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International Education Forum

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Reform and Practice of the Course “Civil Engineering Construction Technology and Organization” Based on Smart Classroom

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Abstract: As a new form of deep integration of information technology and education and teaching, the smart classroom has promoted educational reform and is an inevitable choice for the informatization of higher education in the intelligent era. The research expounds the connotation of the smart classroom, constructs an effective teaching model of the smart classroom based on the BOPPPS model, and conducts teaching reforms and practices in the three stages of pre-class, in-class, and post-class, relying on the course “Civil Engineering Construction Technology and Organization.” Through questionnaire surveys, it was found that building an effective teaching model for smart classrooms can fully mobilize students’ enthusiasm for learning and improve their learning efficiency and effectiveness.

Keywords: Smart classroom; BOPPPS model; Teaching design; Teaching evaluation

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1. Introduction

The smart classroom is a new form of classroom that deeply integrates information technology with subject teaching^[1]. The report of the 20th National Congress of the Communist Party of China put forward the new goal of “digitalization of education”, and for the first time included “promoting digitalization of education” in the report of the Party Congress. This has pointed out the direction for further doing a good job in scientific and technological innovation and digitalization of education in colleges and universities in the new era, and provided fundamental guidance. How to make good use of the “smart classroom”, build high-quality online open courses, and promote the deep integration of information technology and teaching is worth the research and exploration. The author has designed an effective teaching model that integrates the characteristics of the BOPPPS teaching model and the smart classroom. Taking the course “Civil Engineering Construction Technology and Organization” as an example, teaching reform and practice have been carried out. During the practice process, the operability and effectiveness of this model have been tested, and the plan has been optimized and adjusted

to improve the teaching model in order to achieve the goal of enhancing teaching effectiveness.

2. Research background

The course “Civil Engineering Construction Technology and Organization” is a specialized course for the civil engineering major. It mainly teaches construction technology and construction organization technology in the field of civil engineering. It is characterized by practicality, comprehensiveness, and strong policy orientation. The experimental projects involved in the course have difficulties, such as high risk and difficulty in reproduction. Based on the smart classroom, the learning mode is reformed. For instance, sometimes a hybrid teaching approach of online and offline is adopted. Teachers record micro-lessons in advance for basic and simplified content and upload them to the Zhixue Heavy Industry platform. Before class, students are notified to start learning in advance, providing them with sufficient learning time. This is to ensure that every student enters the classroom with a solid knowledge foundation as much as possible. In the classroom, teachers focus on explaining the problems and key and difficult points that students encounter in their autonomous learning, thereby fully ensuring the quality of classroom teaching. Re-integrate and design the learning content, create comprehensive cases, build a real working environment, adopt a task-driven teaching model, transform real work tasks into learning-oriented ones, and let students discuss in groups and independently design construction plans, with the aim of enhancing students’ problem-solving abilities and cultivating their higher-order thinking skills. Based on the relevant virtual simulation projects, students are assigned to visit and experience the virtual simulation projects independently, further deepening their understanding and feelings about the engineering projects.

From the perspective of information technology, a smart classroom is an educational classroom that uses big data, cloud computing, and other means to build an efficient and intelligent multi-learning environment, with the goal of stimulating students’ wisdom. Relying on the “intelligent cloud service + classroom intelligent platform + intelligent terminal” service platform, it is possible to achieve intelligent resource push, data-driven teaching decision-making, three-dimensional communication and interaction, immediate and personalized evaluation and feedback, and integration of “teaching—learning—evaluation.” This enables teachers’ roles to shift more towards guidance and support, while students truly become the main body of the learning process. This will promote personalized learning and all-around development ^[2-3]. This paper explores how to optimize the teaching design based on the smart classroom and BOPPPS teaching mode in the teaching of the “Civil Engineering Construction Technology and Organization” course, ensuring the smooth implementation of teaching, and conducting teaching feedback and teaching effect evaluation.

3. Construction of an effective teaching model of a smart classroom based on the BOPPPS model

The new teaching model is guided by effective teaching theory, combined with the characteristics of a smart classroom and the specific implementation strategies of the BOPPPS teaching model, extending classroom teaching to before and after class.

3.1. Effective teaching design before class

The pre-class stage of the “Civil Engineering Construction Technology and Organization” course under the

Smart classroom mainly consists of four parts: determining teaching objectives and key and difficult points, designing a pre-test, conducting a comprehensive analysis of students' learning conditions, and designing lesson plans.

3.1.1. Pre-setting of teaching objectives and key and difficult points

Teachers need to determine knowledge objectives, ability objectives, and quality objectives based on the professional training program and the course teaching syllabus, and integrate the three-dimensional objectives into the teaching process in the smart classroom environment.

3.1.2. Design a pre-test based on teaching objectives

This stage is an important prerequisite for the implementation of smart classroom teaching. It is used to assess students' completion of previewing and their mastery of relevant basic knowledge, facilitating teachers to conduct a comprehensive analysis of students' learning conditions, promptly adjust teaching methods and content, and formulate appropriate teaching design plans. The pre-test should be based on the pre-class preview, and the pre-test questions should be created in combination with the teaching objectives, teaching content, and students' abilities, and then pushed to students through the smart classroom information technology platform. The pre-test can be conducted in various ways, such as time-limited answering, homework, and discussion. Teachers can grade and comment through the test evaluation system of the smart classroom information technology platform ^[3-4].

3.1.3. Conduct an analysis of students' learning conditions based on teaching objectives and pre-tests

Students complete their preview and pre-test on the Zhixue Heavy Industry platform. Teachers can view students' previewing situations through the smart classroom information technology platform, grasp the basic information of students' learning conditions, and provide targeted classroom explanations for the knowledge points that students have not mastered or have doubts about.

3.1.4. Complete the teaching plan design based on the curriculum standards and students' learning conditions

Based on the teaching content, carefully select resources such as animation demonstrations, micro-videos, and virtual simulation experiments related to the knowledge points of this lesson from the micro-lesson resources, and design and optimize the teaching content, teaching form, and teaching courseware ^[5].

3.2. Effective teaching design in class

3.2.1. Participatory learning

This stage is the key to the implementation of smart classroom teaching. In line with the characteristics of the "Civil Engineering Construction Technology and Organization" course, during the participatory learning phase, it emphasizes student-centered targeted interactive teaching, which can stimulate students' interest in learning and enliven the classroom atmosphere. This research focuses on a student-centered approach, encouraging students to actively participate and explore. Through methods such as questioning, discussion, and cooperation, students learn in practice and grow through exploration. Pay attention to the difficulties, pain points, and emotional states in students' learning, make them like construction-related courses, learn to explore actively, and

enhance their sense of gain. In addition, this section is based on the constructivist learning theory, emphasizing that students should independently construct a knowledge system and develop the ability to solve engineering problems in the course of “Civil Engineering Construction Technology and Organization.” Teachers encourage students to actively build their own knowledge system through practical operations, problem-solving, and reflection activities ^[4-6].

3.2.2. Post-test

Effective teaching is not only about what teachers have taught, but also about what students have learned, and post-testing can be used to understand whether students have understood and mastered the knowledge points and achieved the expected teaching objectives ^[7-8]. Specifically, teachers can distribute post-test questions through the smart classroom information technology platform, and students can complete the test and submit it within a limited period. Teachers can understand the achievement of teaching and learning objectives based on the post-test results and lay the foundation for subsequent teaching summaries and reflections.

3.2.3. Effective teaching design after class

The post-lesson teaching activity stage mainly completes the summary link in the BOPPPS teaching model. The main purpose is to summarize and extend the classroom teaching content, so this session requires academic students to submit a mind map as the post-class assignment. In addition, to help students consolidate what they have learned based on extended learning, students are required to study some typical construction cases by themselves in class.

3.2.4. Application of effective teaching mode of intelligent classroom based on BOPPPS model

This study has been applied in the course of “Civil Engineering Construction Technology and Organization.” “Common Quality Problems and Prevention Measures of Concrete Engineering” is an important part of the course “Civil Engineering Construction Technology and Organization.” The specific process of implementing the effective teaching mode based on the BOPPPS model in the intelligent classroom is shown in **Table 1**.

Table 1. The implementation process of intelligent classroom teaching of “Common Quality Problems and Prevention of Concrete Engineering” based on the BOPPPS model

Teaching sessions	Teaching content	Design intent
0	Sign in through the Super Star Learning Platform Civil Engineering Construction Technology and Organization Classroom before the bell; consciously put away the cell phone after the class.	Access to student attendance in real-time
Pre-test	The study distributes questions that review the key and difficult contents of the last class to deepen students' impressions. The data of the questions can reflect the student's mastery of the content of the last class.	Use digital teaching tools to accurately understand students' prior knowledge and know how well they have mastered the basics.
Bridge-in	Pointing out in combination with the pictures, common quality problems of concrete often occur in actual engineering projects. How on earth do these common problems arise? And how to prevent and control them? This leads to the teaching objectives of this course.	Through the pictures, students' attention is drawn to the topic of this course, and their interest is aroused. Introduce students to the content related to this course and substrate construction.

Table 1 (Continued)

Teaching sessions	Teaching content	Design intent																		
Objectives	<p>Knowledge objectives:</p> <p>Be able to state the causes of common quality problems in concrete projects.</p> <p>Know the quality inspection indicators of concrete projects.</p> <p>Elaborate on the contents of the construction plan.</p> <p>Skill objectives:</p> <p>Be able to analyze the causes of common quality problems in concrete projects and take corresponding treatment measures.</p> <p>Be able to prepare the construction plan for concrete projects.</p> <p>Quality objectives:</p> <p>Students will develop the habit of constructing the following specifications and form an attitude and quality of striving for excellence in work and life.</p>	<p>Let students know the teaching objectives to be reached in this course and clarify the learning objectives.</p>																		
Participatory Learning	<p>Release the task list and let students record while learning.</p> <table border="1"> <thead> <tr> <th></th><th>Cause analysis</th><th>Prevention and control measures</th></tr> </thead> <tbody> <tr> <td>Pockmarked surface</td><td></td><td></td></tr> <tr> <td>Honeycomb</td><td></td><td></td></tr> <tr> <td>Holes</td><td></td><td></td></tr> <tr> <td>Exposed steel bars</td><td></td><td></td></tr> <tr> <td>...</td><td></td><td></td></tr> </tbody> </table> <p>Common quality problems in concrete engineering:</p> <ol style="list-style-type: none"> (1) Surface defects: pockmarked surface, honeycomb, exposed reinforcement, holes, crumbling and falling off, interlayer in gaps, missing edges and corners; (2) Deviation in external dimensions: uneven surface, displacement and inclination, convex and concave bulging; (3) Internal defects: poor homogeneity, failure to meet the strength requirements, poor protective performance, hollowing of embedded parts; (4) Concrete cracks: plastic shrinkage cracks, settlement shrinkage cracks, drying shrinkage cracks, temperature cracks, impact cracks, subsidence cracks, frost heaving cracks. <p>Teacher's explanation: Inspection of the appearance quality of concrete.</p> <p>In-class quiz: How to deal with the quality problem of cracks when they appear in the appearance inspection.</p> <p>The teacher answers questions. For cracks that appear in the concrete structure, if they do not affect the safety and use of the structure after analysis and research, repair treatment can be adopted.</p> <p>Guide students to think: What if it affects the safety of the structure? How to deal with it?</p> <p>How to discover the quality problems that affect the safety and use of the structure? Answer: Strength inspection.</p> <p>The teacher continues to explain strength inspection.</p> <p>For the knowledge points of the concrete construction plan, the task-driven teaching method is adopted. The teacher guides students to receive the in-class task list on the Xuexitong (Superstar Learning) platform and clarifies the tasks.</p> <p>Next, the teacher explains the compilation methods and precautions for the construction plan.</p> <p>Finally, students conduct practical operations in groups.</p>		Cause analysis	Prevention and control measures	Pockmarked surface			Honeycomb			Holes			Exposed steel bars			...			<p>Let students fully discuss, and the teacher summarizes to achieve a student-centered classroom effect.</p> <p>Learning initiates discussions and generates word clouds that allow students to master the configuration of construction machinery.</p>
	Cause analysis	Prevention and control measures																		
Pockmarked surface																				
Honeycomb																				
Holes																				
Exposed steel bars																				
...																				

Table 1 (Continued)

Teaching sessions	Teaching content	Design intent
Learning objectives testing	StudyTalk releases accompanying tests to test students' goal attainment in a timely manner.	Using what students have learned in this course, they can practice online using the smart learning platform to understand students' mastery of the knowledge points in real time, so that teachers can highlight the areas of poor mastery in the class summary.
Summary	Common quality problems in concrete works Quality inspection of concrete construction Compilation of concrete construction scheme	Let students summarize on their own, and the teacher will highlight the key points and difficulties during the summarization process. (In this way, students can also test their memory of the knowledge points explained in class, which is conducive to the improvement of the teacher's teaching methods).
Assignments	Case Study	Assign homework assignments to test student achievement of learning objectives.
Course feedback and enhancement	1. Expansion and extension: After the lesson, study the example of a construction scheme for a concrete project, summarize the construction process and precautions for cement-stabilized soil, and express opinions in the comment section. 2. Course feedback and Q&A Active feedback on learning issues and participation in interactive Q&A through online learning platforms or online after the class.	

4. Analysis of the effectiveness of intelligent classroom teaching based on the BOPPPS model

After the study of the course "Civil Engineering Construction Technology and Organization", a questionnaire survey was conducted on the effectiveness of the new teaching model by using the questionnaire function of the Learning Pass platform. According to the four basic characteristics of effective teaching content, there are six question items^[9-10]. The survey results showed that all students thought that the rich learning materials and clear learning objectives before class gave them a direction to study and helped them plan their study more; 82% of the students thought that the pre-test let them know how much they had mastered the basic knowledge through pre-study; 96% of the students recognized the teacher's leading role and their main role in the teaching process, and believed that the problem discussions and group reports in class enhanced their enthusiasm and initiative in classroom teaching; 89% of the students believed that the group discussions in class could strengthen their cooperation and communication with their classmates; 85% of the students believed that the post-tests and summaries could help them learn the course well and expand their knowledge; 89% of the students 89% of the students think that the classroom environment and atmosphere created by the model can motivate them to learn better. This shows that the new teaching model is not only widely recognized by students but also has four basic characteristics of effective teaching.

5. Conclusion

Guided by the effective teaching theory and based on the characteristics of the smart classroom and the specific implementation strategies of the BOPPPS teaching model, the effective teaching model of the smart classroom based on the BOPPPS model was constructed and practically applied based on the course “Civil Engineering Construction Technology and Organization.” The results show that the teaching effect and teaching quality of teachers, students’ learning interest, classroom participation, and learning effect have been significantly improved under the new teaching model, which is well-received by students.

Disclosure statement

The author declares no conflict of interest.

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Exploring the PBL Teaching Model in Clinical Medicine Based on Core Competencies

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Abstract: The education reform oriented toward core competencies has placed new demands on the cultivation of clinical medical talents. Based on an analysis of the connotation of core competencies, this paper examines the application of core competencies in clinical medical education from the perspectives of professional competence, cognition, interpersonal skills, scientific innovation, personal development, and social dimensions. By constructing a new PBL teaching model with six core competencies as training objectives—"mastery of medical knowledge and application of clinical skills, clinical thinking and decision-making abilities, communication and teamwork, scientific research and innovation capabilities, self-regulation and lifelong learning, as well as professional ethics and humanistic care"—this study explores the deep integration of the core competencies concept into the entire process of PBL teaching in clinical medicine. It aims to provide an effective pathway for cultivating outstanding clinical medical talents that meet the demands of the new era.

Keywords: Core competencies; Clinical medicine; PBL teaching model

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1. Introduction

Against the backdrop of the deepening Healthy China strategy and the rapid development of medical technology, society's demand for clinical medical talents has shifted from merely mastering professional knowledge and skills to possessing comprehensive qualities that enable them to solve complex health problems, adapt to advancements in medicine, and adhere to professional ethics. In the field of medical education, cultivating clinical doctors with core competencies has become a critical task of education reform. Core competencies, as a widely adopted target framework for addressing the challenges of the 21st century, emphasize the cultivation of students' essential character and key abilities. This framework has become a focal point of global education research and an important direction for practical implementation. Enhancing the quality of talent cultivation based on core competencies is directly related to a nation's future development and

competitiveness^[1]. However, traditional teaching models focus primarily on knowledge transmission, leading to practical dilemmas in medical education, such as the disconnection between knowledge acquisition and ability development, the conflict between standardized training and personalized development, and the imbalance between clinical skills and humanistic literacy^[2]. These issues result in deficiencies in cultivating students' comprehensive abilities. The PBL teaching model, which is problem-oriented, student-centered, and conducted in the form of group discussions, aligns highly with the philosophy of core competencies cultivation due to its characteristics of active inquiry, collaborative learning, and practical relevance^[3-4]. This model brings new ideas and methods to medical education. This paper aims to deeply explore the PBL teaching model in clinical medicine based on core competencies, with the hope of providing theoretical support and reference for medical education.

2. The Connotation of core competencies and their application dimensions in clinical medical education

2.1. The connotation of core competencies

In 2003, the Organisation for Economic Co-operation and Development (OECD) first explicitly proposed the concept of “core competencies” in a research report, defining it as a combination of key abilities and essential character traits. It emphasizes the critical knowledge, skills, and attitudes required for individuals to adapt to future society, encompassing dimensions such as cognitive skills, interpersonal skills, and self-regulation abilities. In September 2016, China released the overarching framework of Chinese Student Development Core Competencies, which positions the cultivation of “well-rounded individuals” at its core. The framework divides core competencies into three aspects: cultural foundation, autonomous development, and social participation. These are comprehensively manifested through six core competencies: humanistic grounding, scientific spirit, learning capacity, healthy living, sense of responsibility, and practical innovation^[5-6]. Some scholars, contextualizing the concept within the era, emphasize that core competencies represent advanced abilities and humanistic capacities needed to adapt to the information age and knowledge-based society, address complex problems, and navigate unpredictable situations^[7]. There is also a stronger emphasis on the value orientation of fostering virtue and nurturing talents^[8]. In summary, core competencies refer to the comprehensive embodiment of key abilities, essential character traits, and values that individuals need to adapt to lifelong development and societal demands in an era of informatization and globalization. In the context of medical education, core competencies extend beyond professional knowledge and clinical skills. They place greater emphasis on cultivating critical thinking, communication, and collaboration, humanistic care, and lifelong learning abilities among medical students, which are crucial for training high-quality medical talents capable of adapting to future healthcare environments.

2.2. Application dimensions of core competencies in clinical medical education

2.2.1. Professional competence dimension (Mastery of medical knowledge and application of clinical skills)

Medical knowledge and clinical skills form the foundational core competence of medical students. This encompasses a broad range of basic medical knowledge, such as anatomy, physiology, and pathology, which serves as the cornerstone for understanding normal physiological functions and disease mechanisms. Clinical diagnosis and treatment skills are equally critical, including medical history taking, physical examination,

diagnostic methods, and treatment techniques. Proficiency in fundamental clinical operations, such as punctures and suturing, enables the delivery of higher-quality medical services to patients and represents a vital aspect of medical students' practical abilities.

2.2.2. Cognitive dimension (Clinical thinking and decision-making skills)

Clinical thinking and decision-making skills are essential competencies for medical students when addressing complex clinical issues. These skills require students to employ critical thinking to analyze, synthesize, and evaluate clinical information. For instance, when dealing with a patient presenting with chest pain, medical students must comprehensively consider various potential causes, such as angina, myocardial infarction, or pneumothorax. By analyzing the patient's symptoms, signs, and examination results, they can eliminate confounding factors and arrive at an accurate diagnosis. Developing a reasonable diagnosis and treatment plan not only involves disease identification but also requires consideration of the patient's individual circumstances, such as age, physical condition, and financial situation.

2.2.3. Interpersonal dimension (Communication, collaboration, and teamwork)

In medical practice, effective communication, collaboration, and teamwork are crucial for ensuring the quality of healthcare services. On one hand, medical students need to communicate effectively with patients and their families to understand the patient's condition, needs, and psychological state, while also explaining treatment plans and precautions to enhance patient compliance. On the other hand, collaboration with members of the healthcare team, including physicians, nurses, and pharmacists, is equally important. By leveraging their respective strengths within the team, they can work together to provide comprehensive medical care to patients.

2.2.4. Scientific innovation dimension (Scientific research and innovation capability)

The capability for scientific research and innovation is primarily reflected in two aspects: First, medical students should be proficient in data collection, statistical analysis, literature retrieval, and other essential skills when participating in clinical research. They should be able to integrate existing research findings through systematic evaluation methods to form scientific argumentation processes. Second, they should demonstrate innovative thinking in clinical operations or process optimization. For example, in addressing issues such as poor medication adherence among elderly patients, they should develop innovative medication management solutions, fostering an innovative mindset to explore the unknown and solve clinical challenges.

2.2.5. Personal development dimension (Self-regulation and lifelong learning ability)

The ability to engage in self-reflection, update knowledge, and adapt to the evolving field of medicine is a core competency for medical students. Emotional and behavioral regulation in high-pressure scenarios is crucial. For instance, in high-stress situations such as emergency rescues or doctor-patient conflicts, they must quickly adjust their mindset to maintain professional judgment. Additionally, proactive efforts to continuously update their knowledge systems are essential. This includes regularly reading authoritative journals, participating in annual academic conferences or online seminars, and promptly applying the latest diagnostic and treatment guidelines to case discussions, ensuring their knowledge remains aligned with advancements in medicine.

2.2.6. Social dimension (Professional ethics and humanistic care)

Professional ethics and humanistic care reflect the core values of medical students. Upholding professional

ethics requires adherence to medical ethical principles, respect for patients' rights and dignity, and protection of patient privacy. Humanistic care embodies the compassion and respect medical students show toward patients, focusing not only on disease treatment but also on patients' physical and mental well-being and quality of life. A sense of social responsibility enables medical students to recognize their role and obligations in safeguarding public health, actively participate in public health activities, and contribute to society by providing health services.

3. Theoretical foundation and framework of the core competency-based PBL teaching model in clinical medical education

3.1. Theoretical foundation

The Problem-Based Learning (PBL) teaching model is primarily grounded in constructivist theory and pragmatist theory. Constructivist theory posits that learning is an active process where students construct knowledge through interacting with their environment based on prior knowledge and experiences ^[9]. In PBL, students integrate existing medical knowledge with new problem scenarios by solving real clinical cases, thereby deepening their understanding and application of knowledge. For example, when analyzing treatment plans for diabetic patients, students must draw on multidisciplinary knowledge such as endocrinology and pharmacology, and through group discussions and self-directed inquiry, develop a comprehensive understanding of diabetes management. Pragmatist theory emphasizes the integration of learning and practice ^[10]. PBL immerses students in authentic clinical scenarios, enabling them to enhance practical skills and problem-solving abilities through hands-on experience. For instance, when managing simulated emergency cases, students must make rapid decisions and implement appropriate first aid measures, thereby translating theoretical knowledge into practical operational skills.

3.2. Overall framework

3.2.1. Problem design

Problem design is a critical component of the PBL teaching model. The selection of clinically representative cases forms the basis of problem design. These cases should be typical, instructive, and moderately complex, covering multiple disciplinary knowledge points and clinical skills. For example, a case of a hemiplegic patient after cerebral infarction not only involves diagnosis and treatment in neurology but also requires the formulation of rehabilitation plans in rehabilitation medicine and nursing care considerations. Problem design should revolve around such cases, guiding students to delve deeper into critical thinking with questions such as: "How to recognize early signs of cerebral infarction?" "What are the treatment principles and methods for cerebral infarction?" "How to develop a personalized rehabilitation plan for a hemiplegic patient?"

3.3.2. Group collaboration

Group collaboration is a key organizational form in PBL (Problem-Based Learning) teaching. Group discussions among students facilitate knowledge sharing and the exchange of ideas. Typically, each group consists of 5–8 students who collaborate by dividing tasks and working together to solve problems. For example, in the PBL teaching at the Reproductive Medicine Center of the Second Xiangya Hospital of Central South University, students enhanced their teamwork skills through group collaboration ^[11]. Within the group, tasks can be assigned based on students' strengths and interests, such as searching literature, organizing materials, and delivering

presentations. During discussions, students are encouraged to actively express their viewpoints, listen to others' opinions, and collaboratively explore solutions.

3.3.3. Outcome presentation and reflection

The presentation of solutions by each group is a critical component of PBL teaching. By showcasing their learning outcomes, students not only improve their presentation skills but also receive feedback and suggestions from teachers and other groups. Teacher-guided reflection is a key step in helping students deepen their understanding of knowledge and enhance their abilities. In the PBL teaching at Shandong Provincial Third Hospital, teachers provided instructional feedback and conducted theoretical knowledge tests through inter-group scoring comparisons, which deepened students' understanding of gynecological clinical cases ^[12]. Additionally, teachers can guide students to reflect on the strengths and weaknesses of their problem-solving process, helping them summarize experiences and improve learning outcomes. For instance, questions such as "Which pieces of information played a critical role in the diagnostic process?" or "Is there room for improvement in the treatment plan?" can be discussed.

4. Design of a core competency-based PBL teaching model in clinical medicine

4.1. Case design

Taking "COPD with Respiratory Failure" as an example, a three-stage PBL case was designed to guide students' in-depth thinking and problem-solving by gradually revealing the patient's condition and related information.

4.1.1. First stage: The patient is admitted with chest pain and difficulty breathing

Students are required to analyze possible causes. This stage primarily guides students to apply their existing knowledge of respiratory diseases to conduct a preliminary analysis and judgment of the patient's symptoms. Students need to consider various potential conditions, such as COPD, asthma, pneumothorax, and pulmonary embolism, and collect more information through medical history inquiries and physical examinations.

4.1.2. Second stage: Provide auxiliary examination results to guide students in formulating diagnosis and treatment plans

In this stage, based on the information collected in the first stage and newly provided auxiliary examination results (such as blood gas analysis and chest CT), students further clarify the diagnosis and develop corresponding treatment plans. They need to comprehensively evaluate the advantages and disadvantages of various treatment methods, such as oxygen therapy, mechanical ventilation, and medication, to select the optimal treatment plan for the patient.

4.1.3. Third stage: Simulate changes in the patient's condition to assess students' emergency response capabilities

This stage sets up a scenario where the patient's condition suddenly deteriorates, such as the occurrence of complications like arrhythmia or heart failure, to evaluate students' ability to handle emergencies and the flexibility of their clinical thinking. Students must quickly analyze the reasons for the changes in the patient's condition, adjust the treatment plan, and take effective emergency measures.

4.2. Implementation process

4.2.1. Problem-oriented learning

Problem-oriented learning serves as the starting point of PBL implementation, where students raise questions based on clinical cases. In a case of “COPD complicated by respiratory failure”, students may propose questions such as: “How to differentiate COPD from other respiratory diseases?” “What are the types and diagnostic criteria for respiratory failure?” These questions reflect students’ critical thinking and uncertainties regarding the case, thereby guiding subsequent learning and discussions. Students are encouraged to identify core competency challenges embedded in the case and conduct literature retrieval with a competency-aware approach.

4.2.2. Self-directed inquiry and group discussion

This phase constitutes the core of PBL, where students integrate knowledge from disciplines such as physiology and pathology through literature review and discussions. During group discussions, students share their findings and collaboratively explore solutions. Key components include: Structured Facilitation: Instructors employ questioning techniques (e.g., “What is the patient’s primary concern at this moment?”; “What evidence supports your diagnosis?”; “How would you handle the situation if the patient refuses treatment?”) to guide students in analyzing information, evaluating evidence, weighing pros and cons, and considering patient values. Role-Playing and Simulation: Students assume roles as patients, family members, or healthcare professionals from different specialties to simulate communication scenarios and multidisciplinary consultations, enabling firsthand experience and reflection on communication dynamics. Ethical and Humanistic Reflection: Dedicated sessions are held to discuss ethical dilemmas and psychosocial needs in the case, encouraging perspective-taking and empathy. Knowledge Integration and Application: Emphasis is placed on immediately applying newly acquired knowledge to interpret case phenomena, revise hypotheses, and formulate or adjust management plans.

4.2.3. Teacher guidance and feedback

Teachers play a crucial role in ensuring the smooth progression of PBL by timely intervening and correcting deviations. During discussions, instructors transition from “knowledge providers” to “learning facilitators” and “competency guides”, skilled in questioning, active listening, and providing feedback. They foster a safe and open discussion environment, introduce perspectives related to humanism, ethics, and communication when appropriate, and closely monitor student progress to offer guidance and suggestions. During presentations, students are expected to not only report medical conclusions but also elaborate on their decision-making processes, communication strategies, ethical considerations, and encountered challenges, engaging in team-based reflection. After student presentations, instructors provide objective evaluations and constructive feedback, acknowledging strengths while identifying areas for improvement and offering specific recommendations for growth.

4.3. Effectiveness evaluation

4.3.1. Formative evaluation

Formative evaluation includes student self-assessment (reflecting on the learning process and competency development), peer assessment (focusing on communication, collaboration, and contribution), and teacher evaluation (comprehensive performance and competency development). It serves as a crucial method for holistically assessing students’ learning processes and ability development. In clinical medicine PBL teaching, adopting a multi-dimensional evaluation system allows student self-assessment to help learners reflect on

their progress and identify their strengths and weaknesses. Peer assessment promotes communication and learning among students, fostering critical thinking and evaluation skills. Teacher evaluation provides objective, professional feedback on student performance and offers targeted guidance.

4.3.2. Summative evaluation

Summative evaluation employs standardized patient tests (assessing communication skills and humanistic care) to evaluate students' clinical skills, serving as an important means to examine learning outcomes. Standardized patient tests simulate real clinical scenarios, examining students' abilities in medical history taking, physical examination, diagnosis, and treatment, thereby comprehensively assessing their clinical practice proficiency.

5. Conclusion and outlook

Constructing and implementing a core competency-based PBL teaching model in clinical medicine is a key exploration in deepening medical education reform and enhancing the quality of talent cultivation. By integrating the concept of core competencies with PBL teaching methods, this model can effectively develop medical students' comprehensive abilities and lay a solid foundation for their future professional development. Although many challenges exist in its implementation, with the evolution of educational concepts and the advancement of teaching practices, this model is poised to play an even greater role in cultivating high-quality medical talents. Medical educators should actively explore, innovate courageously, and continuously refine the core competency-based PBL teaching model to promote the sustained improvement of medical education quality. In the future, this model must be continuously refined through practice, reflection, and improvement, and its application should be expanded both broadly and deeply to lay a solid foundation for cultivating outstanding medical talents who possess both moral integrity and professional excellence.

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On the Role and Responsibility of Higher Education Institutions in Cultural Heritage Protection

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Abstract: The protection of cultural heritage is not only a cultural work, but also a work with political significance, which is related to a country's cultural sovereignty, cultural status, and cultural security. With the vigorous development of cultural relics protection and the continuous improvement of technological innovation capabilities, higher requirements and expectations have also been put forward for higher education institutions. This study focuses on the systematic functions and implementation paths of higher education institutions in cultural heritage protection, proposes a five-dimensional support system to ensure the implementation of responsibilities, and ultimately verifies that higher education institutions have become the core strategic force driving the sustainable development of cultural heritage by balancing the protection of historical authenticity and innovative activation and utilization.

Keywords: Higher education institutions; Cultural heritage; Cultural heritage protection

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1. Introduction

Cultural heritage is divided into tangible cultural heritage and intangible cultural heritage. Material cultural heritage refers to tangible cultural carriers with historical, artistic, and scientific value, and is a tangible witness to the development of human civilization. It includes both immovable and movable heritage, such as historical sites, architectural complexes, ruins, outstanding artworks, manuscripts, ancient books, artifacts, etc.^[1]. Intangible cultural heritage refers to all creations from a cultural community that are based on tradition, expressed by a group or individuals, and considered to be expressions of their cultural and social characteristics that meet the expectations of the community. Its principles and values are orally transmitted through imitation or other means^[2]. Both tangible and intangible cultural heritage have historical, artistic, and scientific value. Cultural heritage is a non-renewable resource that witnesses the progress of human civilization

and plays an important role in the current socio-economic and cultural development ^[3]. In the grand picture of the continuation and innovation of human civilization, the protection of cultural heritage, as the foundation of national identity and the treasure trove of historical wisdom, is crucial. Cultural heritage, as a witness to history, is a treasure of human civilization, carrying the collective memory of a country and a nation. Protecting cultural heritage is not only a respect for the past, but also an investment in the future. Therefore, the development and protection of cultural heritage has become a hot topic in the economic, cultural, and educational development of countries around the world. From the overall situation of the current development of cultural heritage protection, developed countries in Europe have a long history and tradition of cultural heritage protection. Whether it is the concept and restoration technology of cultural heritage protection, or the level of education, they are in a leading position in the world, especially in Western European countries such as Italy, France, Germany, and the United Kingdom ^[4].

