness of the study. Additionally, teachers should guide students to transform research results, providing more people with opportunities and ways to understand ritual and music culture and the Temple of Heaven, contributing to the inheritance of ritual and music culture, and forming a long-tail effect of study travel education.

Disclosure statement

The author declares no conflict of interest.

References

- [1] Guo M, 2021, Enlightenment of Traditional Ritual and Music Thought on Cultivating and Practicing Socialist Core Values. *Party Building and Ideological Education in Schools*, 2021(24): 70–72.
- [2] Xu C, 2022, The “Ritual and Music” Path of Traditional Culture Education in Primary Schools. *Educational Practice and Research*, 2022(16): 57–60.
- [3] Chen Y, 2024, Chinese Traditional Family Ritual Culture and Its Contemporary Value. *Studies in Ethics*, 2024(2): 51–58.
- [4] Zhu K, 2021, Research on Cultural and Historical TV Programs from the Perspective of Semiotics—Interpretation of the Cultural Symbols in “Meet the Temple of Heaven.” *West China Broadcasting and TV*, 42(22): 21–23.
- [5] Lu L, 2024, Inheritance Strategy of Intangible Cultural Heritage Tiantan Inkstone in Art Education in Primary and Secondary Schools. *New Curriculum Guidance*, 2024(23): 55–58.
- [6] Tang J, 2023, Exploration of the Ritual and Music Thought in “The Analects of Confucius” and Its Contemporary Value from the Perspective of Implicit Ideological and Political Education. *Road to Success*, 2023(35): 33–36.
- [7] Li A, 2023, Research on the “Regional Cultural Collaborative Education” of Heluo Culture. *Journal of Luoyang Institute of Science and Technology: Social Science Edition*, 38(5): 5–8.
- [8] Wang Y, Hua H, Yan X, et al., 2023, Design of Research and Study Courses in Cultural Heritage Sites from the Perspective of Ecological Civilization Education—Taking Honghe Hani Terraced Fields as an Example. *Reference for Middle School Geography Teaching*, 2023(24): 11–15.

- [9] Qin W, Liu D, Ju L, 2024, Exploration of Museum Research and Study Course Design Based on the REWRITE Concept—Taking the “Exploring the Imprint of Chinese Civilization, Disseminating the Information of Chinese Cultural Context” Research and Study Course of the National Library of China as an Example. *National New Book Catalog*, 2024(12): 105–111.
- [10] Lu Y, 2024, Feasibility Study of Research Travel Promoting the Development of Rural Spiritual Civilization Practices—Taking Jiangyin Area as an Example. *Village Director*, 2024(1): 123–125.

Publisher's note

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

Research on the Integration of Ideological and Political Elements in the Civil Engineering Construction Organization Design Course

Ying Xu*

Harbin Institute of Technology, Shenzhen, Shenzhen 518055, Guangdong, China

**Author to whom correspondence should be addressed.*

Copyright: © 2025 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: By organically integrating ideological and political elements into the civil engineering construction organization design course, and through methods such as course content reconstruction, guidance of typical cases, and integration into project practices, a teaching model centered on professional skills cultivation and oriented towards value guidance is constructed. In the teaching links such as the formulation of construction plans, the control of construction progress, and the optimal allocation of resources, ideological and political education contents such as engineering ethics, safe production, and responsibility and commitment are integrated to enhance students' sense of social responsibility and professional mission, and achieve the goal of collaborative education of knowledge imparting and value guidance. Teaching practice shows that this integrated path is conducive to improving students' comprehensive quality and promoting the synchronous development of professional ability and ideological quality.

Keywords: Ideological and political education; Integrated teaching; Construction organization design; Engineering ethics; Teaching reform

Online publication: July 3, 2025

1. Introduction

With the in-depth advancement of ideological and political education in college courses in the new era, how to effectively integrate ideological and political education into professional courses has become an important issue for improving the quality of education. Civil engineering, as an important discipline related to the construction of national infrastructure, its construction organization design course not only carries the imparting of technical knowledge, but also serves as an important carrier for cultivating students' awareness of engineering ethics and their sense of responsibility and commitment. Skillfully integrating ideological and political elements into the teaching process helps to build a teaching system that attaches equal importance to value guidance and ability cultivation, and promotes students to achieve the simultaneous improvement of professional quality and ideological quality.