In the acceleration of globalization and modernization, cultural heritage is facing unprecedented challenges. Higher education institutions, as temples of knowledge and cradles of talent, play an indispensable role in the protection of cultural heritage. They are an important component of the cultural heritage protection force and play an irreplaceable role in the construction of the theoretical system and talent cultivation of cultural heritage protection. They are not only the center of academic research, but also a key force in cultural inheritance and social services. However, in practical protection work, there is still a common phenomenon of unclear understanding of the role and function of higher education institutions in cultural heritage protection, as well as their responsibilities and functions. This seriously affects the role of higher education institutions in cultural heritage protection and the formation of the overall social protection force, resulting in a certain degree of lack of guidance theory and human resources urgently needed for protection work. To change this situation, it is necessary to address the role and implementation methods of higher education institutions in cultural heritage protection work.

2. The role and function of higher education in the protection of cultural heritage

Currently, higher education institutions, with their unique resources, mission, and social functions, have become an indispensable cornerstone and core engine for the protection of cultural heritage. They play multiple and critical roles, building a complete ecosystem that covers research, education, innovation, and practice, and their role runs through the entire chain of cultural heritage research, protection, inheritance, innovation, and dissemination.

2.1. Core research and development base for knowledge and technological innovation

2.1.1. Frontier technological exploration

Higher education institutions are hotbeds for interdisciplinary research. The close cooperation between science and engineering, and humanities and social sciences has promoted the innovation of cultural heritage protection technology. This includes developing safer cleaning and reinforcement materials and methods, applying technologies such as hyperspectral imaging, non-destructive testing, 3D laser scanning, and digital modeling, artificial intelligence-assisted restoration and virtual reconstruction, etc., to provide a precise diagnosis and scientific basis for cultural relic protection.

2.1.2. Research on protection theory and methodology

Scholars in the fields of humanities and social sciences delve into the value, significance, and threats faced by cultural heritage, exploring the ethical framework, legal norms, policy formulation, management strategies, and theoretical basis for cultural adaptive reuse of protection. These studies provide theoretical support and value guidance for conservation practices.

2.1.3. Interdisciplinary solutions

Complex cultural heritage issues often require comprehensive solutions. Higher education institutions can organize experts from multiple disciplines, such as history, archaeology, architecture, and cultural relic protection technology, to break down disciplinary barriers, integrate wisdom from all parties, and conduct comprehensive and in-depth research on cultural heritage. For example, to address the impact of climate change on ancient architecture, it is necessary for climatologists, material engineers, and experts in historical building preservation to collaborate on research. The protection of intangible cultural heritage may involve the joint participation of anthropologists, communicators, community planners, and digital technology experts.

2.2. The cradle of professional talent cultivation

2.2.1. Systematic education

Higher education institutions are the main channel for cultivating professionals in cultural heritage protection. Higher education institutions offer majors such as cultural relic protection, museum studies, and cultural heritage management to cultivate talents with professional knowledge and skills. Through systematic course learning and practical training, students can master skills in cultural relic restoration, protection planning, and cultural heritage tourism development. At the same time, by setting up bachelor's, master's, and even doctoral degree programs, a systematic professional knowledge system, rigorous method training, and practical skill development can also be provided.

2.2.2. The bridge between theory and practice

Higher education institutions not only impart theoretical knowledge, but also enable students to master professional skills in real or simulated environments through laboratory operations, field archaeological internships, restoration studios, museum/heritage site internships, and other methods, organically combining theory with practice. In addition, higher education institutions cooperate with museums, cultural relics protection units, and other institutions to provide students with practical teaching and internship opportunities, allowing them to learn and practice in a real cultural heritage protection environment, and improve their ability to solve practical problems.

2.2.3. Lifelong learning platform

Higher education institutions can provide opportunities for on-the-job practitioners to update their knowledge and improve their skills through short-term training, professional certificate courses, seminars, and other forms, meeting the needs of sustainable industry development.

2.3. Cultural heritage itself and its practical carriers

2.3.1. Guardians of physical heritage

Many higher education institutions are themselves important historical buildings, scenic gardens, or cultural

landscapes, and are important witnesses to the history of cities or regions. They shoulder the direct responsibility of restoring, maintaining, interpreting, and sustainably managing their own cultural heritage, becoming demonstration sites for “dynamic” protection. Campus heritage, such as the ancient college buildings of Oxford and Cambridge, and the early modern architecture of Wuhan University, has become a practical example for the protection of theory and technology. There are also numerous unique intangible heritages that continue to exist, such as Cambridge’s collegiate tradition, Harvard’s graduation ceremony, and Peking University’s academic spirit of “freedom of thought and inclusiveness”, all of which have been passed down from generation to generation as institutional memories.

2.3.2. Guardians of institutional memory and cultural traditions

The unique traditions, rituals, values, campus culture, and academic spirit formed by higher education institutions over a long history are themselves valuable intangible cultural heritage that needs to be understood and inherited.

2.3.3. The center of museums and archives

Higher education institutions usually have important departments such as museums, art galleries, archives, and libraries. These institutions not only preserve precious material and intangible cultural heritage, but also carry out research, protection, exhibition, and public education projects, which are important nodes in the cultural heritage protection chain.

2.4. The bridge between social services and public education

2.4.1. Public participation advocates

Higher education institutions disseminate cultural heritage knowledge through diverse forms such as lectures, exhibitions, guided tours, workshops, publications, and digital projects open to the public, enhancing public awareness of protection, aesthetic literacy, and a sense of identity and pride in their own culture.

2.4.2. Community collaboration partners

Researchers and students from higher education institutions can delve into the communities where heritage sites are located, participate in community-led conservation projects, respect and protect local knowledge systems, and collaborate with communities to carry out cultural heritage tourism projects, promote local economic development, and use tourism revenue to support cultural heritage protection and promote sustainable development of cultural heritage. In addition, higher education institutions can also transform professional knowledge into a social action force, bringing the public closer to cultural treasures through projects such as digital museums, intangible cultural heritage community workshops, and volunteer services at heritage sites.

2.4.3. Policy consultation and think tank function

Higher education institutions can provide professional intellectual support and decision-making consultation for governments at all levels and international organizations to formulate cultural heritage protection regulations, plans, policies, and standards based on their profound research accumulation and expert teams.

2.5. A platform for global communication and cooperation

2.5.1. Knowledge sharing network

Higher education institutions have a natural international nature and are important hubs for cross-border and cross-cultural academic exchange and cooperation. The mobility of scholars and students, international collaborative research projects, joint degree programs, international conferences, etc., promote the rapid dissemination, experience sharing, and common improvement of protective technologies, concepts, and methods on a global scale.

2.5.2. Addressing global challenges

Many threats to cultural heritage, such as climate change, illegal trafficking, and large-scale construction, are global in nature. Through international cooperation, higher education institutions can integrate global resources, jointly seek solutions, and promote the establishment of more universal ethical norms and practical guidelines for protection.

In summary, higher education institutions are not a single participant in the cultural heritage protection system, but a comprehensive core force that integrates multiple roles such as research engines, talent cradles, carrier demonstrations, public bridges, and international hubs. They are deeply embedded in every aspect of cultural heritage protection with their unique academic research capabilities, educational and training systems, social service missions, and cross-cultural perspectives, from basic research, technological innovation, theoretical exploration, to talent cultivation, physical protection, public education, and international cooperation. In contemporary society, the protection of cultural heritage is becoming increasingly complex and urgent, and the fundamental support and innovative leadership role of higher education institutions will be more prominent. They are not only material carriers for preserving the past, but also key driving forces for endowing cultural heritage with knowledge and life, enabling it to sustainably nourish the present and future. Higher education institutions solidify their foundation through academic cultivation and give new life to their heritage through talent and innovation. Only by fully recognizing and leveraging the core roles of higher education institutions can a more scientific, sustainable, and dynamic cultural heritage protection system be constructed.

3. The responsibility of higher education institutions in the protection of cultural heritage

Higher education institutions bear multi-level and cross-dimensional systematic responsibilities in the protection of cultural heritage, which stem from their academic mission, social functions, and their own attributes as cultural subjects.

3.1. Educational responsibility: Building a talent ecological chain

Higher education institutions have the responsibility to popularize cultural heritage knowledge to students and enhance their awareness of cultural heritage protection. By offering relevant courses, hosting lectures, organizing visits, and other forms, students can understand the value and significance of cultural heritage and cultivate their sense of cultural responsibility. From professional education to lifelong learning, higher education institutions need to establish a complete talent cultivation system: establish interdisciplinary degree programs; provide on-site training for archaeological excavations, cultural relic restoration, and other related activities; and design on-the-job competency modules. This lifecycle chain ensures that practitioners continue to receive a cutting-edge knowledge supply.

3.2. Research responsibility: Innovative theory and technology

Higher education institutions have a responsibility to conduct in-depth research on cultural heritage, revealing its historical, cultural, artistic, and social values. The research results should serve the practice of cultural heritage protection and provide a scientific basis for government decision-making. Higher education institutions must break through the cognitive and technological boundaries of the protection field, such as developing non-invasive repair technologies at the material level, building a digital twin system, deepening the research on ethical theory, establishing risk prediction models, etc. These actions provide innovative methodologies for global conservation practices.

3.3. Guardianship responsibility: To preserve the essence and memory

If higher education institutions have cultural heritage, such as historical buildings, cultural relics collections, etc., they have a responsibility to protect and manage it. A comprehensive protection plan should be formulated, and effective protection measures should be taken to ensure the safety and integrity of cultural heritage. Higher education institutions are primarily guardians of their own cultural heritage, with a direct obligation to preserve their historical buildings, academic archives, and intangible traditions. This includes developing scientific restoration plans, establishing digital projects for endangered literature, and ensuring the sustainability of campus memory through institutional inheritance.

3.4. Public responsibility: Activate the public value of heritage

Higher education institutions have the responsibility to inherit cultural heritage and revitalize it in the new era. By developing cultural and creative products, organizing cultural activities, and conducting cultural heritage tourism, more people can understand and love cultural heritage. Higher education institutions can break down academic barriers and promote heritage sharing, such as developing public participation projects, supporting community revitalization practices, and empowering local government decision-making. Transforming heritage into a spiritual bond of modern society through knowledge transfer.

3.5. Ethical responsibility: Practicing protective principles

Higher education institutions should become exemplars of industry ethics: upholding authenticity in their actions, ensuring cultural fairness, and implementing intergenerational equity. These practices establish ethical benchmarks for global protection.

3.6. Collaborative responsibility: Building a global protection network

Faced with the crisis of transnational cultural heritage, higher education institutions need to establish collaborative platforms, such as leading international rescue efforts, promoting open-source technology, and developing universal standards. This network consolidates dispersed protective forces into a protective community for human civilization.

In short, the core mission of higher education institutions is to use academic strength to resolve the contradiction between traditional preservation and modern innovation in heritage protection to uphold authenticity when replicating Dunhuang murals with digital technology, and to maintain historical dignity when revitalizing and utilizing industrial heritage. This requires higher education institutions to not only serve as the “Noah’s Ark” to prevent the extinction of cultural memory, but also as the “innovation engine” to catalyze the rebirth of heritage, ultimately making cultural heritage an eternal force driving human development.

4. The Implementation of responsibilities of higher education institutions in cultural heritage protection

4.1. Institutional rigidity guarantee

Embedding the responsibility to protect into the core architecture of higher education institution governance, legalizing it through the development of statutes, and formulating clear policies to incorporate cultural heritage protection into its mission and strategic planning, establishing the institution's responsibility for cultural heritage protection in research, education, public services, and institutional operations ^[5].

4.2. Collaborative flow of resources

Break down disciplinary and institutional barriers, and build a shared ecosystem. Such as creating a cross-platform for arts, science, and engineering, opening up key laboratory resources, and establishing diversified funding pools. This can ensure the cross-domain circulation of technology, data, and funds.

4.3. Capability closed-loop construction

Building a three in one competency chain of “education technology practice”: offering relevant courses, reforming the curriculum system, and enhancing students' understanding of the value and importance of cultural heritage protection; Promote technological transformation, provide funding and resource support, and ensure the smooth progress of research projects; Encourage on-the-job training and encourage students to participate in practical projects for cultural heritage protection, thus forming a closed loop of ability building from classroom to on-site.

4.4. Social network activation

Building a diverse collaborative network for governance: establishing community empowerment mechanisms, building cooperative relationships with local communities, and raising public awareness of cultural heritage protection through community services and volunteer activities; Develop a public participation platform to increase the sense of experience and participation; Join the Global Responsibility Alliance to root conservation actions in the soil of society.

5. Conclusion

Higher education institutions play an important role and responsibility in the protection of cultural heritage. ICOMOS (International Council on Monuments and Sites) relies on a global network of university experts to develop emergency protection plans for heritage damaged by the Syrian war; The Dunhuang Academy has collaborated with numerous research institutes and universities to tackle the digitization technology of cultural relics ^[6]. Together, they have created the “Digital Dunhuang” project, which utilizes the most advanced digital technology to comprehensively and permanently record, preserve, and study precious cultural relics such as Dunhuang grottoes, murals, and sculptures in digital format, providing high-precision digital access and sharing services for the global public. These collaborations not only accelerate the dissemination of technology but also promote the formation of a joint action mechanism to address global threats such as the climate crisis and armed conflict. This multidimensional support system enables the millennium heritage to break through the

limitations of time and space, continuously providing cultural identity and spiritual nourishment for humanity, and maintaining the vitality of civilization in the changing times. Higher education institutions are not only the preservers of civilization's genes, but also the reconstructors of cultural vitality. Only by fully leveraging the advantages of higher education institutions can we better protect cultural heritage, inherit, and continue civilization.

Disclosure statement

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Research on the Cultivation Path of Innovative and Entrepreneurial Talents in E-commerce Courses under the Background of the Digital Economy

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Abstract: The digital economy, supported by advanced technologies such as cloud computing, artificial intelligence, big data, and new media, has driven unprecedented changes in talent demand across all industries. Particularly in the e-commerce sector, the job responsibilities and skill requirements of practitioners have undergone significant changes. This necessitates corresponding adjustments in e-commerce course teaching to cultivate outstanding, innovative, and entrepreneurial talents, thereby providing sustained impetus for the development of the industry. Therefore, starting from the background of the digital economy, the author explores the problems existing in the cultivation of innovative and entrepreneurial e-commerce talents in colleges and universities, such as the mismatch between talent cultivation and the demand for innovative and entrepreneurial talents, the single subject participating in the cultivation of innovative and entrepreneurial talents, and the lag in the construction of the teaching team. Corresponding improvement paths are proposed to promote the high-quality development of e-commerce course teaching.

Keywords: Digital economy; E-commerce courses; Innovative and entrepreneurial talents; Cultivation; Path

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1. Introduction

With the advent of the digital economy era, the development pattern of the e-commerce field has also undergone rapid changes. E-commerce courses need to keep up with the talent demand of the industry by adjusting talent cultivation methods and standards, focusing on developing students' abilities in technology application, market insight, and innovative thinking, guiding them to grow into innovative and entrepreneurial talents, and enhancing their adaptability to the market. Teachers should have an understanding of the digital economy, analyze the problems in the cultivation of innovative and entrepreneurial e-commerce talents based on changes

in the economic development situation, and emphasize a problem-oriented approach in the construction of teaching models.

2. Problems in the training of innovative and entrepreneurial talents for e-commerce courses in the background of the digital economy

2.1. Mismatch between talent training and the demand for innovative and entrepreneurial talents

Against the backdrop of the digital economy, various advanced technologies have injected new impetus into the e-commerce industry. Meanwhile, they have also put forward new requirements for the job responsibilities and operational skills of practitioners in the industry ^[1]. To adapt to the development needs of the industry, e-commerce professionals must not only master basic knowledge and skills but also develop abilities in technology application, market insight, and innovative thinking. However, the innovation of e-commerce talent training models in many colleges and universities still lags behind to a certain extent. These models have not been fully integrated with innovative and entrepreneurial education, resulting in a gap between talent training and the actual demand for innovative and entrepreneurial talent ^[2]. Firstly, this mismatch is reflected in the lagging update of course content. The existing course content focuses on traditional business models and basic theoretical teaching, while lacking content related to blockchain, artificial intelligence, big data applications, as well as instant retail and social e-commerce. This leads to students having insufficient understanding of changes in market development trends. Secondly, it manifests in the absence of practical teaching. For example, the teaching model emphasizes the explanation of theoretical knowledge while neglecting the design of practical links. Teaching activities lack case analyses and real operational scenarios, failing to closely connect with the actual business environment. This hinders the development of students' ability to solve practical problems. Finally, the lack of innovative education elements in teaching activities restricts the development of students' abilities in risk management, entrepreneurial spirit, and innovative thinking, which is not conducive to students adapting to the innovative and entrepreneurial environment in the e-commerce field ^[3].

2.2. Single subject of participation in the training of innovative and entrepreneurial talents

In the process of training innovative and entrepreneurial talents for e-commerce courses, colleges and universities usually take on the teaching tasks independently, failing to form a pattern of joint talent cultivation with other social entities. A single participant in the training of innovative and entrepreneurial talents means there are significant limitations in the development and application of educational resources. It is impossible to form a synergistic effect, which is not conducive to cultivating students' practical abilities and helping them understand market conditions.

To address this issue, some colleges and universities have attempted to establish cooperative relationships with outstanding enterprises and integrate teaching resources from both sides. However, due to insufficient depth and breadth of cooperation, the forms of collaboration are usually limited to traditional models such as holding lectures and providing internship opportunities. Under such circumstances, enterprises cannot participate in the specific formulation and implementation of talent training programs, and many of their teaching resources cannot be organically integrated with those of colleges and universities ^[4]. In addition, the roles of research institutions, industry associations, and the government in the training of innovative and entrepreneurial talents

for e-commerce courses have not been fully exerted. This is mainly reflected in insufficient resource integration, delayed standard-setting, and limited policy support and capital investment ^[5].

2.3. Lagging development of the teaching staff

With the development of digital technology, e-commerce course teaching has put forward more stringent requirements for teachers, including requirements for professional knowledge and skills. However, the development of e-commerce teaching staff in many colleges and universities lags behind. On one hand, some e-commerce professional teachers have insufficient skill levels. They still focus on traditional e-commerce models and lack an understanding of new e-commerce knowledge and operational methods, making it difficult to meet the talent development needs of the industry. Teachers' lack of professional theoretical knowledge and practical skills fails to meet the teaching requirements ^[6]. On the other hand, some teachers face severe challenges in technological transformation. They struggle to meet the requirements brought about by new technologies and cannot adjust teaching practices in a timely manner, which hinders the improvement of students' practical and innovative abilities. In the field of e-commerce education, there is a shortage of compound teachers who possess rich theoretical knowledge, practical experience, and an understanding of the development of the e-commerce industry. This situation cannot fully meet the actual needs of cultivating innovative and entrepreneurial talents. Many teachers "enter colleges and universities directly after graduating from colleges and universities", lacking experience in innovation and entrepreneurship as well as work experience in the e-commerce industry. As a result, they have deficiencies in practical teaching capabilities, leading to insufficient connection between e-commerce teaching and the current situation of the digital economy ^[7].

3. The cultivation path of innovative and entrepreneurial talents for e-commerce courses in the context of the digital economy

3.1. Optimize curriculum design and strengthen practical teaching

In talent cultivation, teachers should pay attention to the mismatch between talent development and the demand for innovative and entrepreneurial talents, continuously optimize curriculum design, and enhance the effectiveness of practical teaching ^[8]. First, teachers can form teams with corporate executives and industry experts to jointly conduct regular reviews and updates of course content, ensuring it aligns with the evolving trends of industrial development. This dynamic adjustment mechanism effectively keeps the course content up-to-date and is of great significance for improving the innovation and effectiveness of teaching models. Second, to meet the needs of practical teaching, teachers should design practical course modules such as e-commerce simulation experiments, corporate internships, and entrepreneurial practice. Corresponding to these modules, they should promote the construction of on-campus and off-campus practical teaching bases—for example, establishing cooperation with e-commerce entrepreneurial parks and enterprises to co-build innovation and entrepreneurship platforms. These platforms can provide students with a real e-commerce environment for learning practical e-commerce courses, allowing them to complete operations such as store setup, product listing, and marketing promotion in relevant scenarios, thereby accumulating practical experience. Third, teachers should organically integrate innovation and entrepreneurship education into teaching plans and talent cultivation frameworks. They need to optimize the talent cultivation model from various dimensions, including curriculum design, teaching implementation methods, and teaching evaluation models, to enhance the systematicness of cultivating students' entrepreneurial awareness and innovative thinking. Fourth, teachers

should attach importance to interdisciplinary integration, break down the barriers between different disciplines, and organically integrate knowledge from related disciplines such as computer technology, marketing, and logistics management into e-commerce courses^[9].

3.2. Deepen school-enterprise cooperation and build a collaborative talent cultivation mechanism

By taking the school-enterprise cooperation model as a key approach to cultivate skilled and practical talents, teachers can better align talent cultivation with the development needs of the industry^[10]. Regarding the cultivation of innovative and entrepreneurial talents for e-commerce courses in the digital economy context, teachers should continuously deepen the level of school-enterprise cooperation and promote the construction of a collaborative talent cultivation pattern. The resulting school-enterprise collaborative education ecosystem, featuring a “joint creation, joint cultivation, joint management, and resource sharing” mechanism, provides better conditions for schools and enterprises to jointly formulate talent cultivation plans, develop curriculum resources, and carry out practical teaching activities^[11]. Therefore, teachers should attach importance to the construction of school-enterprise collaborative education platforms. Through these platforms, they can gather resources and wisdom from all parties to achieve resource sharing and fully highlight the advantages of each party in the cultivation of e-commerce professionals. For example, to optimize the allocation and efficient integration of teaching resources, teachers can use modern digital technologies to build a “four-in-one” integrated platform that integrates teaching, practical training, office work, and entrepreneurship. Equipped with advanced information facilities, this platform enables students to conduct relevant operations in a real e-commerce environment and experience the entire process from product selection and planning to the creation of “bestselling products.”

Furthermore, based on this platform, teachers can also build a “Metaverse + Teaching” model. By creating virtual commercial blocks through 3D scenario-based teaching, full-scale business simulation, and intelligent data analysis, this model integrates theoretical knowledge teaching with practical training activities.

3.3. Strengthen and promote the integration of industry and education, and integrate the educational resources of schools and enterprises

The integration of industry and education can provide support for the cultivation of innovative and entrepreneurial talents in e-commerce courses. Starting from the background of the digital economy, colleges and universities should integrate the educational resources of schools and enterprises, build a school-enterprise collaboration platform, and promote school-enterprise cooperation to evolve from “superposition” to “integration”, so as to effectively leverage the educational advantages of both parties. Firstly, it is necessary to build a regional community for the integration of industry and education. Colleges and universities should establish cooperation with local e-commerce enterprises, organically integrate cutting-edge technologies with teaching content, and build an integrated system of “production, teaching, research, innovation, and service.” This system aims to promote the transformation of teaching achievements into industrial achievements, thereby enhancing students’ innovative and entrepreneurial capabilities and sense of social service. Secondly, it is essential to jointly build school-enterprise practical training bases. In accordance with the principles of “co-integration, co-cultivation, co-research and sharing”, schools and enterprises should build simulated practical training bases that replicate real e-commerce scenarios of enterprises^[12]. Using the resources of these bases,

teachers can closely combine theoretical teaching with project practice in line with the development trend of the e-commerce industry, and carry out project-based and case-based teaching. This enables students to improve their practical operation capabilities and ability to solve practical problems in the process of simulating the real business processes of enterprises. Finally, efforts should be made to expand school-enterprise practical training resources. In the context of school-enterprise cooperation, colleges and universities can introduce real enterprise projects and cutting-edge technical equipment to expand and extend practical training resources. For example, integrating the actual business of enterprises into practical training courses allows students to accumulate practical experience in real work scenarios; by virtue of digital technologies such as big data and artificial intelligence, highly simulated digital practical training scenarios can be created. This enables students to access and proficiently use various e-commerce operating systems, thereby enhancing their ability to apply professional knowledge in a digital environment ^[13].

3.4. Strengthen teacher training and build a “Dual-qualification” teacher team

To meet the demand for innovative and entrepreneurial talents in the e-commerce industry, colleges and universities need to strengthen teacher training and build a “dual-qualification” teacher team, laying a solid foundation for the smooth implementation of professional teaching reform. Firstly, to build a “dual-qualification” teacher team, colleges and universities should recruit teachers with more than three years of front-line work experience in enterprises. This is conducive to promoting the smooth development of subsequent practical teaching. Against the digital background, e-commerce professional teachers who master cutting-edge disciplinary knowledge and skills and possess good learning abilities can more effectively promote teaching reform, making the teaching model better aligned with students’ needs. In addition, to accelerate the structural transformation of the “dual-qualification” teacher team, colleges and universities need to pay attention to the proportion of “dual-qualification” teachers, ensuring that they account for more than half of the total number of e-commerce professional teachers. At the same time, regular teacher training should be carried out to encourage teachers to participate in further study activities. For instance, colleges and universities can organize professional teachers to take on temporary positions in enterprises. By setting fixed periods, teachers are encouraged to participate in e-commerce activities in enterprises, helping them continuously accumulate work experience ^[14]. These practical activities are conducive to the structural improvement of the “dual-qualification” teacher team, enabling it to more effectively meet the development needs of e-commerce and cultivate a large number of innovative and entrepreneurial talents.

3.5. Improve the incentive and assessment mechanism to mobilize students’ learning enthusiasm

In the cultivation of innovative and entrepreneurial talents for e-commerce courses in the background of the digital economy, it is necessary to highlight the dominant position of students, encourage them to take the initiative to engage in innovative and entrepreneurial activities in the e-commerce field, and promote the development of their comprehensive quality. This requires teachers to construct a multi-dimensional incentive and assessment system to mobilize students’ learning enthusiasm. For example, special scholarships can be set up to reward students who have performed outstandingly in innovative and entrepreneurial activities, and support them to participate in entrepreneurial projects and innovation and entrepreneurship competitions, so as to stimulate their passion for innovation and entrepreneurship. At the same time, teachers should also design a

corresponding assessment system to evaluate students' performance in innovative and entrepreneurial activities in a fair, objective, and comprehensive manner^[15]. Specifically, this evaluation system should include indicators such as social practice, scientific research achievements, and entrepreneurial projects, so as to comprehensively evaluate students' innovative and entrepreneurial achievements and provide an important basis for the implementation of relevant incentive measures. In addition, according to the dynamic changes in students' participation in innovative and entrepreneurial activities, teachers should also establish an evaluation feedback, and dynamic adjustment mechanism. This mechanism is used to adjust the student evaluation and incentive methods, ensuring their applicability.

4. Conclusion

To sum up, against the backdrop of the digital economy, significant changes have taken place in the job responsibilities and skill requirements of practitioners in the e-commerce industry. This requires the teaching focus of e-commerce courses to expand from the imparting of knowledge and skills to the cultivation of technical application, market insight, and innovative thinking abilities.

At present, the cultivation of innovative and entrepreneurial talents in e-commerce courses is faced with such problems as the mismatch between talent cultivation and the demand for innovative and entrepreneurial talents, the single subject involved in the cultivation of innovative and entrepreneurial talents, and the lag in the construction of the teaching staff. Taking a problem-oriented approach, teachers can explore the direction of teaching reform, adjust the talent cultivation methods, and provide the necessary support for students to grow into innovative and entrepreneurial talents who meet the development needs of the industry.

Disclosure statement

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Research on Strategies for Activating High School Politics Classroom Teaching with Information Technology

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Abstract: Against the backdrop of the digital age, information technology is developing at an unprecedented speed, transforming people's lifestyles and learning methods. In the context of education and teaching, information technology can change traditional teaching concepts and models, injecting new vitality into high school politics classroom teaching. Based on this, this paper conducts research on activating high school politics classroom teaching by using information technology. It expounds on the important value of this practice, analyzes the current dilemmas existing in high school politics classroom teaching, and explores specific teaching strategies. The purpose is to provide practical references for high school politics teachers, so as to improve the effectiveness of classroom teaching and promote the cultivation of students' core literacy in the political discipline.

Keywords: Information technology; High school politics; Classroom; Teaching strategies

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1. Introduction

With the widespread application of information technology in the field of education, profound changes are taking place in educational and teaching models. As a discipline that cultivates students' correct values, outlook on life, and worldview, the teaching quality of high school politics is directly related to the all-around development of students. Information technology is characterized by rich and diverse resources and strong interactivity. Introducing it into high school politics classrooms can inject new vitality into classroom teaching^[1]. By applying information technology, teachers can transform abstract political theoretical knowledge into vivid images, audios, videos, etc., making the teaching content closer to students' real-life situations and stimulating their interest in learning. At the same time, information technology can also provide students with platforms for independent learning and cooperative learning, cultivating their independent learning ability and innovative thinking. Therefore, researching strategies for activating high school politics classroom teaching with

information technology holds important practical significance.

2. The important value of activating senior high school political classroom teaching with information technology

2.1. It is conducive to broadening students' learning horizons

Information technology breaks the limitations of time and space, providing students with a vast amount of learning resources. Teachers can collect materials related to teaching content—such as news reports, academic papers, expert lectures, and documentaries—through the Internet, and present them to students with the help of multimedia equipment ^[2]. In addition, information technology enables students to access political phenomena and perspectives from different regions and cultural backgrounds, helping them view issues from a broader perspective. Students can learn about the political systems, cultural traditions, and social customs of other countries through online learning platforms, virtual museums, and other channels. This enhances their understanding and cognition of the world and cultivates their global vision and cross-cultural communication skills.

2.2. It is conducive to promoting students' preview

Preview is a crucial link in classroom learning. Adequate preview helps students identify the key points and difficulties of classroom learning, and improves the efficiency of classroom learning. The application of information technology provides strong support for students' preview. During the preview process, students can consult teachers via online platforms when encountering problems they do not understand, and also conduct online discussions and exchanges with classmates. Teachers can gain real-time insights into students' preview progress through online platforms, grasp the common problems existing in students' preview, and thus conduct targeted explanations and guidance in classroom teaching ^[3]. This preview method based on information technology can improve the enthusiasm and effectiveness of students' preview, laying a solid foundation for the smooth development of classroom teaching.

2.3. It is conducive to improving teaching quality

From the perspective of teachers, information technology provides them with rich teaching resources and advanced teaching tools, which help teachers optimize their teaching design. Information technology also enables teachers to realize the digital management of the teaching process, facilitating them to track and analyze students' learning status and adjust teaching strategies in a timely manner. From the perspective of students, information technology can create a more relaxed and free learning environment for them, stimulating their learning interest and initiative ^[4]. In classrooms supported by information technology, students can independently choose learning content and methods according to their own learning progress and needs. They can participate in classroom teaching through interactive games, online discussions, and other forms, enhancing their sense of learning experience and accomplishment.

3. Existing difficulties in senior high school political classroom teaching

3.1. Singleton teaching methods

In the current senior high school political classroom teaching, many teachers still adopt the traditional “teacher-

centered” and “cramming” teaching methods, resulting in a relatively singleton approach to instruction. Teachers mainly focus on explaining textbook knowledge in class, with a lack of interactive communication with students. As a result, students are in a passive position of receiving knowledge. This singleton teaching method neglects students’ dominant role in learning, making it difficult to meet their learning needs and the requirements of their personalized development. In class, students merely take notes mechanically and memorize key points, without opportunities for independent thinking and exploration. Consequently, their learning abilities fail to be developed effectively.

3.2. Tedious teaching content

Most content in senior high school political textbooks consists of abstract theoretical knowledge, involving a large number of concepts, principles, and laws, which pose certain difficulties for students to understand. During the teaching process, some teachers merely explain the textbook content verbatim without connecting theoretical knowledge to real life. This makes the teaching content tedious and unappealing. The disconnection between teaching content and real life prevents students from perceiving the practical value of political knowledge. Students tend to regard political learning as merely a means to cope with exams, thereby reducing their enthusiasm and initiative for learning. Additionally, the update speed of textbook content is relatively slow, making it difficult to keep pace with the development of society.

4. Teaching strategies for activating senior high school political classrooms with information technology

4.1. Create information-based teaching scenarios to stimulate students’ learning enthusiasm

Teaching scenarios can create a favorable emotional atmosphere for students, enabling them to acquire knowledge and skills unconsciously. Creating information-based teaching scenarios refers to integrating abstract theoretical knowledge into specific scenarios using information technology. This allows students to perceive the value and significance of knowledge in the scenarios, thereby effectively stimulating their learning enthusiasm. For example, in the teaching of the senior high school political course “The Disintegration of Primitive Society and the Evolution of Class Society”, considering that the knowledge points of this course are relatively complex—covering the characteristics and evolutionary processes of different social formations such as primitive society, slave society, and feudal society—students face certain difficulties in learning ^[5]. In response to this, teachers can create an information-based teaching scenario by introducing the case of the interaction between Charles Darwin and the indigenous people of Tierra del Fuego. First, teachers can use information technology to display video clips of the indigenous people of Tierra del Fuego. From the videos, students can observe the indigenous people using simple living tools and living in a state without class differentiation. At the same time, teachers can tell the story of Darwin’s interaction with them in an interesting way. This helps students gain a more intuitive understanding of the living conditions of primitive society and recognize its characteristics ^[6]. When introducing production in a slave society, teachers can use multimedia to display film and television clips about the living conditions of people in the Shang and Zhou dynasties, such as scenes of slave labor and slave owners’ exploitation. Then, teachers can guide students to think about each scene and analyze questions like “What changes occurred from primitive society to slave society?” and “Why did private ownership of property emerge?” This allows students to understand the causes of the emergence of private

ownership of property and the basic characteristics of a slave society while watching videos and thinking about questions. By creating information-based teaching scenarios and problem-based teaching scenarios, students' thinking vitality can be stimulated. Students can deepen their understanding of knowledge through thinking about and exploring problems, thereby effectively improving teaching effectiveness ^[7].

4.2. Introducing micro-lecture teaching methods to promote students' independent preview

Previewing before class can enable students to understand the course knowledge in advance and develop good learning habits of students. In the pre-class session, teachers can create corresponding micro-lecture videos based on the course content and students' actual situations. These videos can present the key and difficult knowledge of the course as well as the analysis of typical examples to guide students to conduct an independent preview and improve the effectiveness of course learning ^[8]. For instance, in the teaching of "the dialectical relationship between the universality and particularity of contradictions", teachers can make micro-lecture videos focusing on this knowledge point. They can use common objects in life as examples, such as the relationship between fruits and apples. Through this vivid metaphor, students can understand that the universality of contradictions exists in particularity, and particularity contains universality. By watching the micro-lecture videos, students can gain a preliminary understanding of the course knowledge points. At the same time, they can also identify their own doubts and participate in the subsequent in-class learning with these questions, which effectively improves the learning effect ^[9]. Teachers upload the produced micro-lecture videos to the online learning platform. Students can choose the time and frequency of watching according to their own schedules. When they encounter parts they do not understand, they can watch them repeatedly or discuss online with other students to solve their learning doubts ^[10]. Teachers can check students' browsing data and discussion status through the online platform to understand the degree of students' mastery of pre-class knowledge. This helps to clarify the key and difficult points of the subsequent in-class learning, so that teachers can conduct targeted explanations and teaching. The introduction of micro-lecture teaching methods breaks through the limitations of traditional teaching, makes students' pre-class preview more targeted, and fully prepares them for the subsequent in-class teaching, which can improve teaching efficiency.

4.3. Presenting information resources in a diversified way to enrich students' learning experience

To promote the effective empowerment of information technology in high school politics classroom teaching, teachers should pay attention to integrating course teaching resources, use modern information technology to conduct structural analysis of teaching materials, reform course content in a high-quality manner, and improve teaching effects. The knowledge points in high school politics textbooks cover multiple fields such as the economy, politics, and culture. Simply explaining the content of textbooks is not conducive to students' understanding and mastery. However, diversified information resources can enable students to understand the course knowledge from different angles and levels and gain a rich learning experience ^[11]. In this regard, teachers should grasp the internal connections of the theoretical system and effectively integrate course resources relying on information technology to enrich the course knowledge. For example, in the teaching of traditional culture in the cultural life module, teachers should integrate information resources related to traditional culture and present them in a diversified way. First, teachers can display pictures of buildings containing traditional cultural

elements, such as the Forbidden City and the Great Wall. This allows students to intuitively feel the unique artistic style and connotation of traditional architecture and stimulates their enthusiasm for exploring traditional culture^[12]. During the display, teachers can provide corresponding explanations to introduce the structural characteristics of the buildings and the implied meanings. For example, the architecture of the Forbidden City reflects the idea of the supremacy of imperial power, helping students connect the buildings with cultural thoughts. Then, teachers can play traditional opera videos for students. Through watching and listening, students can feel the artistic charm of traditional operas and understand their cultural value. After the playback, teachers can ask students questions like: “How do you feel after listening to these traditional operas? What difficulties do they face in inheritance and promotion? What should we do?” These questions promote teacher-student interaction, allowing students to explore traditional culture from the perspective of inheritance and deepen their understanding.

After the discussion, teachers can introduce legends and stories about traditional culture to students, such as the origin of the Dragon Boat Festival customs and the legends of the Mid-Autumn Festival. These interesting stories attract students and enhance their sense of belonging to traditional culture. The introduction of information technology fills some gaps in teaching materials, enables students to learn knowledge beyond textbooks, and brings students a good learning experience^[13].

4.4. Optimizing the classroom teaching process to enhance course teaching effectiveness

Optimizing the classroom teaching process is crucial for improving teaching effectiveness. Teachers should leverage information technology to optimize all links of classroom teaching, thereby making the teaching process more compact and enhancing teaching outcomes. First, optimize the introduction section. A good introduction can quickly capture students’ attention and help them focus more on their studies. Taking the teaching of “Economic Life” as an example, when covering the knowledge point of “the impact of price changes”, students can first be shown short clips of recent news about pork price fluctuations. Real events are used to attract students’ attention and help them perceive the connection between price changes and daily life. After the video is played, the teacher asks students: “How do you think the rise in pork prices will affect your daily life? And what impact will it have on your consumption behavior?” Guided by these questions, students start from the topic of “pork” to develop their thinking and discuss with each other the impact of price changes on daily consumption. This interactive process lays a solid foundation for the introduction of subsequent course knowledge^[14]. Second, reform the knowledge point explanation section. With the support of information technology, teachers should transform abstract knowledge points into concrete content and simplify complex problems, thereby helping students understand better. For instance, when explaining the knowledge point of “the role of public finance”, teachers can introduce dynamic images to show the state’s public finance expenditure in areas such as education and infrastructure construction. This allows students to understand the relationship between public finance and residents’ lives, and recognize the positive role of public finance in promoting social equity and improving people’s well-being. At the same time, teachers can incorporate specific cases into their explanations—such as introducing the state’s public financial support for poverty-stricken areas, covering aspects like educational resources and medical conditions—to help students gain a deeper understanding of the significance of public finance. Third, adjust the classroom summary section. Teachers should use information technology to sort out and summarize the knowledge points of the current course. For example, they can use mind mapping tools to present the key and difficult points of the course, helping students clarify the connections

between different knowledge points and make their learning thinking more organized; they can also play short videos summarizing the knowledge points, leading students to review the classroom content again to deepen their memory ^[15].

5. Conclusion

To sum up, activating high school politics classroom teaching with information technology holds significant practical significance and value. In practical application, teachers should create information-based teaching scenarios, introduce micro-lecture teaching methods, present information resources in diverse forms, and optimize the classroom teaching process. This enables students to understand knowledge from multiple perspectives, enhances the effectiveness of course teaching, and improves classroom teaching efficiency. With the continuous development of information technology and the deepening of education reform, high school politics classroom teaching will embrace more opportunities for innovation and development. Teachers should actively explore new models and methods for the in-depth integration of information technology and politics classroom teaching, making high school politics classes more vivid, lively, and attractive.

Disclosure statement

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Feasibility Study on Intangible Cultural Heritage Inheritance Empowering Students' Mental Health Education from the Perspective of the Simultaneous Development of Five Educations

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Abstract: This study aims to conduct an in-depth exploration of the feasibility of intangible cultural heritage (ICH) inheritance enhancing students' mental health education from the perspective of the simultaneous development of Five Educations (moral education, intellectual education, physical education, aesthetic education, and labor education). By excavating the unique values of ICH in moral education, intellectual education, physical education, aesthetic education, and labor education, this study explores effective paths for integrating ICH into mental health education. It provides theoretical support and practical references for enriching and improving the students' mental health education system, and promotes the all-round development and physical and mental health growth of students.

Keywords: Simultaneous development of Five Educations; Intangible cultural heritage inheritance; Students' mental health education

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1. Introduction

Intangible Cultural Heritage (ICH), as a treasure of human civilization, carries rich historical and cultural information as well as national spirit, and possesses unique educational value. Combining ICH inheritance with students' mental health education provides new ideas and approaches for solving students' mental health problems^[1-2]. On the one hand, activities such as handcrafting and artistic performances in the process of ICH inheritance enable students to gain immersive experiences in practice, divert their attention, forget troubles, and achieve the effect of relaxing both body and mind. For example, in the case of ICH techniques like woodblock printing and cloisonné enamel, students can focus on the operation of the techniques when participating in the production process, thereby alleviating psychological pressure. On the other hand, learning and inheriting

ICH culture helps to enhance students' sense of national pride and cultural identity, enabling students to obtain psychological satisfaction and a sense of belonging in the nourishment of culture, and promoting the development of mental health.

2. Definition of core concepts

2.1. Simultaneous promotion of the Five Educations

The “simultaneous promotion of the Five Educations” includes moral education, intellectual education, physical education, aesthetic education, and labor education. It is a crucial component of all-round development education and plays a key role in cultivating talents with all-round development ^[3]. Moral education is the kind of education that fosters students' correct world outlook, outlook on life, values, as well as sound moral qualities and behavioral norms. It aims to guide students in establishing proper value orientations and shaping noble moral sentiments. As the soul of education, it provides directional guidance for all other educational domains. Intellectual education focuses on imparting systematic scientific and cultural knowledge to students, developing their intelligence and abilities, and enhancing their cognitive level and thinking skills, thus laying a knowledge foundation for students' all-round development. Physical education is related to students' physical health. Through sports activities and exercises, it strengthens students' physical fitness and cultivates their sportsmanship and athletic skills. Aesthetic education aims to develop students' aesthetic taste and artistic literacy, improve their ability to perceive, appreciate, and create beauty, and enrich their spiritual world. Labor education emphasizes that students should master labor skills, develop labor concepts and habits by participating in various labor practices, enabling them to realize their self-worth through labor.

2.2. Mental health education

In the modern education system, mental health education has become an indispensable part of quality-oriented education and plays a vital role in students' growth and development ^[4]. It helps students better understand themselves, including their emotions, needs, and values, thereby enabling them to plan their personal development more effectively. It enhances students' psychological quality, improves their abilities in self-awareness, emotion management, and stress coping, cultivates a positive and optimistic mindset, and strengthens their ability to face setbacks and pressures. It promotes students to establish good interpersonal relationships, improves their social adaptability and interpersonal skills, reduces social problems caused by psychological issues, and contributes to the harmonious development of families and society.

3. The inherent connection between the simultaneous promotion of the Five Educations and mental health education

3.1. Moral education and mental health education

Moral education provides an important ideological foundation and value orientation for mental health education during students' growth ^[5]. Primarily by fostering students' correct worldview, outlook on life, and values, moral education guides them to develop a positive attitude towards life, shapes sound moral character and behavioral norms, thereby promoting the development of students' mental health.

In terms of value guidance, moral education helps students clarify the meaning and value of life, enabling them to correctly understand themselves and society, and establish lofty ideals and goals. When students possess

firm value beliefs, they can draw strength from their own value system when facing difficulties and setbacks, maintain a positive and optimistic mindset, and enhance their psychological resilience.

3.2. Intellectual education and mental health education

Intellectual education plays a positive role in promoting mental health education. It helps students improve their cognitive level and enhance their learning abilities, thereby enabling them to better cope with various challenges in study and life and maintain mental health ^[6-7].

In the aspect of cognitive development, intellectual education enriches students' knowledge reserves, broadens their horizons, and promotes the development of their thinking abilities. With the continuous accumulation of knowledge and the improvement of thinking abilities, students can understand the world and themselves more comprehensively and in-depth, and enhance their ability to analyze and solve problems. When students have strong cognitive abilities, they can think more rationally when facing complex learning tasks and life problems, and avoid negative emotions such as anxiety and fear caused by cognitive biases.

3.3. Physical education and mental health education

Physical education is an important way to promote students' physical health, and it also has a positive impact on students' mental health ^[8]. Physical activities not only strengthen students' physical fitness but also promote the development of their mental health by relieving pressure, regulating emotions, and cultivating willpower.

Physical exercise can enhance physical fitness, providing a material foundation for mental health ^[9]. Moreover, physical activities help cultivate students' willpower, such as perseverance, stamina, courage, and teamwork spirit. In sports competitions, students need to face fierce competition and various difficulties, such as fatigue, injuries, and strong opponents. Only with strong willpower can they overcome these difficulties and persist until the end, thereby gaining a sense of belonging and identity and improving their mental health.

3.4. Aesthetic education and mental health education

Aesthetic education is the education that cultivates students' aesthetic taste and ability. Through artistic activities, appreciation of nature, and other methods, it guides students to perceive beauty, appreciate beauty, and create beauty, thereby enriching their spiritual world and promoting the development of their mental health ^[10]. For example, art forms such as painting, music, dance, and drama allow students to express their inner emotions and thoughts in a unique way during the process of creation and performance, achieving emotional release and satisfaction, and thus enhancing their sense of happiness and life satisfaction.

3.5. Labor education and mental health education

Labor education is the education that cultivates students' labor concepts, labor skills, and labor habits. Through labor practice activities, it enables students to experience the process of labor and feel the value of labor, thereby promoting their all-round development and playing an important role in strengthening students' mental health.

4. The unique value of intangible cultural heritage inheritance (ICH) for students' mental health education

4.1. Emotional regulation and stress relief

In modern society, students face pressure from multiple aspects such as academic studies, examinations, and

interpersonal relationships, making them prone to negative emotions like anxiety, depression, and irritability^[11]. ICH practice activities provide students with a platform to relax, divert their attention, help them regulate emotions, and relieve stress.

Studies have shown that when people engage in handcrafting activities, the brain secretes neurotransmitters such as endorphins. These substances can regulate emotions and evoke a sense of pleasure and well-being. Therefore, by allowing students to focus on the handcrafting process, ICH practice activities not only cultivate students' interests, hobbies, and hands-on skills but also play a positive role in emotional regulation and stress relief, thereby promoting students' mental health.

4.2. Self-cognition and self-confidence enhancement

Self-cognition refers to an individual's understanding and evaluation of themselves, including knowledge of their own interests, abilities, personality, and other aspects^[12]. Self-confidence is an individual's trust and recognition of their own abilities and values. In the process of learning and inheriting ICH techniques, students can continuously explore their interests and potential, gain a better understanding of themselves, and at the same time, enhance their self-confidence through the achievements they have made and the recognition from others.

Furthermore, ICH inheritance activities also provide students with a platform to showcase themselves. Students can display their works and skills to others by participating in ICH exhibitions, performances, and other activities, thereby gaining more attention and recognition. During communication and interaction with others, students can receive different opinions and suggestions, further understand their own strengths and weaknesses, so as to better improve themselves and enhance their self-confidence.

4.3. Improvement of social skills and expansion of interpersonal relationships

Social skills refer to an individual's ability to communicate, cooperate, and coordinate with others in social interactions. Positive interpersonal relationships play a crucial role in promoting students' mental health and personal growth^[13]. ICH inheritance activities are usually characterized by collectiveness and interactivity, which provide students with abundant social opportunities and help promote their interpersonal communication and improve their interpersonal relationships.

5. The implementation path of intangible cultural heritage inheritance to enhance students' mental health education from the perspective of the simultaneous promotion of the Five Educations

5.1. Developing specialized courses

The development of specialized courses integrating intangible cultural heritage (ICH) and mental health education aims to enable students to gain an in-depth understanding of ICH culture through systematic teaching, while mastering mental health knowledge and skills, so as to promote their all-round development and mental health^[14].

The knowledge module of mental health education addresses common psychological issues among students and explains knowledge and skills in areas such as emotion management, stress relief, self-awareness, and interpersonal communication. For instance, through case studies, it teaches students how to identify their own emotions and use methods like deep breathing and meditation to regulate emotions; it also introduces communication skills in interpersonal interactions to help students improve their relationships. The practical

operation module organizes students to participate in intangible cultural heritage (ICH) practice activities, such as handcrafting and folk custom experiences. These activities allow students to experience the charm of ICH in practice while applying mental health knowledge for self-regulation. For example, when learning pottery making, students may encounter failures in their work. At such times, they are guided to apply stress-coping skills, maintain a positive mindset, and continue their attempts.

5.2. Integrating into existing courses

In moral education courses, rich moral education resources embedded in ICH are thoroughly explored, and ICH culture is closely integrated with the education of socialist core values ^[15]. By telling the stories of ICH inheritors, students learn about the professional dedication, craftsmanship spirit, and perseverance in and passion for traditional culture that these inheritors demonstrate in the process of ICH inheritance. This guides students to establish correct values and professional ethics.

In intellectual education courses, ICH projects are used to cultivate students' innovative thinking and practical abilities. In science courses, traditional ICH items such as astronomical calendars and knowledge of traditional Chinese medicine (TCM) can be introduced to guide students in exploring the scientific principles behind them, thereby stimulating students' interest in science and the spirit of exploration. In language and literature courses, students learn ICH-related literary works-such as folk tales, poems, and songs-to deepen their understanding and perception of ICH culture, while improving their literary literacy and language expression skills.

Physical education courses are combined with traditional sports in ICH, which not only enriches the content of physical education but also allows students to experience the unique charm of traditional sports. Traditional sports like martial arts, Tai Chi, and dragon-lion dancing are incorporated into physical education curricula. Through learning these traditional sports, students not only exercise their bodies but also inherit and promote the excellent traditional Chinese culture, enhancing their sense of national pride.

In aesthetic education courses, the artistic elements of ICH are fully utilized to cultivate students' aesthetic ability and artistic literacy. In art courses, students are guided to appreciate traditional artworks such as paper-cutting, embroidery, and New Year paintings, and learn their unique modeling styles, color schemes, and expressive techniques-helping students feel the simplicity and vitality of folk art.

Labor education courses take ICH inheritance as a carrier, enabling students to master labor skills and develop labor concepts and habits through practice. Learning traditional craftsmanship requires patience and carefulness in every step. Students are organized to participate in ICH inheritance activities, such as assisting inheritors in organizing exhibitions or participating in the arrangement of folk custom events. These practices help students develop their organizational skills and teamwork abilities, while further deepening their understanding of the value of labor.

6. Innovation in teaching methods

6.1. Experiential teaching

Experiential teaching organizes students to participate in intangible cultural heritage (ICH) practical activities, allowing students to perceive the charm of ICH culture through personal experience, while achieving psychological adjustment and growth.

To ensure the effectiveness of experiential teaching, teachers must make adequate preparations before the activities, including the arrangement of activity venues, the preparation of tools and materials, and the explanation of safety precautions. During the activities, teachers should provide students with sufficient guidance and assistance, encouraging them to actively participate and dare to try. After the activities, teachers should organize students to reflect and communicate, guide them to share their experiences and feelings, further deepen students' understanding and perception of ICH culture, and promote their psychological growth.

6.2. Situational teaching

Situational teaching creates teaching scenarios related to ICH, enabling students to feel the atmosphere of ICH culture in specific situations, stimulate their learning interest and emotional resonance, and guide them to solve psychological problems.

Simulating ICH inheritance scenarios is also an effective method of situational teaching. Teachers can organize students to conduct role-playing activities, simulating the life and work scenarios of ICH inheritors. When simulating the inheritance scenario of traditional handicrafts, students play the roles of craftsmen and apprentices, respectively. By imitating the production process of craftsmen, students learn ICH techniques and, at the same time, experience the responsibilities and missions of inheritors. The design of scenarios should be combined with teaching objectives and students' actual situations, with a certain degree of challenge and inspiration, which can guide students to think actively and explore independently. Teachers should also pay attention to students' emotional experiences in the scenarios, provide timely encouragement and support, help students overcome difficulties, and achieve psychological growth and development.

6.3. Cooperative learning

Cooperative learning organizes students to carry out group cooperative learning and jointly complete the ICH project research or practical activities, so as to cultivate students' social skills, team spirit, and problem-solving abilities.

Jointly completing the ICH project practical activities is also an important part of cooperative learning. During the practice, group members need to cooperate closely, divide work according to their respective strengths and advantages, and jointly complete the design, production, and decoration of works. For example, when cooperatively making paper-cut works, some students are responsible for designing patterns, some for cutting, and some for pasting. Through joint efforts to complete an exquisite work, students can experience the power of team cooperation and enhance their self-confidence and sense of accomplishment.

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Practical Research on Cloud Computing Skills Competition in Promoting Learning through Competition in Vocational Education

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Abstract: With the rapid development of cloud computing technology, the demand for highly skilled cloud computing talents continues to grow. Vocational education, as the main base for cultivating technical and skilled talents, how to achieve the reform goal of “promoting learning and teaching through competition” through skills competitions has become the focus of current research. Based on the practical case of the cloud computing skills competition, this paper analyzes the mechanism of its role in promoting teaching reform, proposes the implementation path of promoting learning through competition, and explores the innovative model of cloud computing talent cultivation in vocational education through dimensions such as school-enterprise cooperation, curriculum reconstruction, and faculty construction, providing a reference for the high-quality development of vocational education.

Keywords: Cloud computing; Skills competition; Vocational education; Learning through competition

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1. Introduction

With the rapid development of information technology, advanced technologies such as big data, the Internet of Things, and cloud computing are emerging one after another. While promoting industrial transformation, they can also provide new directions for the reform of the training model of computer professionals in vocational colleges. In this context, the skills competition has also shifted from the previous separation of teaching, learning, and practice to a new model that combines promoting teaching, learning, and reform through competition. While deepening school-enterprise cooperation, it promotes the reform of teaching, teaching, and teaching, strengthens the connotation construction, and can also provide better services for regional economic development and help the school construction reach a new level^[1]. In addition, cloud computing, as the core infrastructure of the digital economy, has been widely applied in various industries. According to the prediction of the Ministry of Human Resources and Social Security, there will be a shortage of 1.5 million cloud

computing talents in China by 2025, and vocational colleges, as the main supply of skilled talents, urgently need to improve the efficiency of talent cultivation through teaching model reform. Vocational skills competitions, as an important means of vocational education, have become an effective way to promote teaching reform by closely integrating industry standards, technological frontiers, and teaching practice through competition mechanisms^[2].

2. The mechanism of the cloud computing skills competition in promoting teaching reform

This type of competition is of a national nature and holds a significant position. It is extremely important and necessary to attach importance to the application and practice of this competition in vocational education^[3].

2.1. Promoting learning through competition: Stimulating students' autonomy and innovation ability

Skills competitions stimulate students' practical motivation by simulating real working scenarios and industry demands. For example, the "Cloud Computing Application" event of the Jiangsu Vocational College Skills Competition requires contestants to complete cloud service setup, operation, and maintenance, and development tasks, and integrates cloud-edge-device integration technology to enhance students' comprehensive application ability^[4]. During the preparation process, students need to improve their technical proficiency and problem-solving skills through high-intensity project training, forming a virtuous cycle of "learning by doing and doing by learning."

In order to win the competition, students need to understand what cloud computing is and have a preliminary understanding of it. Then, in combination with the competition content, they need to understand the logical relationship between the modules, supplemented by repeated training, allowing them to discuss, communicate, collaborate, and explore related issues to solve practical problems. Such skills competitions are conducive to transforming students' attitudes towards learning from passive acceptance to active completion. In conclusion, "Give a man a fish and you feed him for a day; teach a man to fish and you feed him for a lifetime." By taking the competition as an important starting point and instilling the spirit of craftsmanship, it is beneficial for students to further their studies in this skill. At the same time, it can also allow some outstanding students to act as little teachers to drive the progress of other students. While stimulating and continuing students' interest in learning, it can also create a competitive learning atmosphere. It is conducive to achieving the teaching and learning goals of this major^[5].

2.2. Promoting teaching through competitions: Optimizing the curriculum system and teaching team

The cloud computing skills competition covers a wide range of knowledge points, such as cutting-edge knowledge of the IT industry. In order to improve students' performance in the skills competition, teachers need to actively learn new ideas and methods so as to keep up with the development pace of the industry, and at the same time master the steps of cloud computing, construction, and architecture, and be familiar with big data-related knowledge. Only when teachers establish the concept of lifelong learning can they provide students with correct guidance and convey more cutting-edge knowledge of the industry, which is an important way to eliminate students' blind mentality in professional learning^[6]. In conclusion, teaching and learning promote

each other. With the help of such competitions, it is beneficial to improve the teaching level and quality of teachers. For instance, skills competitions push teaching content to be updated in line with industry trends and enhance the practicality of teaching ^[7].

2.3. Promoting improvement through competition: Reconstructing the training environment and evaluation system

There are problems, such as outdated equipment and insufficient resources in traditional practical training teaching, while the high standards of practical training conditions in skills competitions prompt institutions to upgrade their hardware facilities. For instance, Jiangxi Vocational College of Applied Technology has introduced enterprise technical experts as coaches and designed practical training projects in line with the “1+X” certificate assessment standards, significantly enhancing students’ job adaptability ^[8]. In addition, the competition, through a diversified evaluation model of “skill operation + on-site defense”, breaks the limitations of traditional written tests and comprehensively examines students’ technical literacy and innovation ability ^[9].

At present, technologies such as virtual reality and software-defined networking are emerging one after another, and the teaching of this major cannot meet the demands of the new era (i.e., the cloud computing era). Through this competition, the goals and plans of the major can be clarified, and the pace of reform can be accelerated. In addition, an analysis of the content of this type of competition reveals that it includes the construction of cloud computing infrastructure platforms, the construction of operation and maintenance big data platforms, etc. In order to better cope with the competition, adjustments should be made to the curriculum, such as offering relevant basic courses and giving them vitality through curriculum reform to lay a solid foundation for subsequent reforms ^[10].

2.4. Promote development through competition: Build a cloud computing laboratory

In traditional laboratories, students are required to conduct experiments and training operations on computers, and these operations are often confined within the laboratory. In the era of cloud computing, it is possible to create a traditional laboratory service model that is free from the constraints of time, space, and services. The laboratory uses server nodes to build a cloud platform, and through pre-configured environment templates, it creates new environments that include multiple hosts and experimental networks in batches and quickly. In this environment, students can log in with a terminal device, and after logging in, they can perform experiments in the cloud host at any time and from anywhere ^[11]. This type of laboratory has significant advantages, mainly in the following aspects: First, it is conducive to making full use of resources. For the idle host, the resources on the host can be recycled, and the cloud platform can receive these resources and distribute them to other users who need them. Second, it helps to change students’ attitudes towards learning and improve their learning efficiency and effectiveness. This type of laboratory breaks through the limitations of time and space, allowing students to conduct experiments and practical training anytime and anywhere, that is, through cloud hosts, to improve their learning outcomes. The third point is that it helps improve the management level of the laboratory. Instead of spending a lot of time creating the environment, cloud computing-related laboratories make templates based on the course environment, then clone and distribute them, and update the environment while also improving the efficiency of administrators ^[12].

2.5. Promoting cooperation through competition: The impact of cloud computing skills Competition on school-enterprise cooperation

Colleges and enterprises are two separate entities, and this kind of competition serves as a link between them. In fact, vocational colleges lag behind industry technology in terms of teaching content, knowledge update, and teacher structure change. Therefore, they need to rely on the power of enterprises to catch up with the gap and support their development^[13]. Such competitions have played a significant role in this, providing references and lessons for vocational education to actively face the market, adhere to the correct direction of running schools, focus on the integration of work and study, and promote the reform of the talent cultivation model and improve the effectiveness of talent cultivation through the cultivation of both morality and skills and the spirit of craftsmanship^[14].

3. Practical paths and typical cases of promoting learning through competitions

3.1. Building a teaching platform that integrates industry, education, and competition

Vocational education needs to build a dual-education model of “school-enterprise cooperation + competition-driven.” For instance, Amazon Web Services (AWS) and Shenzhen Technician College jointly established a cloud computing training base, providing a cloud experimental platform and industry certification resources. After students passed the SAA (Assistant Solution Architect) and SAP (Expert Solution Architect) certifications, their employability improved significantly by 38%. Nanjing Finance and Economics Vocational School, on the other hand, starts from the lower grades to discover and cultivate potential students by organizing professional interest groups and conducting on-campus competitions. At the same time, it has strengthened exchanges and cooperation with other institutions in competitions, learning from each other, and jointly improving the level of competition^[15].

3.2. Reconfigure the modular curriculum system

Based on the requirements of the competition project, vocational colleges can dynamically adjust the course content to a modular structure. For example, a certain vocational college in Shandong has broken down the competition project of the Cloud computing skills competition into modules such as “Cloud platform construction” and “Cloud security operation and maintenance”, integrated them into daily teaching, and developed loose-leaf teaching materials to strengthen the application orientation.

3.3. Strengthen the construction of the teaching staff

The ability of the teaching staff directly affects the teaching effect. Vocational colleges can use the “bringing enterprises into teaching” strategy to hire technical experts from enterprises to participate in teaching and encourage teachers to obtain industry certifications (such as Amazon Web Services SAP certification). Shenzhen Technician College has significantly improved its teaching quality through joint training with enterprises.

3.4. Improve the mechanism for the transformation of competition results

The results of the skills competition should be transformed into teaching resources and employment advantages. For instance, Anhui National Defense Science and Technology Vocational College has incorporated the competition preparation experience of its award-winning students into its school-based teaching materials and provided them with high-paying positions through school-enterprise cooperation, ordering classes to achieve a

closed loop of “competition—teaching—employment.”

4. Challenges and countermeasures

4.1. Solutions to the problem of insufficient integration of resources

Some institutions are facing a shortage of equipment and funds. They can take advantage of the Ministry of Education’s policy on “Construction of Vocational Education Practice Centers” and jointly build and share training bases with enterprises. For example, the Ministry of Education plans to build 300 national-level practice centers by 2025 to promote the optimal allocation of vocational education resources. In addition, the fragmentation of resources could be addressed by building a shared platform. For example, a cloud competition resource center could be established to optimize the allocation and collaboration of various resources, and on this basis, new operational models could be adopted. At the same time, establishing a corresponding points system for resources, based on the competition level and in combination with the training scale, to determine the amount of resources that vocational colleges can apply for, will help improve the efficiency of equipment utilization. In addition, the platform can be used to build a circulation network (which combines enterprises, colleges, and regional centers) so that the relevant products of enterprises can be synchronized with the training environment of schools in the shortest time. The application of the platform helps to shorten the update cycle of training equipment, improve students’ access to cutting-edge technologies, and build a new resource ecosystem while addressing the shortage of resources in colleges and universities.

4.2. Strategies for improving the disconnection between teaching and industry

At present, significant progress has been made in the teaching of the cloud computing major, but at the same time, there are some problems that need to be solved urgently, such as the separation of teaching and the industry. Therefore, a three-dimensional linkage improvement mechanism should be established: First, a new curriculum system should be established and combined with the competition, referring to its technical standards, to form a closed loop, that is, first the competition assessment, then the enterprise verification, and finally the teaching transformation. This closed loop puts forward new requirements for the proportion of core course updates and focuses on the absorption of cutting-edge technologies. In practice, by converting the technical points related to the competition assessment, the match between the teaching content and the demands of enterprises will be improved. Secondly, a new system was implemented, namely “dual teachers and three positions”, which means that professional teachers undertake three responsibilities, namely teaching, enterprise practice, and competition guidance. The number of enterprise projects that teachers can participate in is clearly stipulated to be no less than 80 class hours. At the same time, the performance assessment method was reformed, that is, the conversion rate of engineering cases was added to enhance the practical ability of teachers. Finally, a new platform was established, which is characterized by the combination of virtual and real, integrating real enterprise projects and creating corresponding databases. On this basis, based on the new training system, students were guided to complete enterprise projects while addressing the disconnection between the two.