2. Analysis of the current teaching situation and educational shortcomings of the construction organization design course

2.1. Basic information about the construction organization design course

The construction organization design course is an important component of the civil engineering major, aiming to cultivate students' abilities in construction planning, resource allocation, progress control, and safety management in actual engineering projects. This course helps students master the basic process of project implementation by teaching relevant content such as construction technology, management methods, and engineering economics. However, in the current teaching process, although students' professional skills have improved, there is less attention paid to aspects such as engineering ethics and social responsibility, resulting in students lacking the necessary professional ethics and social responsibility in actual work ^[1].

2.2. Current situation of integrating ideological and political education

In the civil engineering major of many colleges and universities, the course of construction organization design pays more attention to the imparting of techniques and theories, while the integration of ideological and political education is relatively weak. Some teachers occasionally mention moral and ethical issues in class, but there is a lack of systematic ideological and political education arrangements. With the country's emphasis on educational quality, especially the requirements for ideological and political work, many institutions have realized the issue of integrating professional courses with ideological and political education, but there are still difficulties in effectively integrating them. Most courses still remain at the stage of simple moral explanations and fail to be fully reflected in the actual teaching design and case analysis.

2.3. The gap between the training objectives and the actual demands

With the high demands of the state on the engineering industry, especially the increasing attention paid to safety management, environmental protection, and other aspects in the construction industry, students not only need to master exquisite professional skills, but also need to have a strong sense of social responsibility, teamwork awareness, and engineering ethics. However, the current teaching content focuses more on technical knowledge and neglects the cultivation of students' comprehensive qualities, especially the guidance in aspects such as responsibility and social ethics is insufficient. This single training approach that focuses on professional skills is difficult to meet the comprehensive requirements of talent cultivation in the new era, and has a certain gap with the industry's demand for high-quality engineering and technical talents.

2.4. Shortcomings of integrating ideological and political elements in education

The course of construction organization design fails to effectively integrate ideological and political education, resulting in students easily neglecting the cultivation of social responsibility and professional ethics in engineering practice. For instance, in some project decisions, students may pay more attention to technical feasibility and cost-effectiveness, while neglecting social issues such as environmental protection and personnel safety ^[2]. This kind of thinking limitation restricts the improvement of students' comprehensive abilities. Due to the lack of guidance from ideological and political education, students may lack the ability and courage to deal with complex social and ethical issues when facing engineering projects.

3. Exploration of the integration path of ideological and political elements in the teaching of construction organization design

3.1. Reconstruction of course content is combined with ideological and political elements

First of all, the reconstruction of the course content is the basis for integrating ideological and political elements into the teaching of construction organization design. In the formulation of the teaching syllabus, it is necessary not only to cover traditional knowledge such as construction organization design theory, construction progress control, and resource allocation, but also to integrate ideological and political education content into each teaching link. For instance, when explaining the compilation of construction plans, the topics of social responsibility and environmental protection can be introduced to discuss how to balance economic benefits and social benefits in the construction organization design, how to deal with environmental protection regulations and safety norms during the construction process, and cultivate students' sense of social responsibility. In the teaching of schedule and cost management, case analysis can be combined to guide students to pay attention to reasonable construction period arrangements and construction quality, and avoid overly pursuing cost savings while neglecting the long-term impact on society and employees.

3.2. Case analysis method and typical event guidance

In the teaching process, ideological and political education is organically integrated into the discussion of actual engineering projects through the case analysis method. Teachers can select some representative architectural project cases, especially those with significant social impact, as teaching materials. For instance, explain how to balance social and economic benefits during the design and construction of a certain engineering project, and how to deal with social public opinion caused by moral issues during the construction process, etc. Through the guidance of such cases, it can not only help students better understand professional knowledge, but also trigger their thinking on ideological and political issues such as social responsibility, engineering ethics, and teamwork, and enhance their moral judgment and sense of social responsibility^[3].