4.3. Deepening the development of students’ comprehensive qualities

In practice, to cultivate students’ comprehensive qualities, a new system of cultivation should be established. This system combines technical skills with professional qualities and achieves the above goals through

dual-track training. In daily teaching, teachers can incorporate elements of the competition, such as scheme design, technical analysis, etc., to build a new training model that combines competition standards, course teaching, etc. Through closed-loop training, it is conducive to achieving the expected goals. Specifically, the indicators for quality assessment should be defined, and when defined, some non-technical types of indicators in the competition, such as document norms, innovative consciousness, etc., can be included. At the same time, organize students for project-based learning and strengthen their development through real project environments, such as communication and expression skills, cooperation skills, and other comprehensive abilities. In addition, a new conversion mechanism can be established to combine students' competition results with quality credits, that is, converting students' rankings into credits, thereby enhancing students' enthusiasm for competition while developing their professional skills and improving their professional qualities.

5. Conclusions

The cloud computing skills competition, through the “competition-teaching-industry” linkage mechanism, provides impetus for reform and practical paths for vocational education. In the future, vocational colleges need to further deepen the integration of industry and education, relying on policy support (such as the Ministry of Education's “11 Key Tasks for Vocational Education”), to build a talent cultivation ecosystem that is “competition-led, school-enterprise collaborative, and resource-open”, and provide more high-quality technical and skilled talents for the digital economy era.

Disclosure statement

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AI-Enabled Production-Oriented Approach: Construction and Implementation Paths for College English Teaching Design Principles

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Abstract: The Production-Oriented Approach (POA) drives students' learning processes through task-based scenarios. In the context of the deep integration of digital technology and education, AI-enhanced POA can further improve teaching quality. This paper explores the construction of teaching design principles and practical methods for university English teaching under the AI-enabled POA framework. It argues that teachers should base their practices on the theoretical foundations of POA while aligning with the empowering dimensions of AI technology, thereby establishing teaching design principles that focus on goal orientation, human-machine collaboration, data loops, authentic contexts, and dynamic evaluation. In practice, teachers should create a precise teaching-feedback-optimization loop through a teaching management support system that encompasses pre-class, in-class, and post-class activities.

Keywords: College English; AI; Production-Oriented Approach; Teaching design principles; Practical paths

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1. Introduction

The Production-Oriented Approach (POA), developed by Professor Wen Qiufang based on the “Drive-Promote-Evaluate” theoretical framework, emphasizes that language instruction should start with output and be supported by input. Authentic production tasks drive students to actively acquire language knowledge, facilitating the internalization and application of their language abilities. In an era of globalization, implementing POA in university English instruction can cultivate interdisciplinary talent with comprehensive competencies. Furthermore, the increasing intelligence of social development marks a trend where AI technology reshapes the educational ecosystem, prompting university English teachers to explore the potential of AI to empower POA and deepen its implementation. This involves building systematic teaching design principles and actionable strategies to enhance the efficacy of university English teaching^[1].

2. Rationale for AI-enabled POA

The integration of AI and POA represents a synergy beyond the mere application of technology in pedagogy; it embodies a coordinated enhancement based on educational principles and technological characteristics. At its core, this synergy reflects a bidirectional coupling of cognitive science and technology. Drawing upon cognitive load theory, AI's capabilities—such as automated grammar error recognition and statistical learning data analysis—significantly mitigate the external cognitive load students experience while learning English. Consequently, students can concentrate their cognitive resources on constructing linguistic logic, adapting to cultural contexts, and achieving higher-level language outputs. Moreover, AI's immediate feedback functionality ensures that students' learning errors are corrected before they are forgotten, accelerating language internalization and aligning with theories related to the “working memory window period.” From a socioconstructivist perspective, AI can create virtual simulated environments instead of providing single technical contexts, thereby digitally extending social language. For instance, with its adaptive capabilities, AI can identify individual learners' zones of proximal development (ZPD) boundaries and adjust learning tasks accordingly, continually optimizing the scaffolding provided in AI-assisted learning ^[2].

Table 1. Levels, pathways, and value of educational technology in empowering teaching and learning

Level of empowerment	Technical implementation	Educational value
Process Optimization	Automated grading, data collection	Allows teachers to focus on instructional design
Cognitive Enhancement	NLP analysis of logical fallacies, VR immersion	Deepens language comprehension
Ecological Reconstruction	Learner profiles, resource matching, and dynamic assessment	Achieves an integrated teaching-learning-assessment ecosystem

From a practical feasibility standpoint, this coordination mainly manifests in the precise breakthroughs AI technology can make to address POA's practical focus and to enhance critical teaching components. Notably, traditional POA instruction grapples with the challenge of personalization in large classes, where teachers struggle to accommodate individual students' varying needs and foundational knowledge. However, AI technology can enable personalized analysis on a large scale through learning analytics systems. For example, AI algorithms can process the learning data of hundreds of students concurrently to identify specific English learning challenges and create tailored profiles for each learner. Concurrently, AI technology promotes output-driven instruction effectively through a feedback loop based on real-time diagnostics of students. For instance, when students complete writing tasks on an intelligent writing platform, the system can highlight grammatical errors, inappropriate vocabulary, and logical issues within three seconds, allowing for immediate revisions to enhance the quality of student outputs. This method reinforces the core characteristic of POA—learning through production—and enhances instructional precision and immediacy, thus enabling personalized, effective teaching in large classroom settings ^[3].

3. Core principles for AI-POA teaching design construction

AI excels in automating procedures, improving efficiency, ensuring accuracy and reliability, and emphasizing flexibility and adaptability, which empowers the Production-Oriented Approach in three key areas—data-driven analysis, intelligent interaction, and adaptability. For example, AI can collect and analyze data regarding

students' vocabulary deficits, types of grammar mistakes, and logical structures in output texts for precise diagnostics. Teachers can optimize teaching strategies based on this data-driven insight, addressing both individualized and precise instructional needs. Additionally, by leveraging technologies such as natural language processing (NLP) and virtual reality (VR), AI can create immersive scenarios—such as international conference speeches or cross-cultural negotiations—and provide real-time feedback on students' language outputs. This environment allows students to learn language skills in a more authentic, practical context, enhancing their language application abilities. Furthermore, AI's adaptive systems can offer customized resources aligned with students' learning pace and capabilities, adhering to the principles of differentiated instruction and stratified teaching. Accordingly, the teaching design principles of university English instruction from the perspective of AI-enhanced POA should include: goal orientation, human-machine collaboration, data loops, authentic contextualization, and dynamic evaluation.

Specifically, the goal orientation principle emphasizes that AI-POA teaching design should be guided by clear language production and communication objectives and dynamically adjusted based on AI analysis of societal talent demand in language proficiency, accommodating various teaching contexts. Under this principle, the core technological pathway for AI-assisted POA is to deepen the alignment between instruction and industry needs. For instance, AI can analyze extensive data from employment trends and industry reports to identify competencies required in the cross-border e-commerce sector, such as effective business communication and product description skills. Teachers can use this information to set production task goals like “write a product introduction compliant with international standards” or “conduct effective cross-border business negotiations”, ensuring that students engage with appropriately challenging tasks to enhance efficiency and learning quality.

The human-machine collaboration principle emphasizes that, within AI-POA teaching design, teachers should assume a leading role in the overall planning and management of key instructional processes, while AI handles repetitive tasks such as grammar correction and speech evaluation. For instance, in the design of an English public speaking unit, teachers are responsible for crafting the speech themes and refining evaluation criteria, while AI assesses students' speech content and extracts key terms. Teachers then focus on evaluating the logical structure, emotional expression, and cultural implications of students' presentations, guiding subsequent learning activities and evaluations ^[4].

Table 2. Complementary and synergistic roles of AI and teachers in instructional tasks

Task type	AI functions	Teacher functions
Routine Skills Training	Grammar correction, pronunciation assessment	Designing evaluation standards
Higher-order Cognitive Development	Providing logical discrepancy reports	Facilitating critical discussions
Emotional and Cultural Understanding	Detecting emotional tendencies in expressions	Interpreting cultural metaphors deeply

The data loop principle emphasizes that the entire process of AI-POA instruction should involve continuous data collection and subsequent iteration and optimization based on AI-generated learning profiles. This process incorporates input data, process data, output data, and feedback data, collectively forming a complete feedback loop. Input data primarily concerns learner engagement, such as the duration of access to specific learning resources and navigation paths. Extended engagement with particular materials often indicates heightened interest in those topics, while navigation paths reveal learners' resource-seeking behaviors. Process data focuses on language discussion terms that see higher usage volumes in collaborative platforms. If students

frequently reference terms like “negotiation” and “collaboration” during discussions, this suggests a strong interest in those business negotiation concepts. Output data covers the frequency of cohesive devices and the distribution of pauses in speech, assessing whether written outputs are coherent and logical, as well as the fluency of spoken expression and the continuity of thought. Teachers can then identify weaknesses in students’ writing and speaking skills for targeted guidance. Feedback data primarily reflects students’ acceptance rates of AI-generated recommendations. High acceptance rates demonstrate that students are actively leveraging AI suggestions to enhance their language skills and indicate the applicability and relevance of AI feedback ^[6].

For instance, AI should collect data on the duration of student engagement with learning resources during the input phase, monitor writing content, oral production, and translation results during the output phase, and assess student acceptance rates of AI feedback and teacher evaluations for continual improvement. By analyzing and integrating this data, AI constructs unique learning profiles for each student, clearly outlining strengths, weaknesses, and learning habits to support teachers in optimizing instructional decisions.

The authentic contextualization principle advocates for teachers to utilize AI to generate multimedia production-oriented scenarios, enabling students to practice in genuine language environments. This principle allows for the expansion of multimodal technology options, including VR with digital twin technology, emotional AI, and environmental noise incorporation. For instance, VR combined with digital twin technology can simulate real-world occupational settings. Emotional AI can facilitate simulated medical consultations, where systems assess patient pain levels based on nuanced facial expression analysis, allowing student-doctors to adjust their inquiries based on real-time feedback. Additionally, environmental noise incorporation can provide innovative training for language communication skills by presenting students with scenarios where they must communicate amidst distractions from background chatter, enhancing their focus on dialogue partners ^[6].

The dynamic evaluation principle stresses the establishment of a multidimensional AI evaluation framework that assesses students’ language production based on accuracy, effectiveness, and depth of discussion. Evaluation criteria include students’ vocabulary usage, grammatical structures, and overall coherence of discourse, along with their ability to convey intent accurately, understand others’ messages, and provide appropriate responses. Teachers can visualize this data through capability maps, offering tailored feedback and guidance ^[7].

Table 3. Application scenarios and data interfaces for multi-dimensional evaluation data visualization tools

Tool	Applicable scenarios	Data input
Python Matplotlib	Highly customizable contexts	JSON-formatted dimensional scores (e.g., {"innovation":65})
Tableau	Rapid visualization	Excel files (student names + dimensional score columns)
Built-in Teaching Management System	Standardized evaluation	Directly linked to the AI analysis module API

Through this analysis, it is evident that the goal orientation principle serves as the navigational compass of the entire system, establishing the direction and value benchmarks for teaching activities while ensuring that other principles effectively and efficiently service the achievement of educational objectives. Specifically, this principle delineates responsibilities in human-machine collaboration, provides analytical grounds for data loops, defines types of authentic contexts, and establishes the baseline for dynamic evaluation. The human-machine collaboration principle constitutes the core methodology for achieving goal orientation, facilitating the unity

of instructional efficiency and humanistic value. It also drives the creation of authentic contexts, establishes data loops, and executes dynamic evaluations. The authentic contextualization and data loop principles encapsulate the direct embodiment of AI-enabled teaching, serving as the dual wings to enhance the efficacy of POA: they ignite students' interest in language production through external empowerment while transitioning instruction from an empirical basis to a data-driven scientific decision-making process. Moreover, the authentic contextualization and data loop principles are closely interlinked; the context informs the data loop, while the findings from data analysis can improve contextual experiences. Finally, the dynamic evaluation principle operates as a continuous diagnostic tool, directly supporting the goal orientation principle while heavily relying on human-machine collaboration and data analysis. The content evaluated stems from students' performance in real contexts, with results generating tailored contexts for future interactions ^[8].

4. Implementation strategies for the AI-POA teaching model

4.1. Intelligent pre-class initiatives

Following the establishment of AI-POA teaching design principles, teachers must implement intelligent segments throughout the pre-class, in-class, and post-class processes, integrating a robust teaching management support system to ensure the efficient achievement of instructional goals. In the pre-class stage, teachers should first utilize AI to identify student needs accurately, generating personalized production tasks based on learning data and supplying relevant input materials as foundational resources. For example, teachers can deploy a self-developed intelligent diagnostic system for English learning needs to deliver smart questionnaires to incoming students. These questionnaires may explore various dimensions, including motivational tendencies, academic requirements, current vocabulary levels in reading and listening, and challenges in speaking and writing. AI, leveraging natural language processing techniques, can analyze questionnaire responses and analyze students' professional backgrounds to create individualized learning profiles.

If a student indicates in the questionnaire an interest in reading English-language medical journals, AI can categorize them under academic English in the medical domain and generate a personalized task, such as "write an English abstract for a medical case." Conversely, if a student states a goal of communicating at an international trade fair, the corresponding output task could involve "simulating product recommendations in English for the fair." The input materials provided to students should closely align with these tasks, encompassing various journals, conference presentation videos, negotiation case templates, product manuals, and dialogs typical of cross-cultural communication. Teachers should intervene promptly based on mutual feedback from AI and students, offering more personalized guidance to help students efficiently prepare for pre-class tasks. For example, if AI shares articles from high-impact journals relevant to students focusing on academic writing, teachers could highlight sections within those articles that align with student vocabulary and grammatical difficulty levels ^[9].

Simultaneously, teachers can direct AI to clarify the communication and language objectives embedded within instructional materials. During this process, AI can extract contextual elements from the materials, analyze the core intent behind the proposed tasks, and suggest learning objectives accordingly. For instance, simulating dialogues with various customer negotiation styles can allow students to rehearse communication strategies. In terms of language objectives, AI's vocabulary and grammar training modules can play a significant role. After analyzing the materials, AI will identify critical terms, phrases, and specific grammatical structures,

subsequently proposing interactive tasks to reinforce vocabulary retention, identify grammatical errors in target sentences, and encourage students to frame similar scenarios using newly acquired vocabulary and structures. Teachers can task AI with tracking student self-study data in pre-class assignments to assess the attainment of learning objectives and to derive insights for optimizing instructional strategies.

4.2. Intelligent facilitation in class

The in-class segment represents a crucial transition phase where language production skills shift from input to internalization. This stage requires real-time support from AI tools alongside timely teacher interventions at critical moments to achieve synergy between technological empowerment and teacher guidance. In terms of tool support, teachers should select relevant platforms based on the needs of different language skills. For instance, during writing instruction, teachers may utilize a collaborative framework comprising Grammarly and ChatGPT, while during speaking instruction, they can leverage AI tools such as iFlytek's Spark virtual dialogue platform, integrating real-time emotional analysis to create scenarios closely aligned with output tasks.

Teacher interventions should center on addressing deeper issues that AI cannot manage autonomously, providing students with timely assistance. As an illustration, when students engage in group discussions surrounding consumer rights disputes over imported toy products purchased via cross-border e-commerce, the background setting involves quality issues leading to refund requests. Upon encountering a stalemate in their discussions, AI tools can monitor speech frequency and discern a notable decline in recurring terms like “refund.” Moreover, AI's emotional analysis capabilities may detect rising frustration in certain group members' tones. Based on these insights, AI can suggest remedial phrases, such as “I propose a partial refund of 30% to resolve this”, redirecting the group's dialogue. In parallel, teachers, observing the breakdown in discussion, can retrieve visual data pertaining to group interactions. Should visualizations reveal that students are spending excessive time on liability assessment, the teacher can approach the group to analyze why discussions have stalled and recommend a shift toward discussing possible solutions, helping students reorganize their thought processes.

4.3. Intelligent evaluation after class

If in-class evaluations prioritize real-time corrections of language production—including immediate identification of grammatical errors by AI and prompt guidance from teachers for logical discrepancies—post-class evaluation shifts the focus toward systematic review of students' learning outcomes and long-term tracking. At this stage, AI's role can be realized through three tiers, ensuring evaluation depth and breadth. The first tier involves jointly creating evaluative standards between teachers and students. Teachers can utilize AI's data analysis capabilities to compile common issues in students' language outputs. Coupled with specific grammar mistakes, cultural misunderstandings, curriculum goals, and industry language demands, a preliminary list of evaluation criteria can be established. These criteria may encompass linguistic accuracy, content relevance, and cultural appropriateness. Subsequently, teachers can facilitate discussions and votes among students to revise these preliminary criteria collaboratively, with AI capturing real-time feedback for dynamic adjustment of evaluation metrics.

The second tier focuses on clarifying collaborative approaches with AI, leveraging its objective strengths while harnessing teachers' subjective insights to form a comprehensive evaluative feedback loop. Specifically, AI can employ natural language processing to analyze students' writing, oral recordings, and translation assignments quantitatively. Teachers would then assess facets beyond AI's recognition capabilities, evaluating

aspects such as the coherence of arguments, originality of insights, sensitivity to cultural taboos, and self-awareness regarding personal shortcomings addressed in post-class summaries. The third tier involves constructing and managing digital portfolios for students, facilitating long-term tracking of learning states, and providing personalized feedback. Utilizing a teaching management system, teachers can enable automatic integration of periodic evaluation data, longitudinal progression information, and resource correlation data into the digital portfolios. All records are updated in real-time, allowing teachers to periodically analyze strengths and weaknesses for instructional adaptation. Simultaneously, students can independently view their digital portfolios to clarify areas for improvement.

For instance, after engaging with internet-based oral proficiency assessment systems, students may accomplish tasks like “simulate customs clearance questions at an airport.” The system will evaluate their performance across elements such as pronunciation clarity, language fluency, and completeness of content, generating a breakdown of errors. Students can utilize learning dashboards to gain visual insights into their knowledge retention, strengths, and weaknesses, enabling targeted retrieval of suitable resources from the learning repository. Additionally, teachers can review visualized reports from AI assistants, using data analysis to refine instructional priorities while accumulating empirical support for subsequent course iterations ^[10].

4.4. Privacy protection and algorithmic fairness

As outlined in previous sections, the fundamental logic of AI-enabled POA revolves around algorithmic processing of various data types. Therefore, compliance with data acquisition and fairness in algorithms directly influences the effectiveness of this empowerment. Thus, university English teachers must consider three considerations: First, implement the “minimum necessary principle” to collect data that directly relates to instructional objectives, such as writing outputs, oral recordings, and browsing records of the learning resource library, while avoiding irrelevant accesses like social chat records. Second, apply homomorphic encryption algorithms to facilitate data utility without visibility, allowing for specific computational operations on encrypted data without prior decryption. As for data storage, teachers should utilize blockchain systems to maintain real-time logs of data access, ensuring that any data transactions remain traceable. Additionally, AES-256 encryption standards should be employed for securely storing and transmitting data. After a year following course completion, systems should automatically anonymize data to mitigate risks associated with prolonged data retention.

Secondly, teachers should adopt causal inference algorithms to identify potential systemic biases in AI assessments across various demographics, including gender, major, and language proficiency. Establishing “algorithm-human” dual-validation processes is also crucial. Initial evaluation models generated by AI based on historical data should subsequently undergo random audits by cross-disciplinary teams of educators to mark contentious evaluations and subsequently refine algorithm parameters from feedback. Last, it is essential for educators to avoid falling into the trap of technology replacing human input, constructing a collaborative ecosystem that emphasizes “AI-precision support + teacher-guided pedagogical leadership.” Frequent reliance on AI should be mitigated to safeguard independent critical thinking among students. For example, educators should regularly participate in digital literacy enhancement training to grasp AI technology principles, thereby clarifying the division of labor between human expertise and AI resources.

5. Conclusion

In summary, this study asserts that the Production-Oriented Approach is an effective strategy to overcome the limitations of traditional university English teaching models and enhance instructional quality. The integration of artificial intelligence further refines this approach, lending precision and efficacy. Consequently, instructors can construct teaching principles founded on the core tenets of POA and the robust advantages of AI. These principles should encompass goal orientation, human-machine collaboration, data loops, authentic contexts, and dynamic evaluation, addressing issues such as personalization deficits, delayed feedback, and a lack of diverse learning scenarios in traditional university English instruction. In practical teaching contexts, educators must adhere to these principles, leveraging AI tools like Questionnaire Star and iFLYTEK speech evaluation for generating learner profiles and providing real-time pronunciation feedback, thus contributing to the development of a new English instructional ecosystem suited to the demands of the intelligent era.

Nevertheless, current research presents two limitations: firstly, AI technology's capacity for emotion synthesis and cultural interpretation remains inadequate, especially concerning the accurate simulation of complex human emotional responses within virtual environments and the effective recognition of nuanced value differences and non-verbal signals in cross-cultural communication. Secondly, there is a need for enhancement in teachers' digital literacy. Many veteran educators still operate at a basic level in utilizing AI tools, preventing them from fully harnessing technology for reconstructing teaching ecosystems. Future research could address these limitations in two ways: by exploring ongoing advancements in generative AI and affective computing technologies to uncover more intelligent tool forms, and by fostering specialized training initiatives aimed at enhancing educators' skills in AI data analytics and algorithmic optimization, ultimately deepening the integration of human-machine collaboration from operational to practical pedagogical levels.

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Research on the Construction and Innovation of the Four-Dimensional Teaching Model for the Course “Organizational Behavior” in Sports Universities

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Abstract: Based on the ADDIE model, this paper systematically analyzes the pain points in the teaching of the course “Organizational Behavior” in sports universities, and actively constructs a four-dimensional teaching model. Starting from the four dimensions of teaching objectives, teaching methods, teaching content, and teaching resources, it summarizes and proposes practical teaching strategies, aiming to provide new ideas for the teaching reform of “Organizational Behavior” in sports universities and comprehensively improve the course teaching quality and talent cultivation level.

Keywords: Sports universities; “Organizational Behavior” course; Teaching model; Construction and innovation

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1. Introduction

“Organizational Behavior” aims to explore the behavioral laws of interaction between individuals and organizations from three dimensions: individual behavior, group behavior, and organizational behavior, which is conducive to comprehensively improving managers’ ability to predict, guide, and control human behavior. Traditional course teaching methods are mainly the lecture method, the discussion method, and the intuitive demonstration method. In the entire teaching process, teachers always occupy a dominant position, while students passively accept knowledge. Such traditional teaching models not only make it difficult to fully arouse students’ initiative and enthusiasm for learning, but also may have an adverse impact on the collaborative development of teaching and learning. Therefore, as an interdisciplinary course, the teaching of “Organizational Behavior” should focus on the close integration of theory and practice, and in particular, use a variety of innovative teaching methods to guide students to personally participate in the process of knowledge

formation, fully activate classroom vitality, and comprehensively improve the teaching quality of “Organizational Behavior”^[1].

2. Basic characteristics of the teaching of organizational behavior in sports colleges and universities

2.1. Highlighting the direction of ideological and value guidance

Fostering virtue through education is an important direction for the reform and development of sports colleges and universities, which requires that the teaching of Organizational Behavior should also implement the fundamental task of fostering virtue through education. Only in this way can more outstanding talents with both ability and integrity be cultivated. Organizational Behavior covers a wide range of research areas. In addition to an in-depth exploration of the overall operation mode, development strategy, and behavioral laws of enterprise organizations, it also focuses on the study of employees’ behavioral performance, language expression, ideological dynamics, and their standardized guidance within enterprises. The course involves a variety of knowledge systems, such as the complete process of team management, incentive theories and their application in practice, and the relationship between individuals and organizations^[2]. For this reason, in addition to imparting professional knowledge and skills to students, the teaching of Organizational Behavior should also focus on guiding students to establish correct outlooks on life, values, and the world, thereby helping them grow into high-quality and enterprising professional talents in organizational management.

2.2. Strengthening practical application teaching links

The course Organizational Behavior has obvious practical characteristics. Therefore, teachers should attach great importance to the close combination of theoretical knowledge and actual work scenarios in the actual teaching process, and flexibly use diversified teaching methods to guide students to apply theories to practice in a timely manner, such as case analysis, team cooperation, and scenario simulation, so as to comprehensively improve students’ practical and problem-solving ability. Taking scenario simulation as an example, when teaching the content related to “organizational crisis management and external communication”, teachers can create a vivid and realistic teaching scenario: “Suppose you are a business person of a company, and the company asks you to drive a truck full of expired bread to dump it in a remote suburb. However, on the way, you meet a group of hungry refugees and a group of journalists who heard the news. If you want to help the refugees, what will you do?” In class, teachers can let students simulate the scenario in groups and provide solutions, so that students can personally experience the complexity of crisis management, improve their ability to apply knowledge, and help them accumulate rich practical experience^[3].

3. Pain points in the teaching of organizational behavior in sports colleges and universities

3.1. Teaching objectives: Vague positioning (Analysis)

As an important carrier for cultivating high-quality talents, university courses bear the responsibility of shaping students’ correct values and enhancing their sense of social responsibility. Against the backdrop of the in-depth advancement of the “curriculum-based ideological and political education” concept, more and more courses in universities are gradually exploring the flexible and effective integration of ideological and political elements

into various links of teaching. However, for the course Organizational Behavior, the effect of its curriculum-based ideological and political construction is not ideal, with problems such as “valuing skills over quality.” Throughout the learning process, students find it difficult to deeply understand the close connection between organizational behavior and social responsibility. To solidly advance the curriculum-based ideological and political construction of Organizational Behavior, teachers should deeply explore the ideological and political elements hidden in the course and skillfully integrate them into various links such as the formulation of teaching objectives, the design of teaching content, and the optimization of teaching evaluation, thereby truly realizing the synchronous resonance and coordinated development of knowledge imparting and value guidance ^[4-5].

3.2. Teaching methods: Traditional and single (Design)

The current teaching methods of Organizational Behavior are traditional and single, mainly featuring “teachers actively lecturing + students passively learning.” Under the traditional teaching mode, students cannot obtain sufficient practical opportunities, which is not conducive to mobilizing and exerting their subjective initiative in learning. In the new era, modern teaching methods based on constructivist learning theory are emerging in an endless stream, such as case analysis, group discussion, and project-driven learning. However, traditional teaching methods are not only unfavorable for fully stimulating students’ learning interest but also have obvious deficiencies in cultivating critical thinking ^[6]. In addition, the traditional teaching evaluation system focuses on examining students’ mastery of knowledge, rather than evaluating the development of their problem-solving ability, innovative thinking ability, and hands-on operation ability. To a certain extent, this may also restrict the improvement of students’ comprehensive abilities.

3.3. Teaching content: Disconnection between theory and practice (Development)

In most cases, teachers devote more energy and time to instilling theoretical knowledge, but fail to guide students to apply theories to practice in a timely manner. More importantly, they neglect students’ personalized development. In the long run, it will be difficult to cultivate applied talents who can effectively cope with complex organizational environments. Take a simple example: students of different majors learn different knowledge of organizational behavior and will face vastly different application scenarios in the future. If the same teaching content is blindly instilled into students without attaching importance to personalized design, it may not meet the needs of their future career development and may also be detrimental to their subsequent academic research ^[7]. This requires teachers to attach importance to the seamless connection between theory and practice, and at the same time, design course content in a personalized way to meet students’ diverse and personalized career development needs in the future.

3.4. Teaching resources: Inadequate allocation (Implementation and Evaluation)

On the one hand, some teachers in universities have an incomplete grasp of cutting-edge theories in the field of organizational behavior and lack rich practical experience, which makes it difficult for them to give full play to their role in professionally guiding students. On the other hand, some universities have not built a rich case database and lack professional practical equipment to support students’ practice, which may restrict the improvement of students’ practical ability. Moreover, some universities do not attach importance to the construction of online learning platforms, which fail to provide students with rich learning resources and are not conducive to interactive communication between students or between teachers and students, thereby restricting

the cultivation and improvement of students' autonomous learning ability and teamwork ability.

4. Construction and implementation of the four-dimensional teaching model for organizational behavior in sports universities

4.1. Anchoring ideological and political education goals, deepening the integration of ideological and political elements (Analysis)

To advance the construction and implementation of ideological and political education in the Organizational Behavior course with high quality, the primary task of teachers is to comprehensively sort out the course content and deeply explore the ideological and political elements hidden behind the teaching materials. For example, the module "Individual Psychology and Behavior" can be refined into the ideological and political theme of "Patriotism and Values Cultivation"; "Organizational Culture" can be linked to "Critical Thinking, Innovation and the Spirit of the Times." On this basis, teachers can build a systematic and comprehensive ideological and political element system and a supporting resource database to provide solid material support and guarantee for ideological and political education in the course^[8-9]. In specific teaching practice, teachers can flexibly use the precious five minutes before class to encourage students to share short ideological and political stories, or guide students to freely express their thoughts and viewpoints through experience exchange meetings, so as to deepen their understanding and recognition of ideological and political concepts. In addition, teachers can establish close communication with ideological and political theory teachers, and jointly explore methods to integrate ideological and political elements into Organizational Behavior teaching through collective lesson preparation or case discussions, so as to achieve a multiplier effect in education. Furthermore, teachers can integrate corporate social responsibility cases and ideological and political stories about teamwork into the teaching content, and use case analysis, group discussion, project-driven methods to guide students to deeply reflect on the ideological and political connotations such as social responsibility and correct values while learning theoretical knowledge, ultimately giving full play to the educational function of the Organizational Behavior course^[10].

4.2. Applying the "3C-L" teaching model and building a diversified evaluation system (Design)

The "3C-L" teaching model specifically refers to Create Context, Collaborative Inquiry, Construct Knowledge, and Learning from Reflection. These four teaching links should be seamlessly connected to form a complete teaching closed loop^[11]. In addition to creating real scenarios based on actual corporate projects and organizational conflict simulations, teachers should also encourage students to divide labor and cooperate, conduct in-depth exploration of problems, and find solutions through group inquiry. Students, on the other hand, should give full play to their subjective initiative, actively participate in project practice, and timely reflect on their strengths and weaknesses to deepen their understanding and cognition of knowledge. Moreover, teachers should build a diversified evaluation system to comprehensively assess students' learning and practice effects by enriching evaluation indicators and innovating evaluation methods. For instance, teachers can track students' in-class and after-class learning and practice in real time from the perspectives of classroom performance, group projects, online learning, and reflection reports to ensure the comprehensiveness of evaluation^[12-13]. It is worth noting that teachers should effectively break through the limitation of single question types in final exams, and instead comprehensively evaluate students' ability to understand, master, and apply knowledge through well-designed diversified question types such as case analysis, scenario simulation, and project presentation, so as to

provide strong support for their all-round development.

4.3. Building a course content framework of “Individual—Group—Organization—Expansion” (Development)

First, by combining fundamental psychology to conduct in-depth analysis of the impact of individual behavioral motivations and personality traits on work performance, it helps students trace the psychological motivations behind individual behaviors; second, it adds more practical content such as team formation processes, collaboration mechanisms, and conflict resolution strategies to guide students to solidly grasp effective methods for improving team management quality; third, it effectively breaks through teaching difficulties, conducts systematic explanations and key analyses on critical content such as organizational structure design, cultural shaping, and change promotion, thereby enhancing students' ability to steer organizational development; fourth, it incorporates cutting-edge teaching content, such as cross-cultural organizational management and new organizational forms in the digital age, to ensure that the course content keeps pace with the times and continuously expands the breadth and depth of the classroom ^[14].

4.4. Empowering with information technology and optimizing the allocation of teaching resources (Implementation and Evaluation)

Relying on advanced information technology, build an online learning platform for Organizational Behavior to provide students with rich learning resources, such as e-textbooks, teaching videos, and simulation software, helping them plan personalized learning paths. Teachers can carry out a variety of activities through the online learning platform, such as Q&A interactions, group discussions, and knowledge competitions, creating favorable conditions for the seamless connection between offline and online teaching, and enhancing the interactivity and effectiveness of the classroom ^[15]. In addition, teachers can actively create an ideological and political case resource database for the Organizational Behavior course, and promote ideological and political education in modules to consolidate the online education position for ideological and political education in courses.

5. Conclusion

In summary, as a compulsory course for students majoring in business administration, psychology, and public affairs management in sports universities, Organizational Behavior is of great significance for talent cultivation. However, the overall teaching effect of Organizational Behavior in current sports universities is not satisfactory, with a series of problems such as vague teaching goals, traditional and single teaching methods, disconnection between theory and practice in teaching content, and insufficient allocation of teaching resources. These problems may restrict the improvement of course teaching quality and have an obvious negative impact on talent cultivation. To solve these problems, the author has constructed a four-dimensional teaching model and proposed feasible paths from four dimensions: teaching goals, teaching methods, teaching content, and teaching resources, in order to achieve satisfactory teaching effects.

Disclosure statement

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Application of Large Language Models-Based Pedagogical Agents in Classroom Teaching

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Abstract: With The innovative potential of Large Language Models (LLMs) in classroom instruction is becoming increasingly prominent, offering a transformative path for the field of education. The paper focuses on the application of LLM-based pedagogical agents in classroom teaching, aiming to address the limitations of traditional classrooms in providing personalized support and proactive services through their capabilities in multi-modal understanding, natural language generation, and task planning. Centered around an LLM, the pedagogical agents construct a digital brain equipped with reasoning, planning, and interactive abilities, serving multiple roles throughout the entire teaching process—including as a teacher’s assistant, a learning companion, and a personal tutor. The paper elaborates on its specific applications: generating intelligent resources and supporting instructional design during lesson preparation, acting as an interactive medium to facilitate teacher-student communication and personalized guidance during class, and serving as a one-on-one tutoring tool for reinforcement and generative assessment after class. Research shows that the pedagogical agent can effectively enhance teaching efficiency, increase student engagement, and promote the practical implementation of the modern educational philosophy of student-centered learning.

Keywords: Pedagogical agents; Classroom teaching; Large language models

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1. Introduction

Rapid advances in artificial intelligence technology are creating new opportunities for educational reform. As the flagship of AI, large language models (LLMs) are reshaping education in revolutionary ways, leveraging their ability to understand multimodal information and generate content to deliver personalized instruction and interactive Q&A. Yet, when deployed in real classrooms, they still suffer from weak autonomous planning and a lack of proactive service, which undermines their effectiveness and limits their support for self-directed learning. At present, LLMs are evolving from mere question-answering engines into intelligent learning companions. Through natural-language understanding and logical reasoning, they are being re-engineered for

classroom use. Emerging from this shift are LLM-based pedagogical agents—intelligent tutoring systems that combine an LLM with a curated knowledge base to act simultaneously as teacher, peer, and teaching assistant, fulfilling the full range of instructional and nurturing functions. Pedagogical agents, also termed intelligent tutoring systems, are virtual characters that guide learners within a learning environment ^[1]. An LLM-based pedagogical agent is a subset of these systems, distinguished by its capacity to engage learners in deep, open-ended dialogue with a virtual character ^[2]. By overcoming the constraints of traditional classrooms, such agents boost deep learner engagement and open up entirely new pathways for instruction.

2. Building LLM-based pedagogical agents

2.1. Architecture of large-model agents

In contrast to traditional agent technologies, intelligent agents powered by large language models possess the capability to independently reason and utilize tools to progressively achieve assigned objectives. Such agents leverage their inherent strengths in deep comprehension and content generation to perform complex tasks. Without relying extensively on domain-specific data, they can engage in multi-step iterative processes for planning and executing actions, allowing them to quickly adapt to and excel in novel scenarios to fulfill intended operational goals ^[3].

Guided by user-defined targets, the agent assumes a specific role, autonomously perceives and observes its environment, and utilizes the acquired state information to retrieve historical memory and relevant knowledge. Through reasoning and planning, it breaks down tasks, formulates action strategies, and applies these strategies back to the environment to achieve its goals ^[4]. Throughout this process, the agent demonstrates continuous learning, evolving in a manner analogous to human growth. Constructing an agent based on a large language model allows full utilization of the model's native capabilities to drive its various functional components.

2.2. LLM-driven pedagogical agents

The large language model is both the technical bedrock and the prime mover of pedagogical agents. Powered by its formidable natural-language processing and contextual understanding, the agent delivers near-human interaction, acting as a teaching assistant for instructors and a personal peer for every learner. With the LLM as its brain, the agent not only sustains high-quality dialogue but also decomposes complex learning tasks into actionable sub-steps, guiding students to master knowledge progressively ^[5]. Compared with legacy intelligent systems, LLM-based pedagogical agents exhibit two decisive advantages.

First, multi-modal perception: they fuse text, images, speech, and other signals to obtain a holistic view of the learning situation and the user's state, thereby furnishing truly personalized guidance. Second, advanced reasoning and planning: through chain-of-thought prompting and related techniques, they emulate human cognition, autonomously mapping instructional paths, designing solution strategies, and steering learners toward objectives step by step. These capabilities allow the agent to adapt to diverse pedagogical scenarios, provide dynamic, responsive support, and embody the modern ideal of “student-centred” education ^[6].

3. Pedagogical agents in classroom practice

3.1. Pre-class: The teacher's lesson-planning assistant

In the pre-class stage, the pedagogical agent powered by LLMs evolves into an intelligent lesson-design

hub. Its role is not limited to saving teachers' time but also to systematically enhancing the intellectual depth, creativity, and curricular alignment of lesson planning ^[7]. The process begins with a Learning Analytics Radar. By integrating historical data from the school's learning management system (LMS), homework platforms, and classroom response systems, the pedagogical agent applies clustering and sequence modeling algorithms to generate knowledge heatmaps at the class level and cognitive trajectories at the individual level ^[8]. These analytics allow teachers to identify common misconceptions, pinpoint focal areas of student interest, and diagnose differentiated learning needs with precision. Next, the agent initiates the Scenario Generation Module. A teacher may provide a natural-language instructional vision—for example, encourage students to think like economists when reasoning about opportunity cost. Within minutes, the pedagogical agent delivers several fully developed instructional frameworks. Each framework incorporates an introductory narrative, a conflict-based situation, cognitive scaffolds, and emotional anchors, all mapped to disciplinary core competencies to ensure engagement and curricular validity.

From a resource perspective, the agent's multimodal retrieval-generation engine operates on two fronts. On one hand, it conducts semantic searches across open educational resource repositories such as OER Commons, Khan Academy, and the China National Smart Education Platform to retrieve highly relevant videos, simulations, and AR assets. On the other hand, it leverages generative diffusion models to visualise abstract concepts in real time—for instance, rendering mitosis as a rotatable 3D chromatid animation, or transforming trigonometric functions into an interactive unit-circle application ^[9]. All resources are formatted to SCORM standards and can be embedded into PowerPoint slides or Moodle course packages with a single click.

The pedagogical agent also upgrades traditional test item preparation into a Multidimensional Assessment Workshop. It analyzes existing item banks using knowledge-graph algorithms to identify assessed competencies, Bloom's taxonomy levels, and stylistic features. Based on this analysis, it generates item sets across six cognitive levels—Remember, Understand, Apply, Analyze, Evaluate, and Create. For example, if a teacher requests a cross-cultural STEM project for collaboration between students in two countries, the pedagogical agent employs cross-lingual models to produce a bilingual, project-based task complete with rubrics and exemplar answers aligned with advanced reasoning models such as GPT-4. Finally, a Reflective Risk-Audit Module evaluates the cognitive load of the entire lesson plan. It identifies sections that may exceed working-memory capacity and suggests refinements grounded in cognitive load theory ^[10]. For instance, it may recommend replacing a verbal explanation in Step 3 with a visual flowchart, thereby reducing cognitive load. In this way, lesson preparation shifts from an individual, search-based process to a co-creative human-AI endeavour, enabling teachers to reinvest the saved time into providing emotional support and conducting pedagogical research.

3.2. In-class: An interactive medium for teachers and students

During classroom instruction, the pedagogical agent functions as a multimodal partner, reshaping instructional rhythm and social interaction through real-time sensing and generation. Technologically, the agent operates within an edge cloud collaborative framework, integrating IoT-enabled devices such as 4K cameras, microphone arrays, interactive whiteboards, and student tablets ^[11]. Cameras capture micro-expressions and gestures, while microphone arrays localise speech and suppress background noise. These data streams feed into a continuously updated engagement-attention dashboard, refreshed every 30 seconds. Teachers receive discreet feedback through wearable haptic devices.

Instructional interactions are structured into three tiers of support. The first one is real-time Q&A. When students pose verbal questions, the agent provides structured answer capsules, comprising a concise explanation, analogy, real-life application, and a one-minute extension video. If multiple learners raise similar questions, the agent shifts into a collective micro-instruction mode, projecting a synchronized animation to the main display. The second one is dynamic scenario injection, where teachers can discreetly trigger scenario generation. The agent then creates open-ended problems or ethical dilemmas relevant to the current lesson content. For example, while teaching buoyancy, it may challenge students to design an offshore floating farm based on buoyancy principles, thereby transforming the classroom into a design-thinking studio. The third one is differentiated group facilitation, in collaborative activities, the agent assigns roles such as encourager, sceptic, or summarizer to different groups and participates in discussions by offering prompts, counterexamples, and scaffolding through text or voice. Group interactions are logged and analyzed to generate a collaboration quality report, mapping contribution indices and group social-semantic networks.

Assessment is embedded through stealth analytics. By analyzing response times, keystroke dynamics, and gaze-tracking heatmaps, the agent estimates students' mastery probabilities in real time. When these probabilities fall below a set threshold, personalized remedial exercises are automatically deployed, establishing micro-cycles of error correction. Consequently, the classroom evolves from a one-to-many broadcast into a multi-nodal interactive network, enabling large-scale yet fine-grained personalization and enhancing both precision and inclusivity in teaching.

3.3. Post-class: The student's private tutor

After class, the pedagogical agent assumes the role of a personal tutor and growth coach, providing continuous and adaptive learning support. Its first capability is Error Reverse-Mapping. Students can upload images of their assignments, which the agent processes through OCR combined with symbolic reasoning. It identifies the underlying knowledge gaps and generates a closed-loop training package that includes a micro-lecture video, an interactive simulation, and three variant practice problems. If repeated errors occur, the agent lowers task difficulty and activates a Knowledge Backtracking Module to reinforce prerequisite concepts, thereby creating an adaptive staircase for mastery learning.

Second, the pedagogical agent advances generative feedback into a personalized growth narrative. Synthesizing data from assignments, classroom participation, and assessment records, it composes a learning story that includes affective acknowledgement, cognitive diagnosis, strategic recommendation, and metacognitive prompting^[12]. Each narrative is written in the second person and accompanied by an AI-generated digital badge to encourage motivation and self-recognition.

Third, the agent maintains a Metacognitive Dashboard that generates weekly "learning ECGs" for each student, visualizing trends in effort, strategies, and achievement. These dashboards promote adaptive self-regulation by attributing performance to controllable factors, while parents receive only anonymized "growth digests" to safeguard privacy. Finally, the Community Connector function matches students with complementary learning trajectories and recommends peer activities such as paired study sessions or online collaborative whiteboard challenges. In doing so, post-class support evolves from static answer provision into a three-dimensional ecosystem of data-driven insight, emotional companionship, and peer synergy, substantially extending the educational value chain.

4. Application challenges and countermeasure suggestions

4.1. Application challenges

Although large language model-based pedagogical agents demonstrate significant application potential in classroom teaching, their practical promotion faces multifaceted challenges that require systematic responses at technological, ethical, and educational practice levels.

At the technological level, pedagogical agents still exhibit notable limitations. A primary issue is their tendency to produce hallucinations, generating plausible yet incorrect or fabricated knowledge, which poses a direct risk to instructional accuracy^[13]. Moreover, the outputs of these models are somewhat uncontrollable and may not always align with teaching objectives and value requirements. Additionally, current large language models remain limited in supporting complex logical reasoning and training creative thinking, focusing more on pattern matching and information reorganization rather than fostering deeper cognitive abilities. Ethical and security risks also cannot be overlooked. When processing educational data, pedagogical agents may involve issues of student privacy leakage; the algorithms themselves might also contain biases inherent in the training data, thereby affecting educational fairness. Greater concern is that over-reliance on these agents by students could inhibit the development of independent thinking and critical engagement with knowledge, leading to intellectual inertia, which contradicts the educational goal of cultivating higher-order thinking skills. Furthermore, both teachers and students face challenges in adapting to new roles. Teachers need to transition from traditional knowledge transmitters to designers of learning processes, guides, and managers of AI-assisted teaching tools, requiring mastery of human-machine collaborative teaching strategies. Students, too, must develop new learning habits and enhance their ability to discern and critically evaluate machine-generated content.

4.2. Countermeasure suggestions

To address the above challenges, it is necessary to systematically design countermeasures across three dimensions: technology, application mechanisms, and personnel training. At the technological level, it is advisable to adopt a hybrid architecture of a large language model and an education-specific vertical model. By incorporating educational knowledge bases and teaching rule constraints, domain adaptability can be enhanced, and factual errors reduced. Simultaneously, multi-layer filtering and fact-checking mechanisms should be established to verify the reliability of generated content and impose educational safety and ethical constraints on outputs. At the application mechanism level, a teacher-machine-student tripartite collaborative teaching model must be clearly defined, emphasizing that the teacher always maintains a leading role, and the pedagogical agent should be used under teacher supervision. Clear application norms and ethical guidelines should be formulated, including boundaries for data usage, limits on the agent's involvement in teaching, and principles for accountability, to ensure the standardization and safety of the teaching process. At the training level, focused efforts should be made to strengthen teachers' professional development support. Through smart education literacy training, prompt engineering workshops, and case-based teaching, teachers' ability to appropriately design, deploy, and evaluate agent behaviors should be enhanced, enabling them to effectively harness the technology to better serve teaching objectives.

In conclusion, the healthy development and effective application of pedagogical agents require not only continuous technological improvements but also the establishment of a matching educational application framework and teacher development system. Through multi-faceted collaborative efforts, pedagogical agents

can ultimately be promoted as a beneficial force in building a high-quality, personalized education system.

5. Conclusion

This paper has systematically examined the value and practical pathways of LLM-based pedagogical agents in classroom instruction. Research shows that, by deeply integrating the reasoning, generative, and multimodal capacities of large language models, the agent can span the entire “pre-class – in-class – post-class” workflow, offering holistic support to teachers and students alike. Before class, it helps instructors prepare efficiently and generate exercises; during class, it fosters real-time interaction and personalized guidance; after class, it acts as a private tutor for precision consolidation and motivational assessment. The agent not only mitigates the chronic problem of insufficient resources for differentiated instruction but also significantly broadens and deepens human-machine collaboration in education. As large-model technology continues to evolve and application scenarios expand, pedagogical agents are expected to make further advances in emotion recognition, interdisciplinary integration, and adaptive learning, ultimately becoming a core force driving the modernization and transformation of education.

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Digital and Intelligent Transformation of Art and Design Teachers' Teaching Quality: Influencing Factors, AI Empowerment Strategies, and Evaluation System Reconstruction

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Abstract: To further improve the teaching quality of art and design and enhance the effectiveness and quality of talent cultivation, this paper conducts research from the perspective of teachers' digital and intelligent transformation. Firstly, the study explores the influencing factors from the perspectives of enabling factors, challenging factors, and institutional constraints. Secondly, it proposes effective countermeasures for AI empowering art and design teaching from the teacher dimension, school dimension, and governance dimension to assist the digital and intelligent transformation of teaching. Finally, it puts forward the reconstruction strategies of the evaluation system, including the transformation of the evaluation concept, the innovation of evaluation dimensions and tools, and the evaluation implementation mechanism, so as to promote the improvement of the teaching quality of art and design teachers and the digital and intelligent transformation of teaching.

Keywords: Art and design; Teaching quality; Digital and intelligent transformation

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1. Research background and significance

With the widespread popularization of digital technology, the digital transformation of education has become an irresistible trend. In April 2025, the Ministry of Education and nine other departments issued Opinions on Accelerating the Advancement of Educational Digitalization, which clearly proposes to deeply integrate digital technology into the teaching of various disciplines. As an important teaching content for cultivating innovative talents, art teaching should actively adapt to the direction of digital education reform at the education stage. Moreover, in the digital era, AI technology has also shown an explosive growth trend. Generative AI, virtual simulation technology, and other technologies have a subversive impact on promoting creative design, work

presentation, teaching interaction, and other links, which can not only promote the innovation of art and design education tools but also bring new ideas to art and design education. In addition, against the background of educational digital transformation and AI technology empowerment, improving the quality of art and design education has become a key demand in talent cultivation, and social development has an increasing demand for design talents with digital thinking and mastery of intelligent tools. However, in this field, some art and design teachers have problems such as lagging digital literacy, insufficient understanding of new technologies, and backward application ability of digital teaching tools, so they cannot deeply integrate digital technology into art and design teaching. This also hinders the innovation of art and design teaching to a certain extent, making it difficult to meet the social development's demand for compound design talents. Therefore, it is necessary to explore how to deeply combine digital technology to promote the reform and innovation of art and design teaching, so as to improve the level and effectiveness of education and cultivate a steady stream of innovative talents for the field of art and design.

2. Influencing factors of the digital-intelligent transformation of art and design teachers

2.1. Enabling factors

Enabling factors are positive elements that promote the digital-intelligent transformation of art and design teachers. Through the dual support of technology and resources, they can lower the threshold for teachers' transformation and improve the effectiveness of education and teaching. From the perspective of technological efficiency enhancement, digital-intelligent technologies can directly drive the reconstruction of art and design teaching, breaking the drawbacks of traditional teaching models. For example, in traditional teaching, teachers often need to spend a lot of time on hand-drawn demonstrations and revising design sketches one by one. However, AI-based design assistance tools can quickly generate creative graphics, allowing teachers to focus on guiding design thinking in teaching rather than "basic drawing" as in the traditional model. At the same time, 3D modeling software can be integrated with VR virtual classrooms, enabling students to more intuitively perceive the spatial design effect of works without relying on 2D drawings for explanation, thus improving classroom teaching efficiency. At the level of resource integration, digital-intelligent technologies can break down the barriers to resource integration in traditional teaching. For instance, online design platforms can deeply integrate excellent industry design cases, industry development trend reports, and enterprise real demand research reports. They can also link teachers from other institutions to carry out inter-school joint teaching and research, which enables more three-dimensional integration of teaching resources, thereby realizing educational empowerment and promoting teachers' digital-intelligent transformation.

2.2. Challenging factors

Challenging factors are important obstacles to the digital-intelligent transformation of art and design teachers, mainly reflected in aspects such as ability gaps, teaching imbalance, and changes in teachers' roles. In terms of ability gaps, there is a certain disparity between the traditional teaching skills of some teachers and the needs of digital-intelligent teaching. For example, some older teachers with weak learning abilities are more proficient in hand-drawing and traditional craftsmanship but are not skilled in operating AI design tools, digital copyright management, and virtual teaching systems. Although young teachers are good at using digital tools, they lack the ability to deeply integrate digital-intelligent technologies with art and design teaching, leading to a

significant phenomenon of ability gaps. In terms of teaching imbalance, although digital-intelligent technologies can break the original balance of teaching and learning, some teachers rely too much on digital teaching tools in teaching, simplifying the teaching process into technical operation demonstrations and ignoring inspiration stimulation, creative guidance, and humanistic literacy cultivation in art and design education. This results in an imbalance between teaching and learning, which is not conducive to improving the effectiveness of art and design education. From the perspective of changes in teachers' roles, the digital-intelligent teaching transformation requires teachers to shift from "knowledge imparters" in the traditional sense to "innovation guides." They can no longer simply conduct one-way knowledge infusion but need to become stimulators of students' creativity and gatekeepers of technical application. This transformation not only requires teachers to adjust their teaching mindset but also to master multiple teaching methods such as project-based learning, hierarchical guidance, and flipped classrooms, thus putting forward higher requirements for teachers' classroom decision-making ability and comprehensive capabilities.

2.3. Institutional constraints

Institutional constraints are invisible factors affecting the digital-intelligent transformation of art and design teachers, mainly stemming from the mismatch between the current educational management system and digital-intelligent needs, which is mainly reflected in two aspects. First, lagging evaluation. The current teacher evaluation system often cannot fully adapt to digital-intelligent teaching achievements. For example, the evaluation of art and design teachers still mainly takes paper publication, offline course quality, and traditional teaching achievements as core indicators, while the evaluation of digital teaching resource construction, virtual course development, and inter-school joint teaching and research achievements in the digital-intelligent teaching transformation is relatively insufficient. As a result, the evaluation system has weak incentives for teachers. Second, resource barriers. Teachers' digital-intelligent transformation faces the challenge of uneven distribution of teaching resources. For example, in terms of hardware resources, some institutions have insufficient investment in the purchase of VR equipment and professional design servers, leading to a lack of hardware facilities. At the same time, there are also certain barriers in data resource construction, resulting in insufficient integration of high-quality industry design case databases and enterprise project resources. This makes it difficult for teachers to obtain sufficient teaching resource support in teaching, thus facing the impact of insufficient resources in the digital-intelligent transformation.

3. Strategies for improving the teaching quality of art and design teachers empowered by AI

3.1. Teacher dimension: digital literacy and role reconstruction

In the stage of improving the teaching quality of art and design teachers empowered by AI, teachers are the implementers of teaching, who need to promote the improvement of their digital literacy and decision-making transformation. Firstly, to advance the iteration of teachers' capabilities, the focus should be on the dual dimensions of the application of AI teaching tools and the integration of creative design. Teachers should be guided to deeply learn the operating logic of AI design tools and explore the application scenarios of AI technology in creative design, thereby enhancing their teaching ability and enabling them to comprehensively use AI tools to boost art and design education ^[1]. Secondly, in terms of innovating teaching methods, it is necessary to actively construct an integrated educational model of "AI + Project-based Teaching." Then,

combined with the highly practical characteristics of art and design, project-based teaching scenarios should be designed to guide students to learn and use digital tools in the process of promoting projects. For example, students can be required to complete the whole process from project research to design output in groups. This process not only allows students to apply the theoretical knowledge they have learned to practice, but also enables teachers to achieve decision-making transformation while assisting students in promoting projects, thereby improving teaching quality.

3.2. School dimension: Ecosystem construction and resource integration

From the school dimension, to promote the improvement of the teaching quality of art and design teachers empowered by AI, it is necessary to actively promote ecosystem construction and resource integration. Therefore, an educational ecosystem should be built around AI to break resource barriers^[2]. Firstly, colleges and universities should strengthen school-enterprise cooperation and establish a two-way cooperation mechanism of “AI + Art and Design.” Colleges and universities should join hands with AI technology enterprises and design institutions to promote joint teaching, introducing real enterprise projects, AI teaching resources, etc. into teaching, so as to make project-based teaching more in line with industry realities and form a more complete talent cultivation model. For instance, schools and enterprises can jointly build practical bases to provide teachers with training opportunities for AI technology application^[3]. Secondly, to promote curriculum reconstruction, AI elements should be integrated to optimize the curriculum system. For example, courses such as “Fundamentals of AI Design” and “Digital Intelligent Design Thinking” can be added to existing teaching, effectively integrating AI technology into the whole process of art and design education. At the same time, consideration should be given to promoting interdisciplinary curriculum construction based on AI, forming diversified curriculum forms such as “AI + Interaction Design” and “AI + Visual Communication”, so as to expand curriculum resource content and cultivate students’ comprehensive design capabilities.

3.3. Governance dimension: Policy support and infrastructure construction

From the governance dimension, it is necessary to actively promote policy support and infrastructure construction to remove obstacles for AI-empowered art and design teaching. In practice, the top priority is to strengthen the construction of incentive mechanisms. For example, improve the teacher evaluation and reward system: in the process of teacher evaluation, include AI teaching resource construction, AI curriculum development, AI teaching achievements, etc., into the teacher assessment index system; at the same time, provide policy preferences in professional title evaluation, scientific research funding support, etc., for teachers with remarkable achievements. In addition, set up “AI Teaching Innovation Awards” at the regional level to encourage teachers to actively participate in the exploration of new AI teaching models and promote the improvement of art and design teaching quality^[4]. In terms of resource inclusiveness, efforts should be made to promote the sinking of AI teaching resources. For example, build an AI art and design teaching resource database through the establishment of a regional art and design education school alliance, and then open high-quality AI teaching courses, excellent design case materials, AI tool debugging guidance, etc., to local colleges and universities for free. This will enable the widespread popularization and promotion of AI tools and help enhance the quality of art and design teaching.

4. Reconstruction of the digital-intelligent teaching quality evaluation system

4.1. Transformation of evaluation concepts

The primary task in reconstructing the digital-intelligent teaching quality evaluation system is to shift from a “single-result orientation” to a “value-added creation orientation.” This process requires downplaying the weight of final exam scores and traditional homework grades, and instead focusing on the “value increment” of teaching. For example, emphasis should be placed on evaluating the actual transformation effect of students’ innovative works, such as industry awards obtained for design schemes and implemented cultural and creative projects. At the same time, attention should also be paid to the cultural communication effectiveness of the works, such as online display and communication volume, as well as the dissemination and recognition of cultural symbols. This serves to highlight the enabling effect of digital-intelligent transformation on students’ practical abilities and cultural expression skills ^[5–7]. Secondly, it is necessary to promote the construction of an ethical “one-vote veto” system, considering the integration of hard indicators such as data security and algorithm transparency into evaluation feedback. These indicators may include the compliant storage and use of students’ learning data, the logic and interpretability of AI-assisted scoring, and the copyright compliance of AI-generated design content. Incorporating these indicators enables a comprehensive judgment of teaching quality and reflects the effectiveness of teachers’ digital-intelligent transformation.

4.2. Innovation in evaluation dimensions and tools

Reconstructing the digital-intelligent teaching quality evaluation system requires efforts in terms of evaluation dimensions and tool innovation. In terms of evaluation dimensions, two major aspects—teaching process and teaching effectiveness—should be covered. For instance, teaching process evaluation should include teachers’ proficiency in using digital-intelligent tools and the scientificity of AI-assisted teaching design. The teaching effectiveness dimension should encompass multiple indicators such as the improvement of students’ digital literacy, cross-disciplinary collaboration capabilities, and the development of innovative thinking ^[8–10]. At the level of specific evaluation tools, AI evaluation systems should be used to achieve automated collection of various evaluation data indicators. For example, classroom interaction analysis systems can be used to statistically analyze the frequency of digital-intelligent interactions between teachers and students, and AI-based design work evaluation tools can be combined to assess the creativity and technical application level of students’ works. These assessments, presented in the form of quantitative scoring, reflect teaching effectiveness and realize innovation in teaching quality evaluation ^[11–13].

4.3. Evaluation implementation mechanisms

At the implementation level of the evaluation system, a dynamic and diversified evaluation process needs to be constructed to accurately reflect the improvement of teaching quality among art and design teachers ^[14]. First, dynamic tracking: in this link, big data can be comprehensively used to construct digital portraits of teachers’ digital-intelligent teaching, and classroom behavior data (such as the proportion of class time occupied by teachers’ digital-intelligent teaching and the improvement curves of students’ design abilities at different stages) can be integrated. Real-time tracking of various data reflects teaching quality, and dynamic adjustment strategies are adopted ^[15]. Secondly, constructing a multi-subject collaborative evaluation model: this link should adopt a three-level evaluation model of “AI preliminary screening → expert review → enterprise/student feedback.” First, AI conducts a quantitative preliminary evaluation of teaching data and students’ works; then,

expert teams conduct a comprehensive review from aspects such as teaching concepts and design creativity; finally, comprehensive feedback is obtained by combining enterprises' evaluations of students' practical abilities and students' satisfaction with digital-intelligent teaching. This forms a three-dimensional evaluation result that reflects the teaching quality.

5. Conclusion

The study finds that the digital-intelligent transformation of teaching quality for art and design teachers is of profound significance and value. It has improved teaching standards to a certain extent and played a significant role in enhancing students' comprehensive art and design capabilities. In this paper, the proposed comprehensive strategy framework of "teacher dimension + school dimension + governance dimension" is conducive to promoting the optimization of art and design teachers' comprehensive capabilities and improving their teaching quality. Moreover, the reconstruction of the teaching quality evaluation system can more comprehensively reflect the achievements of digital-intelligent transformation in art and design, providing a reference for subsequent teaching optimization. In the future, art and design teaching can further deepen the integrated application of "AI + art and design", actively promote the construction of personalized teaching models, and consider seeking research breakthroughs from the perspective of the adaptability of dynamic evaluation systems, thereby advancing the digital-intelligent transformation of art and design education.

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Research on the Strategies of College English Teaching Empowered by AI Language Models

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Abstract: As the digital wave sweeps across the globe, artificial intelligence (AI) is reshaping all walks of life at an unprecedented speed, and the field of education is no exception. Against the backdrop of the rapid development of generative AI language models such as ChatGPT, they have significant application value in the fields of language processing, intelligent interaction, and personalized services, which can inject new vitality into the implementation of educational work. As an important course in higher education, College English plays a crucial role in cultivating students' language communication skills and broadening their horizons. However, there are still a series of problems in current English teaching. In this context, it is necessary for teachers to leverage the technological advantages of AI language models to solve problems, construct a more intelligent teaching model, and further improve the quality and effectiveness of education. Based on this, this paper conducts an in-depth analysis and research on the strategies of College English teaching empowered by AI language models, for reference.

Keywords: AI language models; College English; Teaching model

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1. Introduction

In the era of big data and artificial intelligence, digital teaching has become an important development trend in foreign language teaching. As a discipline focused on language output, College English has long faced many problems, including students' weak ability in writing conception and monotonous language expression. With the emergence and application of large language models, the English discipline should focus on teaching reform and introduce new technological means to improve the quality and effectiveness of teaching, enabling students to learn and develop better.

2. The value of AI language models in empowering college English teaching

2.1. Making up for the shortcomings of traditional teaching

Restricted by teaching efficiency and the linear knowledge transfer mechanism, traditional teaching models struggle to address the issue of insufficient interactivity. AI language models can leverage natural language processing technology and deep learning patterns to build intelligent systems that adjust and correct problems in texts. This teaching model facilitates better teaching feedback and avoids delays in evaluation. By utilizing massive language databases, AI can establish more accurate analytical models to conduct precise assessments of students' learning. The application of this intelligent technology helps resolve the shortage of teaching resources, thereby improving the quality and effectiveness of education and constructing a more dynamic teaching system ^[1].

2.2. Meeting students' individualized needs

Generative AI language models utilize deep learning patterns to construct educational systems, thereby providing more technical pathways for teaching innovation. Restricted by a single knowledge-based teaching system, traditional standardized teaching struggles to evaluate students in aspects such as language cognition and rhetorical use ^[2]. AI systems can analyze and diagnose problems encountered by students during their learning process using natural language processing technology, and then generate corresponding improvement mechanisms. This intelligent teaching intervention method enables targeted instruction, which is conducive to students' personalized learning and development. This technology ensures the systematicness of language norms while providing support for the initiative of creative subjects, thereby helping to promote the innovative development of English teaching.

2.3. Aligning with the digital transformation of education

Integrating AI language models into college English teaching is conducive to the digital transformation of education. Against the backdrop of intelligent technology reshaping the educational ecosystem, the form of educational practice is undergoing transformation—by building a multi-modal resource integration platform, a human-computer interactive educational model is constructed. The specific manifestations are as follows: at the technical level, the mechanisms of natural language processing and educational theories are utilized; at the process level, the coordinated development of personalized learning trajectories and intelligent evolution is realized ^[3]; at the goal level, emphasis is placed on the reshaping of the subject's cognitive structure. In this process, teachers can adjust parameters to ensure the effectiveness of intelligent teaching. Students, on the other hand, can develop sound English language thinking through human-computer dialogue. This in-depth technological integration can provide more operable methods for the construction of educational systems, thereby reflecting the educational characteristics in the context of digital transformation.

3. Principles of empowering college English teaching with AI language models

3.1. Human-machine collaboration principle

The human-machine collaboration principle emphasizes that in the context of technology-empowered education, teachers' subjectivity and AI's instrumentality form a dialectical relationship. AI language models undertake language-level output, while teachers are responsible for cultivating students' thinking abilities and values. This requires teachers to effectively use AI language models as teaching aids in the teaching process:

through dynamic intervention in teaching, they should leverage AI language generation models to construct a training model for cross-cultural thinking abilities. This model helps maximize human-machine efficiency, build feedback mechanisms, and continuously optimize human-machine collaboration paths through teaching reflection, thereby ensuring the effective application of technical tools. This principle focuses more on building an intelligent educational ecology to avoid other problems and further improve the quality and effectiveness of English teaching ^[4].