3.3. Project-based learning and practice course design

In order to better combine ideological and political elements with professional skills, the project-based learning mode can be introduced in the curriculum design. Through practical courses, students can not only exercise their professional skills in construction organization design during the process of simulating project management, but also experience the challenges of social responsibility and ethics when facing actual problems. Teachers can guide students to think about how to deal with complex social and environmental issues in the construction organization design, such as construction safety, labor rights, green buildings, etc., and incorporate these discussions as part of the project scheme design. During the project implementation process, students should not only consider construction techniques and economic factors but also pay attention to the impact of construction on society and the environment, so as to integrate ideological and political education in practical operations.

3.4. Optimization of the teaching evaluation system

In order to ensure the effective integration of ideological and political elements in the construction organization design course, the teaching evaluation system needs to be adjusted accordingly. In the traditional evaluation system, the focus is mainly on students' technical abilities and the mastery of professional knowledge. However, after the integration of ideological and political education, the evaluation system should also incorporate the examination of students' ideological and political qualities. For instance, in the final grade assessment of students, the performance of ideological and political education in the curriculum can be regarded as an

important assessment content, with a focus on examining whether students can demonstrate concern and reflection on society, the environment, and ethics in the formulation of construction plans.

4. Implementation strategies for constructing a dual-dimensional teaching system of “technology + ideology”

4.1. Curriculum objective setting that emphasizes both technology and ideology

The first step in constructing a dual-dimensional teaching system of “technology + ideology” is to clarify the positioning of the course objectives. In the setting of teaching objectives, it is not only necessary to ensure that students master the core technical knowledge and skills of civil engineering construction organization design, but also to pay attention to the cultivation of students’ ideological and political qualities. Therefore, the course objectives should cover the comprehensive cultivation of professional knowledge, practical ability, and ideological and political quality^[4]. For instance, the teaching objective can be set as follows: Students can master the basic theories and methods of construction organization design proficiently, possess certain engineering practice abilities, and at the same time have a good sense of engineering ethics and social responsibility.

4.2. Integration and design of teaching content

In order to achieve the teaching goals of the dual dimensions of “technology + ideology,” the teaching content needs to be organically integrated. First of all, in the traditional technical teaching content, teachers can enrich the technical explanations by integrating content such as social responsibility and engineering ethics. For instance, when explaining the management of construction progress, one can discuss the potential safety hazards that may arise from overly pursuing a shortened construction period, as well as how to balance factors such as time, cost, and safety, to cultivate students’ awareness of the importance of engineering quality and social responsibility. In the teaching of technical difficulties, teachers can guide students to think about the impact of construction organization design on the environment, society, and human resources, and enhance students’ sense of social responsibility and team spirit.

4.3. Diversified teaching methods and activity designs

When implementing the dual-dimensional teaching system of “technology + ideology,” it is crucial to adopt diversified teaching methods and activity designs. In addition to the traditional lecture method, teaching methods such as case teaching, project-based learning, and role-playing can effectively enhance students’ sense of participation and depth of thinking. For instance, in case teaching, teachers can introduce real cases involving engineering ethics, construction safety, environmental protection, and other aspects, and encourage students to discuss and solve the ideological and political problems therein. In project-based learning, students can simulate the entire process of engineering projects, conduct construction organization design, and cultivate ideological and political qualities such as teamwork and responsibility in practice.

4.4. Establishment of classroom interaction and feedback mechanisms

To ensure the effective implementation of the “technology + ideology” dual-dimensional teaching system, the construction of classroom interaction and feedback mechanisms is an indispensable link. In the classroom, teachers should pay attention to interaction with students, encourage them to discuss technical and ideological and political issues, and promote the collision of students’ thinking. For instance, teachers can raise open-ended

questions such as “How can social responsibility be reflected in the construction organization design?” or “How to balance the relationship between cost and safety and environmental protection?” Through these discussions, students can have a deeper understanding of the dialectical relationship between technology and ideology. In addition, teachers should also provide timely feedback to students. They should not only assess students’ technical abilities but also pay attention to their progress and performance in ideological and political education. Through regular discussions, questionnaires, and other means, they should help students improve both their technical abilities and ideological qualities simultaneously.