3.2. Data-driven principle

The data-driven principle focuses on using dynamic data generated during the teaching process as the core basis to achieve precision and personalization in teaching decisions. AI language models can real-time collect students' learning data in multiple dimensions, such as vocabulary accumulation, grammar application, and listening, speaking, reading, and writing training. Through algorithmic analysis, they generate learner profiles, accurately identifying students' knowledge weaknesses, learning habit preferences, and capacity development bottlenecks. This requires teachers to adjust teaching strategies based on data insights: optimizing key points of in-class explanation for common problems, and pushing customized learning resources and practice tasks based on individual differences.

3.3. Dynamic adjustment principle

The dynamic adjustment principle emphasizes the construction of a dynamic teaching mechanism and the effective integration of AI tools with teaching work through technological evolution, the law of logical ability development, and the construction of teaching objective systems. This principle requires teachers to break through the linear transmission teaching paradigm, build early warning mechanisms to prevent cognitive deviation problems that may occur when using AI tools, and thus establish a dynamically adjusted teaching model ^[5]. This dynamic teaching mechanism helps ensure the effective application of AI technology, avoids ability solidification caused by over-reliance on technology, and further activates the creative potential of human-machine collaboration.

4. Potential risks and challenges of AI language models empowering college English teaching

4.1. Technology dependence and data security

The application of AI in teaching may lead students to become more dependent on technology, which is not conducive to the development of their ability to solve problems independently. If students rely solely on AI technology, they may gradually lose the ability to think independently and engage in innovative practice. In English learning, this could result in difficulties in conducting in-depth text analysis and over-reliance on AI-generated answers to questions, outcomes that are detrimental to students' learning and development. Once they become accustomed to using AI, they may struggle to adapt without technological support and fail to identify and correct their own mistakes. Furthermore, students tend to accept AI-generated content uncritically, which may cause them to acquire incorrect knowledge during the learning process. However, the value of AI technology cannot be completely denied. Teachers need to guide students to use AI correctly and design appropriate learning activities that require students to utilize AI to solve problems, thereby fostering their thinking skills in the process.

AI systems require large amounts of data for analysis, which may lead to the leakage of students' privacy and data. In the digital age, data has become a vital resource. On one hand, the leakage of students' personal information and other data may pose a series of risks. On the other hand, data security issues may also undermine students' trust in AI technology, thereby reducing their enthusiasm for using it.

4.2. Intelligent divide and unequal educational resources

Against the backdrop of the 21st century, the intelligent divide is shifting at the level of users' skills. With the rapid development of artificial intelligence technology, the digital divide is constantly widening. The application of AI technology requires infrastructure support, which may be difficult for institutions with weak educational resources to achieve full technical coverage. From a social perspective, digital technologies represented by generative artificial intelligence and their social resource allocation systems may lead to significant disparities in the access and utilization of digital resources among countries, regions, and individuals, forming a new form of inequality known as the "intelligent divide." This imbalance is reflected not only in hardware infrastructure but also in aspects such as teaching staff and educational philosophy. In schools with insufficient teaching resources, teachers may lack understanding of AI technology, making it difficult to integrate it into teaching. Therefore, during the application of AI technology, teachers should always pay attention to the issue of educational equity, narrow the gap in educational resources, thereby mitigating the impact of the intelligent divide and ensuring that all students have greater access to learning and development opportunities.

4.3. Balance between AI technology and teachers' roles

The application of AI language models in teaching requires teachers to continuously improve their ability to use AI technology. To this end, teachers should strengthen their own learning to adapt to the application of new technologies, identify suitable links in classroom teaching to introduce AI, and thereby maintain the effective conduct of teaching. They should avoid over-reliance on AI and ensure that AI serves as a supporting tool rather than a dominant one in teaching. English teachers should become designers of AI-integrated teaching, continuously enriching teaching content and resources to further improve teaching effectiveness.

5. Attributes of AI language models empowering college English teaching

5.1. Cultural attribute of AI-enabled reading teaching

In college English teaching, educators should not only focus on its instrumental attribute but also bring into play its cultural attribute, enabling students to develop sound humanistic literacy in the process of language learning. Therefore, in the implementation of AI-enabled reading instruction, the cultural attribute empowered by AI should be flexibly utilized. The main forms are as follows:

Firstly, presenting multimodal cultural content. AI visual generation technology is used to display vivid and diverse pictures, videos, and dynamic scenes, thereby integrating reading content with the development of the times, further enhancing students' learning enthusiasm and helping them form cultural identity. AI technology can transform abstract cultural knowledge concepts into multimodal content, thus constructing an immersive learning experience. At the same time, the cultural data resources generated by AI can cover literary works, social practices, and historical events from different regions, allowing students to learn and experience more cultural content and develop good learning qualities.

Secondly, expanding dynamic cultural backgrounds. In traditional reading instruction, the introduction of

cultural backgrounds is more limited to textbook resources, while AI-enabled teaching can expand the scope of cultural knowledge, thereby supplementing more cultural information and providing resource recommendations. The use of AI can provide richer cultural backgrounds according to students' reading needs, and in practical application, teachers need to explore the integration points of AI collaboration. On the one hand, teachers need to use AI technology to design more diverse reading activities; on the other hand, they should pay attention to the accuracy of AI-generated content to avoid other problems.

5.2. Instrumental attribute of AI-enabled writing teaching

AI technology possesses powerful data processing capabilities and a certain level of intelligent processing ability, which can also provide more support for the implementation of teaching. The construction of a personalized writing corpus helps students better engage in writing learning, thereby mastering key writing vocabulary and sentence patterns. Teachers can integrate the instrumental attribute of AI technology in teaching to carry out personalized instructional guidance:

Firstly, the collection and analysis of dynamic data. Teachers construct portraits of English learners and analyze students' writing data through AI to generate personalized writing teaching plans for them. Personalized English writing portraits can help AI accurately recommend corpus resources, including high-quality model essays, academic expression models, etc., allowing students to gain more inspiration from learning these materials.

Secondly, the construction of interactive corpora enables the development of personalized corpora. The introduction of teacher-student interaction is essential to enrich the corpus. Students tend to use certain materials relatively frequently in the writing process and show obvious preferences for specific materials. For this reason, AI can dynamically adjust the content of the corpus to ensure it aligns with the actual needs of learners. At the same time, such a dynamically adjusted corpus helps to arouse students' learning enthusiasm, further improve teachers' teaching capabilities, promote students' autonomous participation, and ensure the effective implementation of teaching work.

5.3. The emotional attributes of AI-enabled reading and writing instruction

The rapid development of artificial intelligence technology requires teachers to continuously enhance their capabilities, transforming from knowledge imparters to instructional guides. Teachers should focus on playing a supportive role in the learning process, guiding learners to develop a positive emotional state, and designing engaging teaching activities. With the application of AI technology, teachers should prioritize emotional teaching objectives and emphasize the guidance of learners' psychological processes. They need to leverage AI agents to provide learners with greater assistance and support through sentiment analysis and data interaction, thereby helping them overcome problems encountered in learning and maintain positive emotional engagement in language learning.

6. Strategies for empowering college English teaching with AI language models

6.1. Constructing a personalized teaching model

Firstly, conduct a thorough analysis and investigation of students' learning situations. Teachers should make full use of AI language models to gain an in-depth understanding and analysis of students' learning data, which mainly includes students' daily academic performance, study time, and mastery of knowledge ^[6]. By

understanding students' learning foundations and situations through data analysis, teachers can formulate more reasonable teaching plans. They can identify students' weak areas based on their test scores and thus provide targeted learning tasks for them.

Secondly, develop personalized learning goals and plans. Teachers should set specific learning goals according to students' learning situations and characteristics. These goals should be clearer, more definite, and highly operable. For example, for students with a weak foundation in English learning, the learning goals can be set to master basic vocabulary and grammar knowledge, and the learning plans can include basic exercises and corresponding tutoring. For students with a good English foundation, the learning goals can focus on enhancing their comprehensive abilities in listening, speaking, reading, and writing, with a series of practical tasks designed ^[7].

Thirdly, provide personalized learning resources and tutoring. Teachers should develop personalized learning programs based on students' learning situations. Learning resources should be selected according to students' characteristics and needs, and tutoring methods can include one-on-one tutoring and online Q&A. For instance, teachers can recommend suitable reading materials for students and provide them with vocabulary notes and corresponding explanations ^[8]. Additionally, teachers need to recommend appropriate reading materials based on students' learning situations and characteristics, offer vocabulary explanations and sentence analysis, and analyze problems arising in students' oral practice to conduct expression training accordingly.

6.2. Innovating teaching content and methods

Firstly, develop intelligent teaching resources. Teachers can utilize AI language models to develop relevant teaching resources, including interactive courseware, virtual simulation courses, and intelligent question banks. These teaching resources can be presented in the form of animations, videos, and audios, thereby enhancing the interest of teaching. Virtual simulation courses can provide students with more realistic learning scenarios, enabling them to improve their language application abilities through practical learning. In addition, intelligent question banks should generate corresponding practice questions based on students' learning situations and characteristics, and provide functions of marking and feedback ^[9].

Secondly, adopt blended teaching methods. Teaching is carried out by combining AI language models with traditional teaching modes. Teachers can use AI language models for teaching, conducting teaching demonstrations, and case analyses to encourage students to think and explore in depth. During the after-class learning stage, students can use AI language models for autonomous learning, understanding, and applying knowledge through online learning to achieve good learning results ^[10].

Thirdly, carry out situational teaching activities. Teachers should use AI language models to construct authentic language contexts and conduct corresponding teaching activities. They can leverage AI language models to simulate daily life scenarios and learning scenarios, allowing students to immerse themselves in the scenarios for interactive communication. In this process, students can take on different roles and perform dialogue exercises in various environments and scenarios, further improving their practical language application abilities and intercultural communication skills.

6.3. Establishing a dynamic teaching resource library

Resource collection should be conducted from multiple aspects, and a dual-track dynamic capture mechanism should be established to ensure the effective integration of academic cutting-edge and applicability. In this process, AI and teaching wisdom should be effectively combined to build a three-dimensional network system.

In addition, the corpus annotation system needs to establish a multi-dimensional explanation mechanism for dynamically annotating the historical and cultural context of texts, thereby constructing multiple spaces for thinking training. In this regard, colleges and universities also need to establish a resource update mechanism to realize the update and iteration of information resources, and build an intelligent evolution model oriented to teaching needs. Colleges and universities should dynamically monitor the teaching effectiveness of corpora through a multi-dimensional evaluation system and establish a regular update mechanism. At the same time, they should introduce an intelligent gap response system, so that when there is a corpus shortage in specific teaching scenarios, the blended collection channel can be automatically activated, and dual-track supplementary measures of real corpus selection and AI-generated compensation can be implemented simultaneously ^[11-13].

6.4. Optimizing the teaching evaluation system

Firstly, adopt diverse teaching evaluation methods. Move away from a single evaluation approach and implement a diversified evaluation. Evaluation subjects include not only teachers but also students themselves, peers, and AI language models. Evaluation content should cover not only students' academic performance but also their learning attitude, learning ability, and innovative qualities. Formative evaluation and summative evaluation can be employed, and their effective combination ensures the rationality and scientificity of the evaluation. For example, teachers can use AI language models to evaluate students' daily performance, including homework completion and class participation, and conduct an overall assessment of students' learning outcomes through final exams ^[14].

Secondly, emphasize the evaluation of students' learning processes. Teachers should focus on evaluating students' learning processes, using AI language models to effectively track and record these processes, and further collect students' learning data, such as study time, learning progress, and specific mastery of knowledge. In-depth analysis of this data can help identify problems students encounter during their learning, thereby providing corresponding assistance and guidance. Process-oriented evaluation helps teachers better adjust learning strategies based on evaluation results, further improving teaching effectiveness.

Thirdly, achieve immediacy in evaluation feedback. Teachers should use AI language models to provide feedback, ensuring their effectiveness. In the feedback process, AI language models can be utilized to gain a thorough understanding of students' homework completion and test performance, and provide detailed evaluation comments, including analysis of the causes of errors and suggestions for correction. At the same time, teachers can provide targeted learning advice and plans for students based on their learning situations and characteristics, helping them address shortcomings in the learning process ^[15].

7. Conclusion

In summary, the application of AI language models can provide greater support for college English teaching, thereby building a personalized and interactive classroom environment. The use of AI agents helps optimize effective teaching and cultivate students' global perspectives and national sentiments. At the same time, the challenges it brings cannot be ignored. This requires changing fixed mindsets, continuously innovating teaching practices, effectively applying language model technologies, promoting educational digitalization, and thus achieving updates in teaching concepts and methods.

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Mental Health Perceptions and Help-Seeking Behaviors among International Students in UK Universities: A Qualitative Literature Review

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Abstract: This literature review examines the mental health and help-seeking behaviors of international students in the UK universities. The study explores the dynamic interplay of cultural, institutional, and individual factors that shape students' psychological well-being and the support systems. Based on the qualitative studies, the literature review reviews that students from collectivist cultures, such as those of African, Caribbean, and Chinese heritage, often navigate stigmatization of mental health and prefer coping mechanisms, such as peer or family support, rather than professional counselling. Barriers hindering help-seeking behaviors include limited awareness of counselling services, language difficulties, and cultural misalignment. Consequently, international students underutilized the mental health support systems of UK universities and lacked culturally attuned engagement strategies. Peer-arrival orientation and peer network are effective interventions to improve well-being and adaptation. The literature reviews advocate accessible and culturally sensitive mental health strategies within UK universities. Longitudinal qualitative research is recommended to trace the coping mechanisms across students' academic journeys. Through those endeavors, higher education institutions can enhance the academic success and well-being of the diversified international community.

Keywords: Mental health; Help-seeking behavior; UK international students; Cultural adaptation; Academic pressure

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1. Introduction

International students in the United Kingdom (UK) universities experience unique challenges, including cultural adaptation, academic pressure, and social isolation. These experiences affect their mental health substantially, thus influencing their perceptions and help-seeking behaviors^[1]. This literature review explores the experiences of perceptions and help-seeking behaviors regarding mental health among international students in UK universities. The importance of this topic lies in the ever-diversifying UK higher education population, which means that international students experience stressful conditions, such as cultural transition and loneliness,

that threaten their mental health. The qualitative method in this review provides the human angle regarding international students. The research goals are to examine the factors influencing mental health perceptions and the factors that hinder persons with mental health problems from seeking help. Managing mental health issues for this group enhances their academic success, well-being, and overall university experience. Thus, addressing mental health barriers for international students in UK universities requires culturally tailored interventions.

2. Cultural factors and mental health

There are significant differences in stigma, awareness, and understanding across diverse student groups. Clough et al. compare mental health literacy and attitudes between domestic and international tertiary students based on the features of convenience samples ^[2]. This research design, which uses surveys and focus groups, provides a good mix of quantitative and qualitative data. However, it broadly groups international students, making it hard to compare and contrast effectively between people within the same category. Contrastingly, Dare et al. focus on African and Caribbean students, providing a nuanced understanding of how socio-cultural factors shape mental illness conceptualization ^[1]. Dare et al. posit that cultural differences significantly shape perceptions of mental health, with stigma more pronounced among students from collectivist cultures compared to those from individualist backgrounds who often demonstrate higher awareness ^[1]. However, McGettrick bridges perspectives by examining stigma and help-seeking differences between US and UK students ^[3]. Their comparative strategy analyses the role of the national and cultural contexts very well, but does not elucidate intersectionality, like ethnicity.

3. Barriers to help-seeking

Research on barriers to mental health help-seeking highlights challenges such as stigma, language, and limited awareness. Barrow and Thomas conducted a systematic literature review of adolescent mental health and discovered that stigma and lack of service knowledge were the main barriers ^[4]. The study's strengths include a methodologically sound approach. However, their emphasis on adolescents may undermine applicability to university populations. Conversely, Bryant et al. focus on higher education contexts, examining help-seeking behaviors among university students. The authors noted that inadequate knowledge about available services and financial constraints hindered help-seeking, particularly among lower-income students, highlighting systemic inequities in access. However, Burns et al. identified an intensified stigma and isolation barrier due to the COVID-19 pandemic ^[5]. This combined methodology contributes significantly to the study, including numerical patterns and sophisticated descriptions.

4. Role of universities

The role of UK universities in mental health support is pivotal, particularly for diverse international student populations. Broglia et al. examined student mental health characteristics as well as self-identified depression and help-seeking behavior in terms of temporal patterns and service use ^[6]. A major methodological strength of the study is the longitudinal nature of service use data, which has the potential to provide trends. In contrast, Hardy et al. explore mental health help-seeking among racially minoritized students using a systematic review and thematic synthesis ^[7]. Broglia et al. found university counselling services effective in improving mental

health but underutilized, while Hardy et al. emphasized peer networks' role in fostering cultural adaptation ^[6-7]. In a similar study, Stone analyzes the help-seeking behaviors of students in the UK using the lens of the Health Belief Model ^[8]. The study considers perceived susceptibility as a reason for seeking counselling.

5. Coping mechanisms

International students employ varied coping mechanisms to navigate mental health challenges, reflecting cultural and individual differences. Law focuses on Chinese international students in the UK and highlights how social support, peers, and social communication could help limit poor mental health ^[9]. The findings highlight the importance of cultural identity in shaping coping strategies, offering universities direction for culturally tailored interventions. In contrast, Tung examines acculturative stress across diverse international student groups, identifying problem-focused strategies like goal-setting and time management ^[10]. Mindfulness and self-care are the pivotal strategies that Waters finds with Chinese students, focusing on concerns marked by Law ^[11]. Thus, Waters' conclusions are consistent with Law, but the study uses a wider range of theoretical paradigms, such as psychological resilience ^[11]. Nevertheless, its reliance on self-reported data introduces potential biases, echoing limitations in qualitative methodologies.

6. Qualitative research findings

Exploring international students' mental health and help-seeking behaviors, highlighting the interplay of cultural, institutional, and individual factors. For example, cultural background plays a significant role in how mental health is viewed and generalized ^[1]. Similarly, Law and Waters identify how Chinese students prioritize familial and peer support, often over formal counselling, reflecting cultural preferences for informal coping mechanisms ^[9, 11]. Barriers to help-seeking include language difficulties, stigma, and limited awareness of services ^[4, 12]. Students also lack culturally competent services, which negates the institution's support ^[7]. Some students reported using mindfulness, peer support, or problem-focused ways of managing acculturative stress ^[9-10]. Overall, these studies emphasize the need for culturally sensitive interventions and stronger institutional support systems.

7. Methodology

The study undertook a comprehensive search using academic databases such as PubMed, Google Scholar, and university library resources. Keywords used were "international students", "mental health", "help-seeking behavior", "qualitative study", and "UK universities" to tune the search to suited articles. The search focused on studies published in peer-reviewed journals and academic books, emphasizing qualitative methodologies.

Studies included in this review focused on international students in the UK, specifically addressing mental health perceptions, help-seeking behaviors, and coping strategies. This review included only qualitative research with interviews, focus groups, or thematic analyses. Recent research works from the last decade were mostly included to reduce the possibility of any generality in the conclusion. Excluded studies did not specifically involve international students, use quantitative methodologies, or focus on mental health outside the UK context.

The literature was analyzed using a thematic synthesis approach. This analysis entailed grouping major

topics highlighted in the studies, such as cultural factors, facilitators, and barriers to seeking help. Applying thematic synthesis, it was possible to have a fine-grained analysis of how the experiences of mental health in international students may be either similar or different, as well as what factors influence their decision to seek help. This approach ensured a comprehensive and systematic review of qualitative findings across the studies.

8. Discussion

The reviewed literature reveals several key findings about international students' mental health and help-seeking behaviors in UK universities. A prominent theme is the influence of cultural factors on mental health perceptions. Dare et al. and Law have shown that the way students from African, Caribbean, and Chinese backgrounds perceive mental health issues and the decision whether to seek professional assistance is influenced by cultural factors^[1,9]. The study consistently identified barriers such as language difficulties, lack of awareness about available services, and financial constraints.

Universities can address these challenges by offering culturally sensitive support, considering diverse student backgrounds. Hardy et al. pointed out peer support networks as a strategy for minimising stigma and boosting help-seeking behaviors^[7]. Also, including the staff from the university in mental health training in terms of cultural competency can enhance mental health for all learners^[6]. However, there are still some important research limitations in the literature. Here, students from less numerous international groups are not widely studied, and differences between regions in the UK are considered insufficiently investigated. Much research is still needed to identify the best universities to host culturally sensitive mental health assistance. Further qualitative research should focus on longitudinal studies to assess how coping strategies evolve for international students.

The reviewed studies reveal several nuanced factors influencing mental health among international students beyond stigma, cultural barriers, and institutional support. For instance, trends extend to the impact of acculturation stressors, language competence, and personal coping, with differences collectively noted in terms of demographic differences and regional differences. Based on the discussion with Tung, the area of acculturative stress is deemed a major factor influencing international students' mental health, especially focusing on cultural and psychological factors^[10]. Similarly, Law discusses the difficulty of cross-cultural adaptation among Chinese individuals, citing language and discrimination as predictors for increased stress among international students^[9]. These findings align with Waters, who underscores that cultural familiarity and preparatory support significantly mitigate these stressors, suggesting the importance of pre-arrival orientation programs^[11].

Broglia et al. and Stone collectively emphasize language proficiency as both a barrier to accessing services and a determinant of interpersonal connections^[6,8]. While Stone describes how restricted English proficiency discourages help-seeking via the Health Belief Model, Hardy et al. proposed that multilingual peers' support groups are inclusive, which can be shown as the opposite of responding to the absence of the gap^[7-8]. Such a gap points to the notion that the institutional focus on linguistic diversity requires uniqueness. Like Law and Waters, the sources that focus on Chinese students' coping, there are similar results on positive approaches to familial support and community networks for Chinese students^[9,11]. However, there are different perspectives from Tung^[10]. Tung describes specific tactics endured or used to protect the individual, including independence, as reported by students of Western acculturation. This divergence underscores the interplay of cultural

upbringing in shaping coping behaviors, demanding flexible interventions recognizing collectivist versus individualist tendencies.

The role of universities, explored by Hardy et al., is complemented by Bryant et al., who identify low visibility of mental health services as a persistent barrier^[7, 12]. While Hardy et al. encourage expansions through peer groups, and Bryant et al. observe the need for constant service promotion^[7, 12]. This finding reveals the issue of greater visibility of services but less effective reach, suggesting future areas of synergy between service visibility and service accessibility. The studies also indicate the problems of geographic representation. However, Dare et al. also stress the lack of representation of students of African and Caribbean origin in the explored works and the need for a more diverse sample^[1]. These studies collectively stress the interplay of individual, cultural, and institutional factors, calling for holistic, culturally sensitive, and accessible mental health frameworks for international students.

9. Conclusion

This literature review highlights the significant mental health challenges international students in UK universities experience, shaped largely by cultural factors, stigma, and barriers to help-seeking. As evidenced in the reviewed research articles, international students, especially students of color, are at an increased risk of missing signs of mental health problems or seeking the right assistance. The thematic cross-analysis revealed that language barriers, culture-related stigma, and unawareness of the potential services were named across the studies. Peer support networks and culturally competent mental health services were identified as essential strategies for overcoming these challenges.

Based on these findings, UK universities should prioritize establishing culturally considerate mental health services, including language support and awareness campaigns that address stigma and promote help-seeking. Hardy et al. and Bryant et al. recommend that educational sessions be provided for the university staff regarding the appropriate approach toward the needs of international students^[7, 12]. Additionally, Dare et al., Law, and Waters recommend that universities should include more peer support outreach programs and promote students' autonomy in increasing inclusiveness^[1, 9, 11]. Longitudinal studies would also provide insights into how students' coping strategies evolve, helping universities refine their support systems.

Disclosure statement

The author declares no conflict of interest.

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Research on Strategies for Enhancing the New Quality Competitiveness of Talents in Vocational and Technical Undergraduate Colleges from the Perspective of New Engineering

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Abstract: From the perspective of new engineering, promoting the enhancement of the new quality competitiveness of talents in vocational and technical undergraduate colleges is an important educational task and a key to strengthening the quality and level of talent cultivation. Therefore, it is necessary to continuously improve the educational model and update the educational process in the talent cultivation of vocational and technical undergraduate colleges, guided by strengthening the new quality competitiveness of talents, so as to effectively enhance the new quality competitiveness of talents and better fulfill the task of talent cultivation. This paper proposes strategies for enhancing the new quality competitiveness of talents in vocational and technical undergraduate colleges based on the background of new engineering, serving as a springboard for further discussion.

Keywords: New engineering; Vocational and technical; Undergraduate Colleges; Enhancement of new quality competitiveness

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1. Preface

Against the background of new engineering, the development and operation of vocational and technical undergraduate colleges are facing new opportunities and challenges. New engineering is a new type of discipline that emphasizes the intersection of disciplines and practical applications. This raises higher requirements for talent cultivation in vocational and technical undergraduate colleges, which need to continuously improve their educational models, focus on strengthening the intersection and integration of disciplines, and innovate talent cultivation models, so as to cultivate a continuous stream of applied and practical talents for economic and social development. Furthermore, promoting the enhancement of the new quality competitiveness of talents in

vocational and technical undergraduate colleges in the background of new engineering is also key to ensuring the level of talent cultivation. Therefore, it is necessary to deeply explore and analyze the perspectives from which to strengthen the new quality competitiveness of talents in vocational and technical undergraduate colleges, so as to ensure that they can fully exert their educational functions and provide a continuous stream of high-quality, highly skilled applied talents for the development of various fields in society.

2. Overview of the background of new engineering

New engineering refers to the transformation, upgrading, and innovation of traditional disciplines, forming a new interdisciplinary major. The proposal of this concept fully responds to the new round of technological revolution and industrial transformation, can effectively implement innovation-driven strategies, and contributes to promoting the innovative development of the country and society. It is an important part of responding to national strategies such as “Made in China 2025.” New engineering covers inheritance and innovation, intersection and integration, coordination and sharing. The core element is the upgrading and transformation of traditional disciplines, gradually breaking disciplinary boundaries, and achieving the intersection and integration of multiple disciplines. This not only meets the development needs of disciplinary innovation but also helps to optimize the allocation of educational resources and promote the co-construction and sharing of teaching achievements, thereby helping to improve the quality of social talent cultivation and meet the demand for high-quality talents in the stage of social industrial development.

3. The necessity of enhancing the new quality competitiveness of talents in vocational and technical undergraduate colleges from the perspective of new engineering

In the context of new engineering, enhancing the new quality competitiveness of talents in vocational and technical undergraduate colleges is a necessary measure and a key link to improve the quality and level of talent cultivation. It ensures that talent cultivation meets the rapid development needs of social industries, improves students’ employment rates, and promotes high-quality development in various social fields. Specifically, the necessity of enhancing the new quality competitiveness of talents in vocational and technical undergraduate colleges in the context of new engineering is reflected in the following two points.

Firstly, adapting to the rapid development needs of industries and market changes. With the rapid development of science and technology in China, the social industrial structure has also undergone continuous changes, and the traditional social industrial development model is undergoing profound innovation and reform. In this context, new engineering, as a new discipline, can achieve the intersection and integration of disciplines and practical applications under its guidance, which has become an important force leading the innovation of social industrial development. Therefore, vocational and technical undergraduate colleges must keep up with the pace of the times, fully combine the background of new engineering to adjust and optimize talent cultivation models, and respond to the talent demands of industrial development. Moreover, enhancing the new quality competitiveness of talents in vocational and technical undergraduate colleges also means gradually strengthening talents’ innovation spirit and practical ability construction in the process of talent cultivation. Only on this basis can it be ensured that graduates adapt to market changes, master new technologies and processes, and become an important force to promote social industrial changes. Therefore, it is necessary to focus on

enhancing the new quality competitiveness of talents in the talent cultivation of vocational and technical undergraduate colleges, thereby strengthening the quality and level of talent cultivation.

Secondly, enhancing students' employment competitiveness and career development prospects. In the context of new engineering, emphasizing the enhancement of the new quality competitiveness of talents in vocational and technical undergraduate colleges also helps to enhance students' employment competitiveness and provide them with broader career development prospects. This is mainly due to the increasingly fierce market competition in the context of rapid market development in China. To stand out in the fierce market competition, graduates must possess unique new quality competitiveness, such as solid professional skills, rich practical experience, good coordination and cooperation abilities, innovative thinking, and other aspects. Only on this basis can it be ensured that graduates better meet the demand for high-quality talents in social industries and occupy an advantageous position in the employment market. Therefore, it has become a necessary measure for vocational and technical undergraduate colleges to focus on strengthening students' new quality competitiveness based on the background of new engineering. Only on this basis can students' employment competitiveness be effectively improved, enabling them to have good career development prospects and achieve the goal of strengthening the quality of talent cultivation in vocational and technical undergraduate colleges.

4. Challenges faced by vocational and technical undergraduate colleges in enhancing talent competitiveness from a new engineering perspective

4.1. Challenges posed by curriculum optimization and practical teaching

From the perspective of new engineering, vocational and technical undergraduate colleges face dual challenges posed by curriculum optimization and practical teaching in talent cultivation. How they respond to these challenges determines the effectiveness of their talent cultivation and whether they can enhance the competitiveness of their talents. Firstly, to optimize the curriculum system, vocational and technical undergraduate colleges need to fully understand the professional characteristics and industry development requirements in the context of new engineering. They should also focus on integrating emerging technologies and industrial development trends into the curriculum. This requires the colleges to have a strong forward-looking vision and the ability to flexibly adjust their courses. Additionally, practical teaching is a key aspect of improving students' practical operation skills and problem-solving abilities. Therefore, vocational and technical undergraduate colleges need to focus on cultivating students' practical skills in education and teaching, and actively promote the construction of practical teaching bases and improve practical teaching models. This will gradually strengthen students' problem-solving abilities, enabling them to grow into high-quality talents with new competitive qualities.

4.2. Challenges posed by teacher team building

In the context of new engineering, vocational and technical undergraduate colleges face challenges in enhancing the competitiveness of their talents due to teacher team building. The emergence of the new engineering background has raised higher requirements for talent cultivation in vocational and technical undergraduate colleges. Not only do they need to cultivate talents with good professional quality and practical ability, but they also need to ensure that graduates have good innovative thinking and comprehensive quality. This places higher demands on the educational practitioners of vocational and technical undergraduate colleges. In this process, it is necessary for vocational and technical undergraduate colleges to introduce and cultivate high-quality teachers

with a new engineering background. However, this process requires a significant investment of time and resource costs, increasing the difficulty of building the teaching team in vocational and technical undergraduate colleges. On the other hand, how vocational and technical undergraduate colleges can improve the teaching level and scientific research ability of the existing teachers in their colleges is an important requirement. In this process, it is not only necessary to fully consider the requirements of practical teaching, but also to ensure that existing teachers can adapt to the needs of new engineering through training and exercise. This has become an urgent problem to be solved, posing a huge challenge to the construction of the teaching team in vocational and technical undergraduate colleges.

4.3. Challenges posed by innovation in talent cultivation mode and quality

The innovation of talent cultivation mode is an important task for vocational and technical undergraduate colleges in the context of new engineering. This task also brings certain challenges to vocational and technical undergraduate colleges. This is mainly because actively promoting the innovation of talent cultivation mode is an important way to improve the quality of talent cultivation, but in practice, vocational and technical undergraduate colleges also face many challenges and influences. For example, promoting the innovation of talent cultivation mode not only requires vocational and technical undergraduate colleges to have the courage and confidence to break the traditional talent cultivation mode, but also requires the joint efforts and cooperation of all teachers and students in the school. Only on this basis can the talent cultivation mode be gradually improved and the talent cultivation process innovated. In addition, this process also requires vocational and technical undergraduate colleges to focus on the organic integration of theoretical teaching and practical teaching, so as to improve students' comprehensive quality and professional ability. This is also a key issue that needs to be solved to promote the innovation of the talent cultivation mode ^[1]. Furthermore, the innovation of talent cultivation mode also needs to focus on the evaluation feedback in the education and teaching stage. In this process, it is necessary to focus on building a dynamic and scientific supervision and evaluation system. Based on this, it reflects the current status of talent cultivation mode construction and talent cultivation quality in vocational and technical undergraduate colleges, and makes flexible adjustments based on the evaluation feedback results, thus helping to strengthen the quality of talent cultivation in vocational and technical undergraduate colleges.

4.4. Challenges posed by talent cultivation exchange, cooperation, and channel innovation

In the context of new engineering, vocational and technical undergraduate colleges need to actively promote exchange and cooperation in talent cultivation, guided by innovative channels of communication and cooperation, to enhance the competitiveness of new talent qualities. However, vocational and technical undergraduate colleges also face challenges in this regard. For example, how vocational and technical undergraduate colleges can find suitable partners and establish good cooperative relationships with them has become a complex and tedious issue. How vocational and technical undergraduate colleges can leverage their strengths and roles in exchange and cooperation has become an important challenge for them ^[2]. Especially in the context of the gradual internationalization of scientific and technological development, the exchange and cooperation channels for talent cultivation in vocational and technical undergraduate colleges also need to be actively innovated and strengthened to align with international standards. Therefore, vocational and technical

undergraduate colleges are required to have stronger market insight and innovation abilities. Only on this basis can they continuously adapt to market changes and international environmental development requirements, helping to strengthen the competitiveness of new talent qualities in vocational and technical undergraduate colleges.

5. Strategies for enhancing the competitiveness of new talent qualities in vocational and technical undergraduate colleges from the perspective of new engineering

5.1. Optimizing the curriculum system and strengthening practical teaching

To effectively improve the quality and effectiveness of talent cultivation in vocational and technical undergraduate colleges and strengthen the competitiveness of vocational and technical undergraduate talents, it is necessary to gradually strengthen the construction of talent cultivation models in vocational and technical undergraduate colleges based on the background of new engineering. This will help improve the level and effectiveness of talent cultivation in vocational and technical undergraduate colleges. The primary task in this process is to optimize the curriculum system and strengthen the construction of practical teaching, thus providing students with a more comprehensive practical teaching model ^[3]. For example, vocational and technical undergraduate colleges can appropriately add courses related to emerging industries in society, such as artificial intelligence technology courses and big data analytics courses. While adding new courses, they should also focus on adjusting the proportion of traditional courses to ensure the scientific nature of each course's proportion. In addition, in practical teaching, vocational and technical undergraduate colleges need to make full use of on-campus training bases and school-enterprise cooperation models, and vigorously build an integrated model of production, education, and research. This will promote the innovation of practical teaching in vocational and technical undergraduate colleges, improve the quality of practical teaching, and strengthen students' practical abilities, thereby helping to enhance the competitiveness of new graduate qualities.

5.2. Strengthening the construction of the teaching team and improving teacher quality

The construction of the teaching team is of key significance and value in talent cultivation in vocational and technical undergraduate colleges. It is also a crucial link in enhancing the competitiveness of new talent qualities in vocational and technical undergraduate colleges in the context of new engineering. In this process, vocational and technical undergraduate colleges need to attract high-quality teachers with a background in new engineering to meet the talent cultivation needs of vocational and technical undergraduate colleges by introducing new talent. Additionally, professional teacher training should be organized regularly in vocational and technical undergraduate colleges to improve the current teachers' teaching abilities and scientific research levels in vocational and technical undergraduates, thereby strengthening the effectiveness of teacher team building ^[4]. For example, within the scope of vocational and technical undergraduate colleges, experts and scholars in the industry can be actively invited to hold academic seminars, or on-campus teachers can be sent to enterprises for on-the-job training. This will enable teachers to understand the cutting-edge developments in the industry, help improve teachers' practical abilities, accumulate practical experience, achieve the effect of improving teachers' overall quality, and enable them to play a role in education and teaching.

5.3. Innovating talent cultivation models to improve talent cultivation quality

Vigorously innovating talent cultivation models is an important measure that helps improve the quality of

talent cultivation in vocational and technical undergraduate colleges and strengthen the competitiveness of new talent qualities. Therefore, vocational and technical undergraduate colleges need to actively innovate their talent cultivation models, focusing on improving talent cultivation quality as the core to drive the education and teaching process. For example, vocational and technical undergraduate colleges can strongly build an integrated model of production, education, and research through deep cooperation between the colleges, enterprises, and scientific research institutions to achieve joint talent cultivation among the three parties. This not only ensures the orderly progress of the talent cultivation process but also stimulates the vitality of talent cultivation in vocational and technical undergraduate colleges. In addition, vocational and technical undergraduate colleges also need to establish cooperation projects with enterprises to promote personalized student development through school-enterprise cooperation. By providing students with enterprise positions that meet their professional growth needs, students can strengthen their mastery of professional knowledge through practical operations in enterprise positions and gain a certain understanding of new industry trends. This not only improves the quality of talent cultivation in vocational and technical undergraduate colleges but also helps form a more complete talent cultivation model, strengthening the new quality competitiveness of talents in vocational and technical undergraduate colleges and completing high-quality talent cultivation tasks.

5.4. Strengthening international exchange and cooperation to broaden the horizon of talent cultivation

In the context of new engineering, cultivating the new quality competitiveness of talents in vocational and technical undergraduate colleges requires focusing on strengthening international exchange and cooperation. This will broaden the horizon of talent cultivation and improve the quality of talent cultivation. For example, vocational and technical undergraduate colleges can strengthen cooperation and exchange with some international vocational education institutions, carrying out mutual visits between teachers and students and academic exchange activities to learn from international vocational education experiences and broaden the horizon of talent cultivation. Furthermore, vocational and technical undergraduate colleges can appropriately introduce some high-quality foreign education resources, such as online education courses and textbooks, which not only enrich students' learning content but also cultivate their international perspective and cross-cultural communication abilities. This will enhance the new quality competitiveness of talents in vocational and technical undergraduate colleges and improve the quality and effectiveness of talent cultivation.

6. Conclusion

In summary, in the talent cultivation of vocational and technical undergraduate colleges, vigorously strengthening the new quality competitiveness of talents is an important educational task and a key teaching goal in the context of new engineering. Therefore, it is necessary for vocational and technical undergraduate colleges to continuously innovate talent cultivation models, update talent cultivation processes, and promote education and teaching with the goal of cultivating new quality competitiveness among graduates. This, in turn, will help enhance the quality and effectiveness of talent cultivation in vocational and technical undergraduate colleges.

Disclosure statement

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The Manifestation of Core Competencies in English Education

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Abstract: The core competencies of the English subject represent the concentrated embodiment of its educational value. They encompass the correct values, essential character traits, and key abilities that students gradually develop and enhance through English curriculum learning to meet the demands of the information age, knowledge society, globalization, and their lifelong personal development. Comprising four key elements—linguistic competence, cultural awareness, thinking quality, and learning ability—the core competencies of the English subject represent an integrated set of skills that are mutually permeating, interacting, and developing harmoniously. They constitute the educational goal of cultivating students' moral character through English education and serve as the evaluation criteria for the effectiveness of high school English education and students' academic performance in English. This paper emphasizes the design of teaching objectives centered around the core competencies of the English subject and the enrichment of the teaching process. By placing students at the center, deeply integrating the concept of core competencies, and innovating teaching methods, the paper aims to achieve an organic combination of knowledge transmission and competency cultivation.

Keywords: Integration of core competencies into classroom teaching; Student-centered approach; Innovative teaching methods

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1. Introduction

According to the “General High School Curriculum Plan (2017 Edition, Revised in 2020)”, the overall goal of high school education is summarized as “fulfilling the fundamental task of fostering virtue and nurturing talent.” The overarching educational goal outlined in the “English Curriculum Standards (2020 Revision)” is “to further promote the development of students' core competencies in the English subject on the basis of compulsory education, cultivating socialist builders and successors with Chinese sentiment, international vision, and cross-cultural communication abilities.” So, how can subject core competencies in English courses be implemented?

2. Understanding the manifestation of cultural awareness in ideological and political education

The manifestation of cultural awareness is particularly crucial in ideological and political education. On one hand, ideological and political education should guide students to understand the characteristics and values of different cultures, fostering their cultural consciousness and self-confidence. On the other hand, ideological and political education also needs to leverage the power of culture to influence and shape students' ideologies, beliefs, and behavioral habits, guiding them to develop an appreciation and respect for traditional culture and understand the importance of cultural awareness.

Cultural awareness embodies the value orientation of the core competencies in the English discipline. In the process of developing language proficiency, enhancing thinking quality, and improving learning abilities, it is essential to remain true to the original purpose of education, which is to help students foster a sense of belonging to the community with a shared future for mankind, strengthen their national identity and patriotism, learn to be a good person and to conduct themselves properly, and grow into individuals with cultural literacy and social responsibility. In English teaching, the cultivation of cultural awareness should mutually promote and permeate with the cultivation of other core competencies in the discipline, achieving a coordinated and comprehensive development of students' overall core competencies in the subject.

Taking the return to school after the COVID-19 pandemic in 2020 as an example, senior high school students faced the challenge of adapting from online learning to offline learning upon returning to the classroom. Teachers can design emotional education-themed courses to guide students to cherish their learning opportunities while integrating the cultivation of cultural awareness. For instance, by comparing domestic and international responses to the pandemic, teachers can emphasize national identity and patriotism, helping students foster a sense of belonging to the community with a shared future for mankind. Such instructional designs not only enhance language proficiency but also achieve the goal of cultural education. The first lesson back at school should focus on emotional education, encouraging students to study hard, never give up, and move forward towards their goals. The following is a demonstration of the instructional design for an English lesson themed "Returning to School":

2.1. Teaching objectives

Enable students to cherish everything they have now, do the most important things during the most beautiful time, and simultaneously assess their writing and expression abilities.

2.2. Teaching process

- 1) The theme of this lesson is "Back to School." Returning to school for the first time, students are bound to feel a sense of novelty and excitement. The lesson will commence with the song "Juvenile" to arouse students' interest and resonate with the theme.
- 2) Through posed questions, students will be encouraged to reflect on what they have gained during the 100 days at home and consider the reasons for their successes and failures during this period of contemplation.
- 3) By comparing online learning experiences, students will recognize their shortcomings and strengthen their resolve to study diligently. Examples will be presented, such as the perseverance of students like Huang Yuting from Wuhan, who, despite being diagnosed with COVID-19, continued to prepare for

exams diligently in a makeshift hospital amidst physical and mental stress. Some students, lacking internet access at home, would borrow their neighbors' Wi-Fi on rooftops from dawn till dusk to complete their academic tasks. Students will also be prompted to reflect on their behavior during online classes.

- 4) Taking a global perspective, the achievements of our motherland and the praise for medical workers will be highly commended, emphasizing the preciousness of our happy life. Simultaneously, key grammar structures and sentence patterns will be reviewed to prepare students for the final composition of the lesson.
- 5) Encourage students to contemplate how they should spend their remaining time at school.
- 6) Guided by selected famous quotes and aphorisms, students will write a composition titled “Are You Still the Same Boy/Girl You Used to Be?” This will prompt students to deeply reflect on whether they remain the same youthful selves as before. Have they stayed true to their original aspirations and consistently pursued their dreams? Or have they undergone struggles and changes, becoming mature and resolute? Or perhaps they remain unchanged, maybe even unwilling to change.

Through comparative images from the pandemic, both domestically and internationally, students will understand that some countries have adopted a laissez-faire approach to the pandemic, while other regions are plagued by continuous warfare and widespread suffering. In contrast, in China, soldiers and doctors fulfill their duties with dedication and selfless commitment, always upholding noble principles. While facing various crises and challenges, they should always prioritize the safety and interests of the people. Students are greatly inspired and feel even prouder to be Chinese. During the teaching feedback session, teachers learned from letters commemorating graduation that some students found the English class to be profoundly educational, akin to a class meeting, leaving them deeply moved and brimming with confidence. For teachers, inspiring students to genuinely yearn for knowledge, recognize their teachers, and feel proud of their country and nation represents a significant value of education.

3. How to enhance thinking quality in English learning

Thinking and language are closely intertwined. The “English Curriculum Standards (Revised in 2020)” outline four core competencies for English subject education: linguistic competence, cultural awareness, thinking quality, and learning ability. These elements interact and promote each other, with linguistic competence serving as the foundational element, cultural awareness as the value orientation, thinking quality as the mental characteristic, and learning ability as the developmental condition. Thus, the development of thinking quality aids in enhancing students' abilities to analyze and solve problems, observe and understand the world from a cross-cultural perspective, make correct value judgments about things, and promote deep learning among students.

The composition topic for the 2024 English examination was related to technology, and many students failed to perform at their expected level due to a lack of practice on similar topics. However, all compositions are closely linked to the textbook. In Unit 4, “A Glimpse of the Future”, from the New Foreign Language Teaching and Research Press Senior High School English Elective Course 3, numerous vocabulary, sentence patterns, and ideas related to AI can be applied to the Gaokao (National College Entrance Examination) composition. This indicates that students still require continuous practice and improvement in terms of thinking

quality. Therefore, in everyday teaching, it is crucial to design teaching tasks that are tailored to students' proficiency levels and can stimulate their active participation in thinking.

3.1. Design tasks with intellectual engagement

Based on the four levels of Depth of Knowledge (DOK): DOK1 — Observation and Comparison; DOK2 — Analysis and Inference; DOK3 — Generalization and Construction; DOK4 — Critique and Innovation, tasks should be designed to captivate students' attention through questions, continuously enhance the intellectual content, and foster the development of their thinking abilities.

3.1.1. Typical case analysis observation: Predicting the main idea of the article based on the title and accompanying illustrations DOK 2

S1: I've watched the movie "I, Robot." I think the passage might be similar to that movie.

T: What did you realize from that movie?

S1: It's dangerous to rely too heavily on robots.

S2: If we can regulate AI properly, it will bring us many benefits. But if it gets out of control, it will be a disaster.

This dialogue revolves around the movie "I, Robot." Student S1 believes that the content of the article may be similar to the movie and points out the dangers of over-relying on robots. Student S2 suggests that if AI can be effectively regulated, it will bring numerous benefits, whereas if it goes out of control, it will lead to a disaster. The discussion primarily explores the pros and cons of AI and robot applications, as well as issues related to regulation.

Teaching Reflection: 1) Knowledge Level: The dialogue demonstrates that students have a certain understanding of AI and robotics, having acquired knowledge about the risks and benefits of technological applications from the movie. Further guidance can be provided to encourage students to think about how to formulate specific measures for regulating AI from multiple perspectives, including ethics, law, and technology, thereby broadening and deepening their knowledge.

2) At the level of teaching methods: Triggering student discussions through references to popular movies can stimulate their interest and participation, making it an effective introductory approach. Subsequent teaching can continue to employ methods that integrate real-world cases and audiovisual materials. Additionally, organizing group debates, project-based learning activities, and other events can enable students to deepen their understanding of issues related to artificial intelligence through practice, enhancing their critical thinking and language expression abilities.

3.1.2. Word collocations and usage: DOK1 inferring meaning through observation and comparison

Differentiate between "used to do" and "be used to doing" based on example sentences.

E.g., It used to feel like 50 percent of my time was spent researching new restaurants.

I used to drink tea, but now I am used to drinking coffee.

“Used to do” indicates that something was done frequently in the past (but is no longer done); “be used to doing” means being accustomed to doing something.

Teaching Reflection: 1) At the level of knowledge comprehension: This approach of comparing through examples helps students intuitively grasp the differences between the two phrases. If time permits, additional example sentences in different contexts can be provided to help students achieve a more comprehensive and in-depth understanding. Students can also be asked to create their own sentences to test their mastery of the phrase usage.

2) At the level of teaching methods: Using example sentences for comparative learning is an effective vocabulary teaching method. Further expansion can be made in subsequent lessons, such as introducing relevant reading comprehension passages to allow students to identify and apply these two phrases within a textual context. Alternatively, group competitions can be organized to see which group can create the most reasonable sentences using these two phrases within a specified time, thereby increasing the fun of learning and student participation.

3.1.3. Inferring word meanings from context DOK 2

We could be seen as a minor inconvenience standing in the way of solving a bigger problem. If we’re lucky, AI might consider us valuable enough to keep around. If not, it might wipe us all out.

Students inferred the meaning of “wipe out” based on the context, with some associating it with “destroy.” This exercise trains students to understand the meanings of unfamiliar words using contextual clues, enhancing their reading comprehension and vocabulary inference skills.

Teaching Reflection: 1) Knowledge Mastery: The fact that students could quickly associate “wipe out” with “destroy” indicates that some of them possess a certain ability to infer word meanings. However, students can be further guided to analyze the context more deeply, such as considering the attitude of “AI” towards “us” and the consequences of its actions, to more accurately grasp the meaning of “wipe out” as “completely eliminate or eradicate” in the text, thereby deepening their understanding of the vocabulary in terms of both depth and breadth.

2) Teaching Methodology: Inferring word meanings from context is an effective vocabulary learning method. Subsequent exercises could include more passages on diverse topics and varying levels of difficulty to reinforce this skill. Group discussions can also be organized, allowing students to share their approaches to inferring word meanings and learn from each other. Meanwhile, teachers can provide timely feedback and summaries to enhance students’ overall vocabulary learning and reading skills.

3.1.4. Expression of sentence structure and meaning DOK1

By posing questions about each paragraph, educators can improve students’ speed-reading abilities and enable them to analyze sentence structures and infer word meanings from their answers.

For example, when the teacher asks, “*Why is the writer grateful to AI?*”

Answer: *Thanks to AI, I’ve got my own super-smart personal assistant built into my phone.*

Students were able to fully express their viewpoints and quickly identify the important grammar point of using non-finite verbs as postpositive attributives.

Teaching Reflection: 1) Knowledge Mastery: This method helps students consolidate their grammar knowledge, such as their understanding of non-finite verbs used as attributives. However, it can be further expanded by providing more complex sentence structures that include different types of non-finite verbs (present participles, past participles, and infinitives) used as attributives, adverbials, and object complements, thereby deepening students' comprehensive grasp of the grammatical system of non-finite verbs.

2) Teaching Methodology: Question-guided instruction effectively stimulates students' thinking and language use. Subsequently, the diversity of questions can be increased, such as incorporating reasoning and evaluative questions, to enhance students' higher-order thinking skills. Additionally, students can be encouraged to ask their own questions and respond to each other, increasing student participation and interaction, and creating a more lively classroom atmosphere.

3.2. Design tasks to enhance thinking quality

Provide tasks that offer intellectual challenges to stimulate students' thinking and use paragraph-based writing to improve their expressive abilities. For example, after reading an article, ask:

Teacher: *"Which part of the passage do you find the most impressive? Why?"*

Students: *"I find paragraph 4 the most impressive. The writer described the victims of AI so vividly that I could feel the terror and anxiety of the future."*

3.3. DOK4 appreciation, evaluation, and formation of new perspectives

Discussion

Work in pairs to share your impressions of the three individuals in the forum with your partner.

E.g. 1 In my opinion, Popkid is cautious and slightly pessimistic. Because...

E.g. 2 I think Millenniumbutterfly is an optimistic person. Because...

E.g. 3 As far as I'm concerned, Pink-hzae is a wise individual who can view AI issues objectively.

Debate Competition

Proponent: AI is a genuine achievement.

Opponent: AI is a genuine threat.

After reading the article, pose questions to guide students in appreciating, evaluating, and forming new perspectives; have students discuss their impressions of the forum participants in groups; conduct a debate competition on the topic "Is AI an Achievement or a Threat?" Students are required to analyze arguments from multiple perspectives and form critical viewpoints through verbal expression. By employing teaching methods such as debates, story continuation, and role-playing, students' thinking abilities can be exercised, and their critical thinking skills and language expression abilities can be cultivated.

Teaching Reflection: 1) Task Design: These tasks can stimulate students' thinking and expression, but they can be further optimized. For instance, when discussing impressions of forum participants, more relevant background information can be provided to enable students to conduct deeper and more comprehensive analyses. Prior to the debate competition, students can be given more training on debate techniques and

guidance on collecting materials to enhance the quality of the debates. Such tasks can effectively exercise students' logical thinking and cross-cultural perspectives, but it is important to note the balance between reliance on guidance and independent thinking.

2) Teaching Methods: The comprehensive application of various teaching methods is commendable, but attention should be paid to ensuring equitable student participation. Students who are introverted or have a weak foundation in English may exhibit lower participation levels in debates and role-plays. To address this, additional support can be provided in advance, such as offering guidance on group task allocation and providing language frameworks, to ensure that every student has the opportunity to enhance their thinking and expression skills.

4. How to cultivate students' language and learning abilities in English teaching

4.1. Student-centered approach with AI tools as supplements

The emergence of DeepSeek has brought about multifaceted impacts, including, of course, a disruption to the education sector. Modern teaching methods offer tremendous convenience to both teachers and students. Teachers can leverage the various English teaching materials provided by DeepSeek and the results of regular student tracking and assessments to save time on lesson preparation, optimize classroom design, and promptly adjust teaching plans. For instance, in English writing, teachers can input students' English essays into DeepSeek to identify grammar and vocabulary issues, and then receive suggestions for further optimization. Students can also enhance their learning efficiency and broaden their horizons through this process. Additionally, in vocabulary teaching, teachers can input commonly misspelled words and sentence patterns into DeepSeek to generate targeted exercises such as cloze tests or reading passages, enabling students to deepen their understanding of vocabulary and grammar meanings within contextual settings, thereby improving their language abilities.

AI tools like DeepSeek can optimize teaching designs, such as generating personalized exercises and providing writing feedback. However, it is crucial to guard against over-reliance. Teachers should maintain student-centeredness through classroom interactions. If students lazily rely on AI to handle their assignments, it will further hinder the cultivation of their thinking abilities. Therefore, teachers play an extremely important role in the process of using AI to assist teaching. Teachers should pay attention to students' feedback in the classroom to understand their learning quality. By adopting a student-centered approach and delivering precise instruction, teachers can encourage students to actively explain the relevant knowledge they have learned. Gradually improve language and learning abilities through student-student interaction and teacher-student interaction. Break down disciplinary barriers and construct an interdisciplinary curriculum system. For instance, taking "An Unforgettable Trip" as a theme, students can describe their most memorable journey. The task requires the use of the past tense, inclusion of some newly learned English vocabulary, and focuses on describing the destination, interesting encounters, and personal feelings. More interestingly, students can be encouraged to draw simple illustrations related to the topic and create an English picture book. Classmates can guess the storyline based on each other's picture books, experiencing the joy of learning amidst laughter. Such activities can stimulate students' interest in learning, combining illustration with English expression to cultivate interdisciplinary integration of art and language abilities. However, teachers need to clarify language objectives to avoid prioritizing form over content.

4.2. The interaction between learning attitude and learning ability

Cultivating students' English learning abilities first manifests in their having a positive learning attitude, developing good learning habits, being capable of autonomous learning, and valuing collaboration, as well as possessing an awareness of lifelong learning. Secondly, students should have a clear understanding of their own learning status and be able to select reasonable and effective learning strategies and methods based on different contexts and their actual situations.

The division of student ability levels (Level 1, Level 2, Level 3). At Level 3, students are required to have a comprehensive and accurate understanding of the significance of English learning, possess a strong interest and desire for English learning, have long-term plans and clear learning objectives, formulate, adjust, and optimize learning plans according to needs, and possess a strong learning motivation. These points are particularly crucial. After the first English exam, most students did not give up; they firmly believed they would perform better in the next exam. The confidence, expectations, and self-requirements of students towards the English subject are precisely manifestations of improved learning abilities.

A positive learning attitude can unleash students' potential, allowing them to absorb knowledge and tap into their potential in a relaxed and joyful state, continuously enhancing their learning abilities. A negative attitude, on the other hand, can stifle the development of students' thinking, causing them to give up easily when faced with difficulties, be reluctant to think, and be resistant to practice, resulting in a decline in abilities across various aspects. Teachers must be adept at observing and, once they notice that a student's emotions are off or their attitude is not positive, they should promptly understand the situation and provide targeted guidance. Meanwhile, improving learning abilities can help strengthen students' confidence, while a lack of ability can lead to a negative mindset and a sense of frustration in students. As the saying goes, "When you know how, it is not difficult; when you do not, it is hard." This further requires teachers to infect students with their enthusiasm, care about their dynamics, and help them achieve corresponding results, thereby increasing their self-confidence and allowing everything to develop positively.

Students are both willful and adorable. Sometimes, they decide their attitude towards a subject based on their liking for it and the strictness of the teachers in charge. The principle of "loving the person also means loving what is associated with them" is reflected in students' subject choices, highlighting the importance of emotional communication between teachers and students. Teachers can enhance mutual affection and strengthen learning motivation through personalized feedback (such as through cards, letters, or slideshows). When students like and respect a teacher, they will naturally value the subject.

For example, senior three students significantly improved their confidence and self-requirements in English learning through emotional encouragement from teachers, demonstrating a virtuous cycle of learning ability and attitude. In the last class of the previous senior three cohort, the teacher presented each student in the class with a greeting card, each adorned with a poem that cleverly incorporated the student's name. Some of the poems were well-known to the public, such as the one given to student Li Qingyun: "With favorable winds, I soar to the blue sky." For students for whom it was difficult to find a ready-made fitting poem, the teacher composed one themselves. For instance, the poem given to student Yang Yinan reads: "The laurel is plucked, first promised to me; Yang's arrow pierces three leaves, astonishing all." The poem for student Han Ruixuan was: "Wisdom shines like stars, illuminating the path ahead; with unrelenting penmanship, a splendid chapter is forged."

These poems were filled with beautiful blessings for the students and also marked a successful conclusion

to the teaching journey of the previous senior three cohort. This marks not only the end of a learning journey but also the starting point of a new expedition. I would like to express my gratitude for all the dedication and efforts invested in past teaching endeavors.

In summary, integrating the core competencies of the English subject into daily teaching is a task that is both complex and engaging. Against the backdrop of the big data era, while students benefit from technological advancements, they also face new challenges. Teachers need to ensure the effectiveness of core competency cultivation, striving to nurture young talents with innovative thinking that meet the demands of the times. By adopting teaching strategies that keep pace with the times, teachers can enhance students' comprehensive abilities, promote the practical implementation of core competency cultivation, and help students blossom into a more splendid future.

5. Summary and prospects

The cultivation of core competencies in the English subject is a systematic and long-term educational endeavor that requires teachers to continuously explore and innovate in their teaching practices. By analyzing the integration paths of the four core competencies—cultural awareness, thinking quality, language proficiency, and learning ability—and combining them with specific teaching cases, this paper proposes a teaching strategy centered on students, supported by technology, and connected through emotions. Research indicates that the practical implementation of core competencies relies not only on scientific curriculum design but also on teachers' ability to stimulate students' intrinsic motivation and creativity through diverse interactions and interdisciplinary integration.

With the rapid development of educational technology, English teaching will encounter more opportunities and challenges. Teachers need to further explore the following directions:

1. Balancing technological empowerment and humanistic care: While leveraging AI tools to enhance efficiency, teachers should be vigilant against the potential weakening of deep thinking caused by technology and emphasize the cultivation of students' humanistic qualities and critical thinking.
2. Tiered cultivation of core competencies: Tailor teaching methods to the characteristics of students at different levels, refine competency development goals, and establish a more precise evaluation system.
3. Deepening of interdisciplinary integration: Strengthen the linkage between English and other disciplines (such as science and art), design more comprehensive practical tasks in real-world contexts, and promote the all-round development of students.

The ultimate goal of education is to cultivate lifelong learners who are “emotionally engaged, capable of critical thinking, and adept at learning.” English teachers should always be guided by core competencies, driving educational transformation through innovation and reflection, laying a solid foundation for students' future development. On the one hand, they should continuously explore novel and efficient teaching methods to enhance students' language proficiency. On the other hand, they should regularly participate in teaching research activities and engage in teaching reflection to analyze the strengths and weaknesses in the teaching process, adjusting teaching strategies in a timely manner based on student feedback and learning outcomes. This ensures that English education goes beyond merely imparting language knowledge and places greater emphasis on enhancing students' overall competencies, thereby nurturing high-quality talents for our country who possess an international perspective, innovative thinking, and lifelong learning capabilities.

Disclosure statement

The author declares no conflict of interest.

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Research on Teaching Reform and Innovation in a Time Series Analysis Course Based on Artificial Intelligence

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Abstract: Artificial intelligence is developing rapidly, and its applications in the field of education are becoming increasingly widely popular. As a core course in statistics, economics, finance, and related disciplines, the time series analysis course is characterized by its strong theoretical and practical dimensions. This study explores teaching reform and innovation in a time series analysis course based on artificial intelligence. It optimizes teaching content, methodologies, and assessment systems by integrating artificial intelligence tools and techniques. The aim is to enhance students' learning engagement and practical application skills, cultivate their innovative thinking, and strengthen their ability to solve real-world problems. Furthermore, this study provides valuable insights for teaching reforms in related academic fields.

Keywords: Time series analysis; Artificial intelligence; Intelligent tutoring; Evaluation system

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1. Introduction

The time series analysis course serves as a core course across multiple disciplines, including statistics, economics, finance, etc. Its goal is to systematically study observation data arranged chronologically, reveal the inherent patterns of phenomena evolving over time, and this foundation enables the establishment of predictive models to support decision-making ^[1]. With the rapid advancement of big data and artificial intelligence (AI), the application of time series analysis has deepened and expanded across numerous domains, including macroeconomic forecasting, financial market modeling, industrial Internet of Things monitoring, smart medical diagnostics, and climate and environmental monitoring ^[2]. This trend places increasingly urgent demands on universities to cultivate high-caliber talents equipped with solid theoretical foundations, proficient technical tool usage, and interdisciplinary innovative thinking.

However, the traditional teaching of the time series analysis course still faces significant challenges.

In terms of content, instruction often emphasizes theoretical derivations of classical statistical models while failing to effectively integrate emerging time-series models from machine learning and deep learning ^[3–4]. This disconnect leaves students' knowledge systems out of step with industry frontiers. Teaching methods predominantly rely on a one-way lecture format where instructors deliver content and students passively absorb it, which makes it difficult to inspire students' enthusiasm for exploration and innovation. In practical sessions, constrained by limited class hours and software tools, experiments often remain confined to simple modeling of outdated datasets. Students lack experience handling real-world, massive, and high-dimensional time series data. Furthermore, course assessments typically rely heavily on written examinations, which fail to comprehensively evaluate students' model application skills, critical thinking, and practical problem-solving capabilities ^[5].

Therefore, in the current era of AI, teaching reform and innovation for time series analysis courses have become imperative. This study explores teaching reform and innovation in a time series analysis course based on AI. It optimizes teaching content, methodologies, and assessment systems by integrating AI tools and techniques. The aim is to enhance students' learning engagement and practical application skills, cultivate their innovative thinking, and strengthen their ability to solve real-world problems. Furthermore, this study provides valuable insights for teaching reforms in related academic fields.

2. Current applications of AI in education

AI can provide personalized learning paths and content recommendations based on students' learning progress and styles, which help them learn more effectively ^[6–10]. For example, through data analysis within learning management systems (LMS), AI can identify where students struggle with specific knowledge points and recommend relevant learning resources and practice exercises.

With natural language processing and machine learning technologies, intelligent tutoring systems can provide real-time answers to student questions and immediate feedback to resolve learning challenges. For instance, such systems can interact with students via chatbots to address specific course-related queries.

Furthermore, AI can automatically evaluate student assignments and exams, generating detailed analytical reports to help educators better understand learning outcomes and adjust teaching strategies. For instance, machine learning algorithms can automatically grade programming assignments and suggest code optimizations.

In addition, with virtual reality (VR) and augmented reality (AR) technologies, AI creates virtual labs where students perform practical operations to enhance hands-on skills. For example, VR enables students to visually track trends in time-series data, while AR allows them to build models and make predictions directly on real-world data.

3. Teaching reform of the time series analysis course based on AI

3.1. Optimizing teaching content

Systematically integrating AI tools into curriculum reform is a crucial pathway to enhancing students' practical skills. As shown in **Figure 1**, optimizing teaching content involves introducing artificial intelligence tools and integrating real-world case studies. Centered on the Python ecosystem, this course progressively integrates modern machine learning and deep learning toolchains. At the foundational level, it first establishes students' Python programming fundamentals, emphasizing the data processing capabilities of the Pandas library (including

resampling time series data, sliding window operations, and handling missing values) and the numerical computation basics of the NumPy library, laying a solid technical groundwork for subsequent analysis.