5. Mechanisms for integrating effectiveness assessment and continuous optimization of teaching quality

5.1. Establishment of a multi-dimensional evaluation system

In order to ensure that ideological and political elements are effectively integrated into the construction organization design course and achieve the dual cultivation of technology and ideology, it is indispensable to establish a multi-dimensional evaluation system. This assessment system should cover multiple dimensions such as students’ professional skills, sense of social responsibility, ethical awareness, and teamwork spirit. In terms of the assessment of technical abilities, teachers can evaluate students’ professional levels through traditional examinations, assignments, and project achievements. In terms of ideological and political literacy, it can be examined through aspects such as classroom participation, ethical judgment in case analysis, and social responsibility in project design ^[5].

5.2. Regular feedback and teaching adjustment mechanism

The establishment of the evaluation system is only the first step. The key lies in how to make teaching adjustments based on the evaluation results. Therefore, the regular feedback mechanism is particularly important. At the end of each semester or academic year, teachers should collect students’ learning feedback, analyze their performance in professional skills and ideological and political qualities, and identify the problems and deficiencies in teaching. For example, students may perform well in technical issues, but they are lacking in ethical judgment and social responsibility awareness. Based on this feedback, teachers can adjust their teaching strategies and content, strengthen the cultivation of students’ ideological and political qualities, and ensure the continuous optimization of teaching content and methods. In project-based learning or classroom interaction, teachers should also provide immediate feedback to help students identify and correct problems in a timely manner.

5.3. Teaching quality monitoring and continuous optimization

In order to further improve the teaching quality, it is crucial to establish a teaching quality monitoring mechanism. Schools can supervise the teaching process through regular teaching evaluations, classroom observations, and self-assessments by teachers, and formulate corresponding optimization plans in combination with the comprehensive quality evaluation results of students. For instance, schools can provide feedback on teachers’ teaching content, methods, and teaching attitudes based on the assessment results, and offer corresponding training or guidance to help teachers continuously improve their teaching proficiency. Meanwhile, the optimization of teaching content and methods should also be adjusted in accordance with the needs of students and changes in social development. For instance, new social hot issues such as environmental protection and engineering ethics should be continuously integrated to maintain the forward-looking and

timeliness of the courses.

5.4. Long-term development assessment of students and curriculum updates

Finally, in order to achieve the continuous improvement of teaching quality, schools should take the long-term development of students as an important indicator for assessment. By tracking the performance of graduates in their careers, especially in terms of social responsibility, ethical decision-making ability, and teamwork spirit in project management, the actual effect of ideological and political elements in the curriculum can be understood. This kind of assessment can not only provide a practical basis for teaching but also offer direction for the further update and optimization of the curriculum. Through the feedback from graduates, the school can promptly identify the deficiencies in the courses, improve the teaching content and methods, and keep the course content in line with social demands and industry standards, thereby achieving a sustainable improvement in educational quality.

6. Conclusion

Integrating ideological and political elements into the civil engineering construction organization design course is an important manifestation of the curriculum reform and the concept of fostering virtue and nurturing talent in colleges and universities in the new era. Through multi-dimensional approaches such as content reconstruction, case guidance, project practice, and teaching evaluation, a dual-dimensional teaching system of “technology + ideology” is constructed, which not only strengthens students’ professional skills but also enhances their sense of responsibility and engineering ethics. Practice has proved that this integration model is conducive to achieving the unity of knowledge imparting and value guidance, and promoting the full implementation of the educational goals. In the future, continuous optimization in aspects such as mechanism improvement, resource integration, and faculty enhancement is still needed to promote the in-depth and solid development of ideological and political education in courses and serve the contemporary demand for cultivating high-quality engineering talents.

Disclosure statement

The author declares no conflict of interest.

References

- [1] Huang X, He X, 2022, Into the Ideological Elements of Civil Engineering Construction Course Teaching Exploration and Practice. *Journal of Anhui Construction*, 29(12): 112–114.
- [2] Zeng X, Wang L, Ding C, et al., 2021, Exploration and Practice of Ideological and Political Education in Applied Undergraduate Civil Engineering and Architecture Courses: Taking the “Civil Engineering Construction Organization” Course as an Example. *Journal of Changzhou Institute of Technology*, 34(03): 90–95.
- [3] Zhang Y, 2022, Research and Practice on the Path of Ideological and Political Education in Civil Engineering Construction Organization Course. *Anhui building*, 29(11): 103–104.
- [4] Feng Y, Wang Q, Liu K, et al., 2020, Teaching Discussion on the Integration of Ideological and Political Education Elements into the Course Civil Engineering Construction. *Journal of Social Sciences of Jiamusi University*, 38(04): 217–219.

- [5] Jia L, 2024, Analysis of the Path of Integrating Ideological and Political Elements into the Standardized Practical Teaching of Civil Engineering Construction Technology Course. *China Standardization*, (12): 217–219.

Publisher's note

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

Artificial Intelligence in Diagnostics of Traditional Chinese Medicine

Tingye Wang*, Xuemei Wang, Ningyi Wei, Dan He

Yunnan University of Chinese Medicine, Kunming 650500, Yunnan, China

**Author to whom correspondence should be addressed.*

Copyright: © 2025 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: With the rapid development of science and technology, the application of artificial intelligence (AI) technology in medical education has become increasingly widespread in the digital age, bringing new opportunities and challenges to China's higher education of traditional Chinese medicine (TCM). In the context of digital education, it is of great significance to construct a teaching model that integrates AI technology with the characteristics of the diagnostics of traditional Chinese medicine, in order to improve the quality of curriculum teaching in the future. This article aims to introduce how to organically integrate AI technology with diagnostics of traditional Chinese medicine teaching based on the characteristics of the discipline, to achieve teaching mode reform, therefore to improve the teaching quality of traditional Chinese medicine education, and cultivate high-quality TCM talents that meet the needs of the new era.

Keywords: Diagnostics of traditional Chinese medicine; Artificial intelligence; Teaching reform; Traditional Chinese medicine

Online publication: June 30, 2025

1. Introduction

The 2024 National Conference on Traditional Chinese Medicine (TCM) Education and Management pointed out the need to build a high-quality talent team and inject strong impetus into the inheritance, innovation, and development of TCM. At the 2024 World Conference on Digital Education, Minister of Education Huai Jinpeng^[1] pointed out that the digitalization of education is an important breakthrough for opening up new tracks and shaping new advantages in educational development. As teachers of TCM universities in this digital era, it is necessary to closely monitor the development trends of artificial intelligence (AI) technology in education and teaching, and actively explore teaching models that combine AI technology based on digital education concepts. Only in this way can we cultivate TCM talents that meet the needs of the people, the country, and the times, and contribute to the modernization of TCM.

2. Current status of the application of AI technology in medical education

Through the application of digital technology, medical education has spurred digital transformation and reform in areas such as theoretical teaching, practical teaching, and textbook reform. Research has shown that medical students who have received AI-assisted teaching and training will be more advantageous in transitioning into roles such as medical researchers, clinical doctors, or nurses after graduation. With the advent of the digital education era, a large number of medical educators have begun to explore new models of integrating AI with medical education. Wang and colleagues constructed a tongue diagnosis training and assessment platform based on artificial intelligence, which stimulated students' interest in learning and achieved good application results. Cai ^[2] and others found that the scores of acupoint test, acupuncture and moxibustion operation test, and theory test in the AI-assisted teaching group were significantly higher than those in the traditional teaching group, which greatly improved the teaching effects. Zhang and colleagues used an AI-assisted self-directed learning method to enhance students' clinical practice abilities. Chen found that the AI-assisted teaching group had better theoretical scores, report writing speed, and report scores than those in the traditional PACS teaching group, which helped consolidate students' theoretical knowledge and comprehensively improve the effectiveness of pulmonary nodule imaging teaching. All the reported cases show that the application of AI-related technologies in medical course teaching is inevitable and advantageous. Medical colleges should actively seek integration with AI technology to improve the ability of medical students to adapt to future medical development, and eventually achieve the goal of cultivating high-quality medical talents.

3. Current status of diagnostics of traditional Chinese medicine teaching

Diagnostics of traditional Chinese medicine is the core course in the professional curriculum system of students majoring in TCM university, and is a bridge course between theoretical basis and clinical disciplines, which has the characteristics of a close combination of theory and practice and is tightly related to other core courses. In response to these characteristics, a large number of educators have carried out diversified teaching reforms, including incorporating the BOPPPS teaching model into the teaching of diagnostics of traditional Chinese medicine ^[3], implementing differentiated and personalized teaching of diagnostics of traditional Chinese medicine under the credit system background ^[4], utilizing big language models for personalized coaching, virtual case generation, and simulated diagnostic training ^[5]; a small but precise analysis of misdiagnosis cases that correspond to the key and difficult points of the textbook were introduced ^[6]. A large number of teaching reforms based on the characteristics of diagnostics of traditional Chinese medicine have achieved good results in teaching effectiveness and student satisfaction, but there are still some problems, such as the low correlation between teaching content and clinical practice, and students' superficial learning that lacks in-depth exploration. How to empower traditional Chinese medicine teaching and inheritance innovation with digital technology in this digital education era has become an urgent issue for TCM university teachers to consider.

4. Strategies for the integration of AI technology and diagnostics of traditional Chinese medicine teaching

In the digital era, the "Internet plus + TCM" model has greatly enriched and expanded TCM teaching resources. Based on the characteristics of the diagnostics of traditional Chinese medicine and the existing problems in the teaching mode, the following reform ideas for the teaching mode of diagnostics of traditional Chinese medicine based on the integration of AI technology were proposed in this manuscript.

4.1. Construction of the course knowledge graph

With the innovation of educational concepts and the popularization of digital technology, curriculum knowledge graphs have been widely applied in medical teaching^[7-9]. Diagnostics of traditional Chinese medicine has the characteristics of numerous knowledge points and a close connection with the preceding and following courses. However, due to the barriers between courses and the inability to connect them, students face difficulties in learning and find it difficult to achieve coherence between the preceding and following knowledge. The course knowledge graph is based on AI technology, with knowledge points as anchor points, breaking down course barriers, establishing a network structure of relationships between different course knowledge points, and forming a structured learning experience of course content visualization. It is conducive to helping students build knowledge systems and frameworks and cultivate TCM thinking. In the future, based on the knowledge of diagnostics of traditional Chinese medicine, through in-depth interpretation of the professional talent training program, guided by job competency, AI technology will be used to identify and refine standardized knowledge systems through manual correction. A relatively complete and logically rigorous knowledge map framework will be constructed for the knowledge points of this course and related fields, and corresponding teaching resources will be associated to form a course knowledge map with professional characteristics, visualization, and systematization, which will provide strong support for improving teaching quality.

4.2. AI course construction

AI courses are a product of actively exploring artificial intelligence and higher education in the digital age. The establishment and implementation of AI courses such as “Pathology” at Jilin University and “Medical English Terminology” at Capital Medical University reflect a new stage of exploration and practice in teaching new forms of courses. The construction of AI courses cannot be separated from a complete course knowledge graph. In the future, based on the construction of the knowledge graph of diagnostics of traditional Chinese medicine, AI intelligent teaching assistants, AI intelligent lesson preparation assistants, and AI intelligent grading tools will be formed by combining AI technology, providing students with personalized learning paths based on AI and greatly improving teaching quality.

4.3. Construction of AI-based virtual simulation teaching platform

At present, AI technology is widely used in the field of diagnostics of traditional Chinese medicine, including expert systems for observation and inquiry, sensors and intelligent hardware for olfactory diagnosis, palpation, etc.^[10,11]. The field of AI-assisted objectification of diagnostics of traditional Chinese medicine is in a booming stage of development. In the future, the objective research results of the Four Diagnostic Diseases can be used as a driving force, combined with AI technology, to carry out the construction of an AI-based intelligent standardized patient teaching system and virtual simulation system. The design of a standardized patient joint scenario simulation teaching mode in the Four Diagnostic Diseases teaching can break down the barriers between theoretical and practical teaching courses, and cultivate TCM talents with a deep theoretical foundation and strong clinical practice.

5. Conclusion

With the rapid development of digital technology, especially the unprecedented nationwide online teaching during the epidemic, and the explosive popularity of ChatGPT, DeepSeek technology in recent years, educators, healthcare professionals, the education industry, and students are increasingly realizing that the reform of AI-

based teaching models is inevitable for the development of medical education. However, in order to achieve the organic integration of diagnostics of traditional Chinese medicine and AI technology, a series of challenges need to be overcome: (1) Integration of AI technology and teaching: it is necessary to take carefully designed classroom content and teaching strategies as the basic mainline, it is vital that we can keep in mind that AI is an auxiliary technology rather than the center of teaching; (2) Ethical issues in the use of AI technology: Studies have shown that research on ethics of AI teaching in medical education is currently rare ^[12], but in the digital age, AI will have a significant impact on medical education, making ethics of AI teaching an indispensable part of medical education and bringing new challenges to educators; (3) Education quality improvement for teachers and adaptability training for students: Teachers need to establish a lifelong learning concept, constantly strengthen their educational quality with new knowledge and technology as opportunities, so as to better adapt to the digital education era. At the same time, students should also strengthen their understanding of digital technologies such as AI, accept the changes in the mode of integrating AI technology into teaching, and fully utilize these digital tools to carry out more efficient, convenient, and interesting learning.

With the deep integration of AI technology and medical education, there will be profound changes in the teaching mode and evaluation of the diagnostics of traditional Chinese medicine. Under the guidance of the OBE concept in the future, exploring the establishment of an educational model that is in line with the characteristics of the diagnostics of traditional Chinese medicine and adapted to AI technology will help improve the quality of course teaching, enhance the clinical thinking ability of medical students, cultivate traditional Chinese medicine thinking, and become talents in the new era of traditional Chinese medicine.

Disclosure statement

The authors declare no conflict of interest.

References

- [1] Feng T, Liu J, Huang L, et al., 2024, Digital Education: Application, Sharing, and Innovation——Overview of the 2024 World Digital Education Conference. *China Educational Technology*, (03): 20–36.
- [2] Cai W, Shen W, 2024, Application of AI-Assisted Teaching Method in Teaching Reform of Acupuncture and Moxibustion. *Journal of Traditional Chinese Medicine Management*, 32(11): 19–21.
- [3] Feng C, Kong Y, Nie G, 2024, Exploring the Application of BOPPPS Teaching Mode in the Teaching of Diagnostics of Traditional Chinese Medicine. *Journal of Henan Medical College*, 36(04): 552–554.
- [4] Duan J, Xiong G, Wei N, 2024, Research on the Reform of the Layered Teaching Mode of Diagnostics of Traditional Chinese Medicine under the Background of Credit System. *Chinese Medicine Modern Distance Education of China*, 22(13): 1–3.
- [5] Gu R, Gu X, 2024, Application of Large Language Models in the Teaching of Traditional Chinese Medicine Diagnostics. *Chinese Journal of Medicinal Guide*, 26(07): 737–741.
- [6] Du C, Zhao Y, Li J, et al., 2014, Exploration of the Mode of Introducing Misdiagnosis Case Analysis into the Teaching of Diagnostics of Traditional Chinese Medicine. *Shanxi Journal of Traditional Chinese Medicine*, 30(05): 55–56.
- [7] Guo H, 2021, Construction of Knowledge Graph for the Online Course in Colleges and Universities Based on Intelligent Education——A Case Study on Chinese Medical History. *China Educational Technology*, (02): 123–130.