At the machine learning application level, the course strategically introduces the scikit-learn library. It not only covers common regression and classification models but also incorporates time series analysis characteristics, specifically designing teaching content that encompasses feature engineering, cross-validation strategies, and model evaluation methods. Through this module, students will proficiently master standardized processing of time series data, feature extraction, and the construction workflow of traditional machine learning models.

To further address complex time series forecasting demands, the advanced section introduces TensorFlow and PyTorch—two major deep learning frameworks. Through detailed explanations of the structural principles and implementation methods for models like Recurrent Neural Networks (RNN), Long Short-Term Memory Networks (LSTM), and Gated Recurrent Units (GRU), students are guided to build end-to-end deep learning prediction models. The course places particular emphasis on hands-on practice, requiring students to independently complete the entire workflow from data preprocessing, model construction, training optimization, to prediction evaluation.

To integrate theoretical instruction with practical skill development, the course incorporates multiple real-world case projects. In finance, students utilize real-time stock price data from the New York Stock Exchange to predict stock price trends and analyze market volatility patterns by building Autoregressive Integrated Moving Average models (ARIMA) and LSTM neural networks. In meteorology, students utilize multi-year observational data from the National Meteorological Center to perform seasonal decomposition and periodic forecasting, mastering seasonal adjustment techniques in time series analysis. For macroeconomic analysis, students access GDP, Consumer Price Index, and inflation rate data released by the National Bureau of Statistics to build multivariate forecasting models, exploring the intrinsic correlations and patterns among economic indicators.

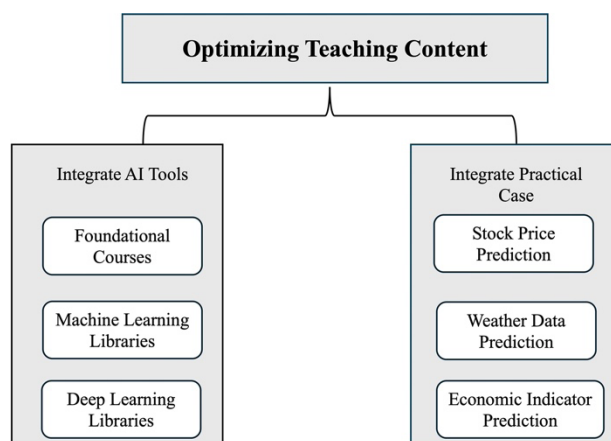


Figure 1. Summary of optimizing teaching content

3.2. Innovative teaching methods

At the pedagogical level, this course actively advances teaching model innovation supported by AI technology, establishing a diversified instructional system that integrates intelligent tutoring, virtual training, and project-based practice. The innovative teaching methods, as shown in **Figure 2**, include an intelligent tutoring system,

virtual laboratories, and project-driven teaching. Firstly, the course incorporates an intelligent tutoring system based on natural language processing technology. This system can automatically identify and categorize questions posed by students, providing precise answers tailored to different question types. For theoretical questions, the system delivers detailed formula derivations, principle explanations, and relevant literature recommendations. For practical questions, it generates concrete code examples and operational guides. Additionally, the system incorporates a robust feedback mechanism that continuously optimizes its knowledge base and response strategies by recording student evaluations of answers, enabling self-evolving teaching resources.

Secondly, the course leverages VR and AR technologies to construct immersive virtual laboratories. Within VR experimental environments, students can use head-mounted displays to enter three-dimensional visualizations, intuitively observing dynamic patterns in time series data—such as tracking real-time stock price fluctuations in simulated financial trading scenarios. In AR environments, students use mobile devices to overlay virtual models onto real-world datasets, enabling interactive analysis and predictive operations within mixed reality. This technology enhances learning engagement and cultivates students’ data perception and spatial reasoning skills.

Finally, the course employs project-driven pedagogy, designing multiple real-world application scenarios. Students select authentic topics based on their interests, such as corporate sales data analysis or financial market forecasting, and undergo the entire process from data collection and cleaning, feature engineering, model building, and optimization, to visualizing results. Throughout project execution, students must prepare technical reports and deliver defense presentations. This process hones their ability to tackle complex problems while simultaneously developing teamwork and academic communication skills. Through this “learning by doing” approach, students gain deep insights into the practical value of time series analysis methods, building solid professional core competencies.

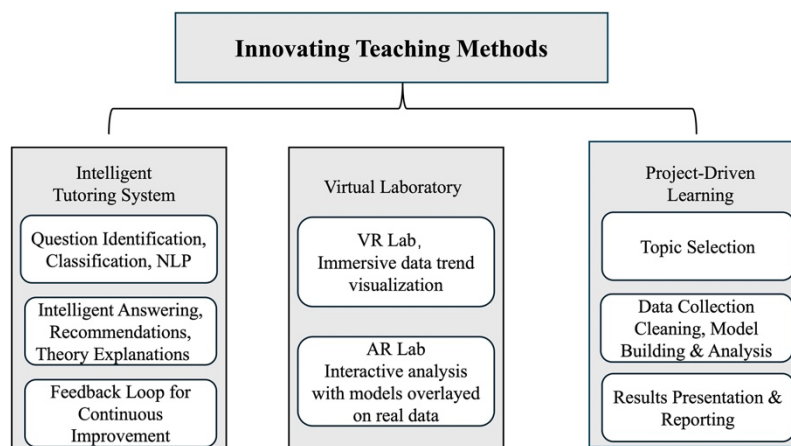


Figure 2. Summary of innovative teaching methods

3.3. Perfecting evaluation systems

Regarding the evaluation system, this course has established a diversified, process-oriented, and personalized comprehensive assessment framework supported by AI technology. **Figure 3** illustrates that the perfecting evaluation system incorporates automated assessment, process evaluation, and personalized feedback. Firstly, an automated evaluation system developed using AI technology enables precise assessment of student learning outcomes. For programming assignments, the system employs machine learning algorithms to perform

static and dynamic code analysis. It not only automatically identifies syntax errors and logical flaws but also provides improvement suggestions in areas such as algorithm optimization, code standardization, and execution efficiency. For theoretical exams, natural language processing technology is employed to perform semantic analysis and knowledge point matching on text-based answers, automatically generating detailed assessment reports that include scoring criteria, error analysis, and knowledge mastery levels, significantly enhancing evaluation efficiency and objectivity.

Beyond focusing on automated assessment of final outcomes, the course places particular emphasis on formative evaluation, comprehensively tracking student performance and development throughout the learning process. Through multidimensional data collection and analysis, the system quantitatively assesses students' classroom engagement, project implementation capabilities, and virtual experiment proficiency. This formative assessment mechanism enables instructors to promptly identify learning challenges and provides data-driven support for instructional interventions.

At the personalized feedback level, the system leverages big data analytics to generate multidimensional learning profiles and diagnostic reports for each student. These reports not only precisely analyze students' mastery across knowledge modules in time series analysis but also reveal their learning behavior patterns and skill development gaps. Based on these analyses, the system intelligently pushes personalized learning recommendations and customized resources. For instance, it recommends classic literature and case libraries to students weak in model selection, and provides specialized training programs for those lacking programming practice skills. This closed-loop evaluation system—"Assessment-Diagnosis-Feedback-Improvement" provides a robust guarantee for cultivating high-caliber data analytics talents.

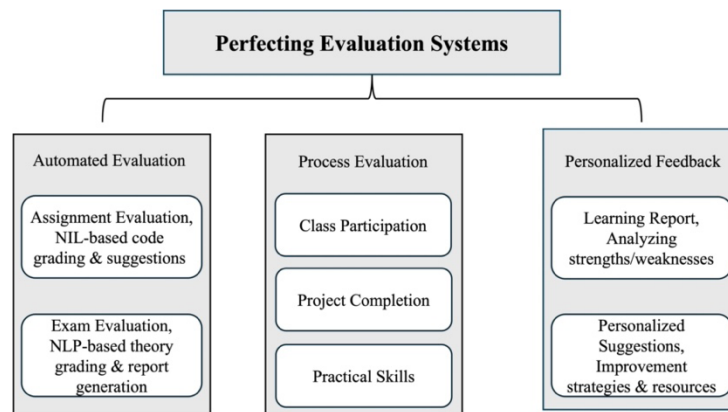


Figure 3. Summary of perfecting evaluation systems

4. Implementation outcomes of teaching reform

4.1. Significant increase in student engagement

The introduction of AI tools and methodologies has markedly heightened student interest in the time series analysis course. Classroom participation has notably increased, with students demonstrating greater initiative in self-directed learning. Specifically, classroom interactions have grown more frequent, with students showing greater willingness to ask questions and participate in discussions, and creating a more dynamic learning environment. Additionally, self-directed study time has expanded significantly, as students now spend considerably more time independently exploring and learning relevant knowledge after class.

4.2. Substantial enhancement in students' practical skills

Through virtual laboratories and project-driven instruction, students' practical operational capabilities have markedly improved. Students can proficiently utilize AI tools for data processing and model analysis, with significantly improved problem-solving capabilities for real-world scenarios. Specifically, firstly, data processing skills have advanced, enabling students to skillfully employ libraries for data preprocessing. Secondly, model construction abilities have improved, allowing students to build and optimize time series forecasting models. Additionally, practical problem-solving capabilities have grown, with students capable of independently completing analyses and predictions for real projects while proposing reasonable solutions.

4.3. Holistic enhancement of student competencies

Through formative assessment and personalized feedback, students not only deepened their theoretical knowledge and practical skills in time series analysis but also cultivated teamwork, innovative thinking, and real-world problem-solving abilities. Specifically, firstly, team collaboration improved significantly, as project-driven learning required students to work collectively with teammates to complete tasks. Secondly, innovative thinking abilities are strengthened, as students must continuously experiment and explore within projects, thereby strengthening and refining their innovative thinking skills. Finally, overall competence is elevated, with students achieving comprehensive enhancement in their comprehensive qualities, laying a solid foundation for future studies and careers.

5. Conclusion

The teaching reform and innovation in the time series analysis course based on AI has effectively enhanced students' learning interest and practical skills by introducing AI tools and methodologies, optimizing teaching content, innovating instructional approaches, and perfecting evaluation systems. This reform has cultivated students' innovative thinking and problem-solving abilities in real-world contexts. This mode of teaching reform offers valuable insights for course instruction in related disciplines and holds significant potential for broader application. In future teaching practices, educators should continuously explore and innovate teaching methods based on students' actual circumstances and course characteristics, further enhancing teaching quality to make contributions toward cultivating high-quality professional talents.

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Disclosure statement

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Analysis of the Practical Value of Virtual Simulation Technology in the Teaching of Critical Care Nursing for Systemic Lupus Erythematosus

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Abstract: *Objective:* To explore the application effect of virtual simulation technology in the teaching of critical care nursing for systemic lupus erythematosus (SLE), and to provide a basis for optimizing the nursing teaching model in the Department of Rheumatology and Immunology. *Methods:* Twenty nursing interns who interned in the Department of Rheumatology and Immunology of the hospital from July 2024 to August 2025 were selected as the research subjects, and they were given a 4-week “virtual simulation + traditional teaching” intervention. The theoretical assessment scores, practical assessment scores, and clinical decision-making ability scores were compared before the intervention (baseline) and after the intervention (end of teaching). Meanwhile, the ability to simulate the handling of adverse events (identification time, emergency implementation time, and correct handling rate) before and after the intervention was compared. Combined with the teaching satisfaction survey after the intervention, the practical value of virtual simulation technology was analyzed. *Results:* After the intervention, the theoretical assessment scores, practical assessment scores, and clinical decision-making ability scores of the 20 research subjects were significantly higher than those before the intervention, with statistically significant differences ($P < 0.05$). After the intervention, the identification time of adverse events and the implementation time of emergency measures for the 20 research subjects were significantly shorter than those before the intervention, and the correct handling rate was significantly higher than that before the intervention, with statistically significant differences (all $P < 0.05$). After the intervention, among the 20 research subjects, 15 (75.0%) were “very satisfied”, 4 (20.0%) were “generally satisfied”, and 1 (5.0%) was “unsatisfied”, with an overall satisfaction rate of 95.0% (19/20). *Conclusion:* Virtual simulation technology can improve the teaching quality of critical care nursing for SLE, enhance the theoretical mastery, practical ability, and clinical decision-making ability of intern nurses, and is worthy of promotion and application in the nursing teaching of the Department of Rheumatology and Immunology.

Keywords: Virtual simulation technology; Systemic lupus erythematosus; Critical care nursing; Nursing teaching; Clinical decision-making ability

Online publication: October 16, 2025

1. Introduction

Systemic Lupus Erythematosus (SLE) is an autoimmune disease that can affect multiple systems throughout the body. When critical conditions such as lupus encephalopathy, severe lupus nephritis, and hemolytic anemia arise, the disease progresses rapidly and is associated with a high mortality rate, posing extremely high demands on the professional competence of nursing staff^[1]. However, clinical cases of critical SLE are relatively rare, making it difficult for nursing interns to gain sufficient hands-on experience through traditional teaching methods. Additionally, the “high uncontrollable risks” and “numerous ethical constraints” in real clinical settings lead to issues in nursing education, such as a “disconnect between theory and practice” and “inadequate training in emergency response capabilities.” Virtual simulation technology, by constructing highly realistic clinical scenarios, can simulate the onset, symptom progression, and emergency treatment processes of critical SLE, providing nursing interns with a “repeatable and risk-free” training environment^[2-3]. In recent years, this technology has demonstrated significant advantages in fields such as emergency nursing and surgical nursing, but there has been limited research on its application in specialized nursing education within the rheumatology and immunology departments. This study systematically analyzes the practical value of this technology in SLE critical care nursing education by comparing the effectiveness of traditional teaching methods with virtual simulation teaching.

2. Materials and methods

2.1. General information

Twenty nursing interns who completed their internships in the rheumatology and immunology department of our hospital from July 2024 to August 2025 were selected as the study subjects. Among them, there were 2 males and 18 females, with an average age of (22.35 ± 0.82) years. Sixteen interns held a bachelor's degree, while 4 held a master's degree. Eleven interns had prior internships in internal medicine, and 9 had internships in surgery. The baseline data (theoretical foundation and operational skills) of all study subjects were assessed and found to have no significant differences, meeting the consistency conditions for self-comparison before and after the study.

Inclusion criteria: (1) Possession of a bachelor's degree or higher in nursing, with their first internship in the rheumatology and immunology department; (2) No prior work experience in SLE nursing; (3) Voluntary participation in this study and signing of an informed consent form. Exclusion criteria: (1) Taking leave for personal reasons exceeding 2 weeks during the internship period; (2) Presence of cognitive dysfunction or communication impairment.

2.2. Teaching methods

All 20 study subjects underwent a 4-week intervention combining “virtual simulation and traditional teaching.” The curriculum was designed around the core competency requirements for critical care in Systemic Lupus Erythematosus (SLE), covering topics such as the etiology, clinical manifestations, nursing assessments, emergency interventions (including intracranial pressure monitoring, blood purification coordination, and immunosuppressant administration care), and complication prevention for conditions like lupus encephalopathy, lupus nephritis with renal failure, severe infections, and hemolytic anemia. The specific implementation process is outlined below:

2.2.1. Basic module of traditional teaching (Throughout the 4-week period)

(1) Theoretical Instruction: Conducted through “PPT lectures and case analysis”, held twice weekly for 60 minutes each session. Clinical instructors with the title of head nurse or above from the Rheumatology and Immunology Department delivered the lectures, focusing on explaining the diagnostic criteria for critical SLE, nursing standards, and guideline-recommended content; (2) Clinical Practice: Bedside teaching was conducted in real wards, where instructors demonstrated basic procedures such as intravenous catheter insertion and vital sign monitoring. Intern nurses practiced in the demonstration room and then performed limited hands-on procedures on patients under the supervision of instructors (three times weekly for 60 minutes each session); (3) Weekly Review: At the end of each week, theoretical Q&A sessions and case discussions were held to reinforce knowledge retention and clinical thinking integration.

2.2.2. Virtual simulation intervention module (Conducted concurrently with traditional teaching)

The “Rheumatology and Immunology Disease Virtual Simulation Teaching System”, developed by a medical technology company in Beijing, was employed. It featured three core intervention modules, implemented in three stages: (1) Pre-class Preview (15 minutes per session, twice weekly): Study subjects viewed animations on the pathological mechanisms of critical SLE conditions (e.g., glomerular damage caused by immune complex deposition) and virtual case symptom demonstration videos (e.g., the progression of consciousness blurring in lupus encephalopathy patients) through the system. They then completed pre-class knowledge tests (with a passing score of 80). (2) In-class Training (60 minutes per session, twice a week): Group-based scenario simulation training is conducted, focusing on six types of typical critical scenarios in systemic lupus erythematosus (SLE) (such as convulsions due to lupus encephalopathy, renal failure due to lupus nephritis, and septic shock), with interactive tasks to be completed ^[4]. For example, in the “Convulsions due to Lupus Encephalopathy Emergency” scenario, participants are required to sequentially complete tasks such as “calculating the dosage of sedative drugs, standard use of restraints, and intracranial pressure monitoring.” The system provides real-time feedback on operational errors (e.g., “The dosage of sedative drugs is too high, indicating a risk of respiratory depression”) and generates immediate scores. (3) Post-class Reinforcement (30 minutes per session, twice a week): The system automatically pushes specialized training tasks (such as blood purification circuit connection and ventilator parameter adjustment) based on the weak areas identified during in-class training and generates personalized error collections ^[5]. The research subjects are required to review and correct the errors until the accuracy rate reaches $\geq 90\%$.

2.2.3. Integration of virtual and real scenarios (Once a week, 45 minutes)

By comparing typical cases from virtual simulation scenarios (such as “Lupus Nephritis Complicated with Septic Shock”) with real-life clinical cases, the differences in nursing care (e.g., the difference between “real-time fluctuations in patient vital signs” in virtual scenarios and the “insidious nature of the condition” in real-life scenarios) are highlighted. This approach aims to guide the research subjects in developing a transferable mindset from “virtual training” to “clinical practice.”

2.3. Observation indicators

2.3.1. Evaluation of teaching effectiveness

(1) Theoretical Assessment: A unified test paper (with a full score of 100 points) is used before and after the

teaching to assess the understanding of the etiology, clinical manifestations, and nursing measures of critical SLE conditions. The test includes multiple-choice questions (both single and multiple answers) and short-answer questions.

- (2) Practical Assessment: Before and after the teaching, a three-member assessment team consisting of head nurses from the rheumatology and immunology departments conducts practical assessments (with a full score of 100 points) using “standardized patients + simulation teaching aids.” The assessment items include “intravenous puncture (25 points), vital sign monitoring (20 points), implementation of emergency measures (35 points), and nursing documentation (20 points).” The average score given by the three assessors is taken as the final result.
- (3) Scoring of clinical decision-making ability: The Nursing Clinical Decision-Making Ability Scale (CDMNS) was employed, which encompasses four dimensions: “Problem Identification (20 points)”, “Plan Formulation (30 points)”, “Implementation and Evaluation (30 points)”, and “Reflection and Improvement (20 points).” The scale has a total score of 100 points. Scores were assigned by the supervising teacher based on the performance of the intern nurses during teaching, with higher scores indicating stronger decision-making abilities.

2.3.2. Assessment of adverse event handling ability

After the completion of teaching, both groups underwent simulated tests for adverse events in critical SLE cases. Two scenarios were set up: “Sudden convulsions in a patient with lupus cerebritis” and “Abrupt drop in blood pressure in a patient with lupus nephritis.” The following were recorded for both groups: (1) Adverse event identification time (from the start of the scenario to the time of definitive diagnosis); (2) Time to implement emergency measures (from the time of definitive diagnosis to the initiation of emergency measures); (3) Accuracy rate of handling (scoring criteria were developed based on the “SLE Diagnosis and Treatment Guidelines (2020 Edition)”, with a total score of 100 points and ≥ 80 points considered accurate).

2.3.3. Teaching satisfaction survey

A self-made satisfaction questionnaire (total score of 100 points) was used to evaluate four dimensions: “Practicality of Teaching Content (30 points)”, “Interest of Teaching Methods (25 points)”, “Effectiveness of Ability Enhancement (25 points)”, and “Quality of Teacher Guidance (20 points).” Scores ≥ 80 points were considered satisfactory, and the satisfaction rate was calculated (number of satisfied individuals/total number of individuals $\times 100\%$).

2.4. Statistical methods

Data analysis was performed using SPSS 26.0 statistical software. Continuous data were expressed as (Mean \pm SD), and paired *t*-tests were used for pre- and post-intervention comparisons within the same group. Categorical data were expressed as [n (%)], and descriptive statistics were used for satisfaction analysis. A *P*-value < 0.05 was considered statistically significant.

3. Results

3.1. Comparison of teaching effects before and after intervention

After the intervention, the theoretical assessment scores, practical assessment scores, and clinical decision-

making ability scores of the 20 study subjects were significantly higher than those before the intervention, with statistically significant differences (all $P < 0.05$) (Table 1).

Table 1. Comparison of teaching effectiveness scores before and after intervention (Mean \pm SD)

Indicator	Theoretical assessment score	Practical assessment score	Clinical decision-making ability score
Before intervention	65.32 \pm 7.15	68.45 \pm 6.92	62.18 \pm 8.34
After intervention	89.62 \pm 5.37	91.25 \pm 4.81	88.73 \pm 6.12
<i>t</i> -value	17.187	17.111	16.232
<i>P</i> -value	0.000	0.000	0.000

3.2. Comparison of adverse event handling capabilities before and after intervention

After the intervention, the adverse event identification time and emergency measure implementation time of the 20 study subjects were significantly shorter than those before the intervention, and the correct handling rate was significantly higher than before the intervention, with statistically significant differences (all $P < 0.05$) (Table 2).

Table 2. Comparison of adverse event handling capabilities before and after intervention (Mean \pm SD)

Indicator	Adverse event recognition time (s)	Emergency measure implementation time (s)	Correct handling rate (points)
Before intervention	68.75 \pm 11.32	105.38 \pm 12.67	81.62 \pm 5.73
After intervention	45.23 \pm 8.67	78.56 \pm 10.24	92.35 \pm 4.18
<i>t</i> -value	10.433	10.412	9.568
<i>P</i> -value	0.000	0.000	0.000

3.3. Comparison of teaching satisfaction before and after intervention

After the intervention, among the 20 study subjects, 15 (75.0%) were “very satisfied”, 4 (20.0%) were “generally satisfied”, and 1 (5.0%) was “dissatisfied”, resulting in an overall satisfaction rate of 95.0% (19/20). The primary reason for dissatisfaction was “slight dizziness after wearing VR equipment for 1 hour” (1 case).

4. Discussion

This study employed a pre- and post-intervention self-control design, effectively controlling for the interference of individual baseline ability differences on teaching effectiveness. The results showed that the “virtual simulation + traditional teaching” model significantly improved the teaching quality of critical care nursing for SLE, which is closely related to the “visual, repeatable, and risk-free” characteristics of virtual simulation technology. In terms of core competency enhancement, both theoretical and practical assessment scores significantly improved after the intervention. The reasons for this improvement are as follows: On one hand, the virtual simulation system transforms abstract pathological mechanisms into visual symptom evolution through “dynamic scenarios + interactive training”, aligning with the cognitive laws of “visual learning” [6]. On the other hand, the system’s “real-time feedback” function promptly corrects operational errors made by nursing interns, avoiding the issue of “difficulty in tracing errors after incorrect operations” in traditional teaching and

enhancing the precision of practical training.

Furthermore, the scores for clinical decision-making abilities also significantly improved after the intervention, thanks to the “multi-variable emergency scenario” design of the virtual simulation system. For instance, scenarios such as “a lupus nephritis patient experiencing concurrent drops in blood pressure and electrolyte imbalances” forced the study subjects to prioritize critical issues within a limited timeframe, gradually cultivating “structured clinical thinking.” This addressed the shortcomings of traditional teaching methods, which often involve “passive knowledge acquisition and a lack of independent decision-making training”^[7].

In terms of adverse event management capabilities, both the identification time and emergency response time significantly decreased after the intervention, while the accuracy of handling improved markedly. This directly validated the value of virtual simulation technology in cultivating “emergency response capabilities.” The core challenges in clinical teaching for severe SLE cases lie in the “scarcity of cases and risk constraints”: trainee nurses find it difficult to access various critical care scenarios, and the fear of making mistakes in real-life operations leads to insufficient training^[8]. However, the virtual simulation system encompasses six categories of severe SLE scenarios, allowing study subjects to repeatedly practice high-risk procedures (such as administering high doses of immunosuppressants) without real-world consequences, even if errors occur. Through “deliberate practice”, they accumulate clinical experience. In this study, one subject initially had a low accuracy rate in handling cases due to a “calculation error in sedative dosage” before the intervention. After undergoing 10 specialized training sessions in the virtual system, their post-intervention accuracy rate exceeded 90 percent, demonstrating the typical effect of “risk-free repetitive training.”

From the perspective of teaching satisfaction, the 95.0% satisfaction rate surpassed that of traditional teaching methods (previous studies indicate satisfaction rates of approximately 70%–80% for traditional teaching)^[9]. This can be attributed to the enhanced “interactivity and targeted nature” of teaching facilitated by virtual simulation technology. On one hand, immersive VR experiences (such as simulating the drop in blood oxygen levels when a patient experiences dyspnea) and group competition-based training (comparing emergency response speeds) transformed “passive learning” into “active participation”, reducing learning aversion. On the other hand, the “personalized learning reports” generated by the system helped study subjects identify their weaknesses (such as low scores in intracranial pressure monitoring procedures), enhancing their sense of learning accomplishment^[10]. Only one subject expressed dissatisfaction due to VR device-induced dizziness, suggesting that future improvements could involve optimizing the weight of VR devices and adjusting scene brightness to enhance the user experience.

This study has the following limitations: Firstly, the sample size is relatively small, and the research was conducted in only a single hospital, which may limit the generalizability of the results. Secondly, the follow-up period is relatively short, and the impact of virtual simulation teaching on the long-term clinical competence of nursing interns has not been evaluated. Thirdly, the “individual differences” among nursing interns were not taken into account.

Future research can be improved in three aspects: Firstly, expanding the sample size and conducting multi-center studies to verify the universality of virtual simulation technology. Secondly, extending the follow-up period to track the clinical performance of nursing interns within 1–2 years after graduation and evaluate the “long-term effects” of teaching. Thirdly, optimizing the virtual simulation system by incorporating a “personalized learning path” feature that automatically adjusts the training difficulty and content based on the

learning progress and ability level of nursing interns, achieving “precision teaching.”

In conclusion, virtual simulation technology holds significant practical value in the teaching of critical care nursing for systemic lupus erythematosus. It can overcome the limitations of traditional teaching methods, enhancing teaching quality and satisfaction. This technology provides new ideas and approaches for specialized nursing teaching in the rheumatology and immunology department.

Disclosure statement

The authors declare no conflict of interest.

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Visualization Analysis of Research Frontiers and Hotspots of CBL in Medical Education in China Based on CiteSpace

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Abstract: *Objective:* This study aims to carry out a visualization analysis of the research literature on Case-Based Learning (CBL) in the field of medical education in China, thereby providing a reference for medical educators and researchers. *Methods:* Literature related to CBL teaching methods was retrieved from databases such as CNKI and visualized using CiteSpace software. *Results:* CBL research in China demonstrates phased characteristics. The research hotspots encompass application, innovation in teaching models, and clinical practice. The research has evolved from the establishment of basic methods (2006–2012) to the evaluation of effects and the application of technology (2013–2018), and further to curriculum integration and professional development (2019–2024). *Conclusion:* CBL research has made progress; however, it still faces issues such as insufficient theoretical exploration. Future research should focus on strengthening theoretical construction, delving deeper into teaching principles, adopting rigorous research designs and multi-dimensional assessment methods, and exploring the integration of information technology to promote the extensive application and in-depth development of CBL teaching methods.

Keywords: CBL; CiteSpace; Bibliometrics

Online publication: October 16, 2025

1. Introduction

Case-Based Learning (CBL), as an effective teaching method, has been widely applied and researched in the field of medical education ^[1]. By integrating theoretical knowledge with practical cases, CBL can enhance students' clinical thinking abilities and practical skills, while also boosting their interest and engagement in learning ^[2]. In recent years, with the continuous advancement of medical education reform, the application of CBL in medical education in China has become increasingly widespread, making it one of the important research hotspots in medical education. Understanding the research frontiers and hotspots of CBL in the

field of medical education in China can help educators and researchers better grasp the development trends of the discipline, optimize teaching methods and content, and improve the quality of medical education. A CiteSpace visualization analysis of medical education in China can clearly illustrate the research hotspots and frontier trends of CBL in this field, identify gaps and deficiencies in research, and provide directions and ideas for future studies.

2. Materials and methods

2.1. Literature retrieval strategy

The databases of CNKI, Wanfang, and VIP were searched using the keywords “CBL”, “Case-Based Learning”, or “case-based teaching method”, along with “medicine”, from the inception of the databases to December 2024. The search was conducted on January 3, 2025.

2.2. Inclusion and exclusion criteria

Inclusion criteria encompassed studies related to the application of CBL in medical education, including its application, effectiveness evaluation, instructional design, and reform. The literature types included formally published works, such as journal articles. Exclusion criteria comprised literature unrelated to this study, such as CBL research in non-medical education fields, dissertations, conference papers, newspapers, and books.

2.3. Literature analysis method

The literature was imported into the NoteExpress software for management. Basic information (such as publication year, research institution, source, research type, funding support, and keywords) and content information were extracted. After exporting the data as a RefWorks format file, it was imported into CiteSpace 6.1.R5 for visualization analysis, generating various visual co-occurrence maps. Research hotspots and development trends were understood through node sizes and connections.

3. Results

3.1. Analysis of publication volume

The number of academic papers serves as a key indicator for measuring the development of a field. From 2006 to 2013, the volume of publications in the CBL field was low, with only 66 papers published in 2013, marking the stage of concept introduction and preliminary exploration. From 2014 to 2020, the field entered a period of rapid growth, reaching 315 papers in 2020, indicating rapid development driven by advancements in educational technology, increased demand for medical education reform, and recognition of the effectiveness of CBL in enhancing clinical thinking skills. From 2021 to 2024, the field entered a mature and adjustment phase, with a peak of 372 papers published in 2021 and a total of 2,152 papers. Despite a decline in 2022–2023, the overall publication volume continued to grow, indicating that the CBL field has entered a mature stage where researchers are integrating and deepening their findings. **Figure 1** illustrates the rise and maturation of CBL in Chinese medical education research.

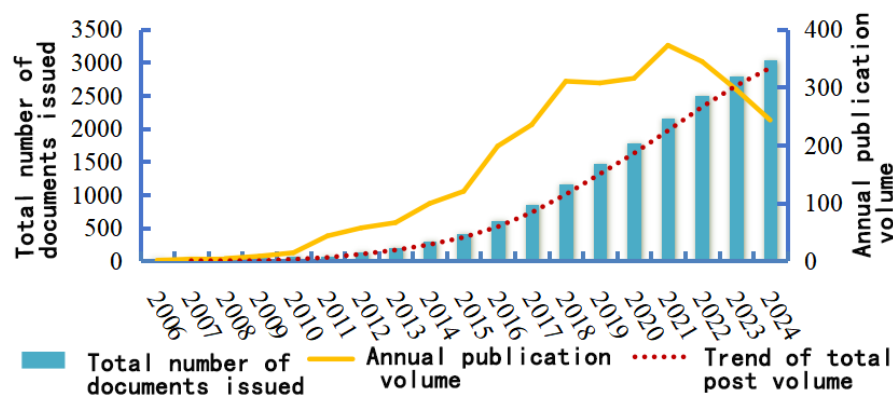


Figure 1. Trend chart of publication volume

3.2. Keyword co-occurrence analysis

Keyword analysis reveals that CBL teaching methods and case-based teaching methods are focal points in medical education research, mentioned 405 and 275 times, respectively (**Figure 2**). Teaching models and methods, as core themes, appeared 231 and 218 times, respectively, indicating researchers' focus on innovation and application. Initially, research focused on CBL teaching, teaching reform, and medical education, then shifted to clinical teaching (264 times), clinical internships (98 times), and clinical clerkships (88 times), emphasizing the application of CBL in clinical practice. The mention of teaching effectiveness and standardized training indicates researchers' attention to the efficacy and standardization of CBL. Research on emerging teaching models, such as flipped classrooms, PBL teaching, and applications in medical imaging, reflects innovation and expansion in the CBL field.

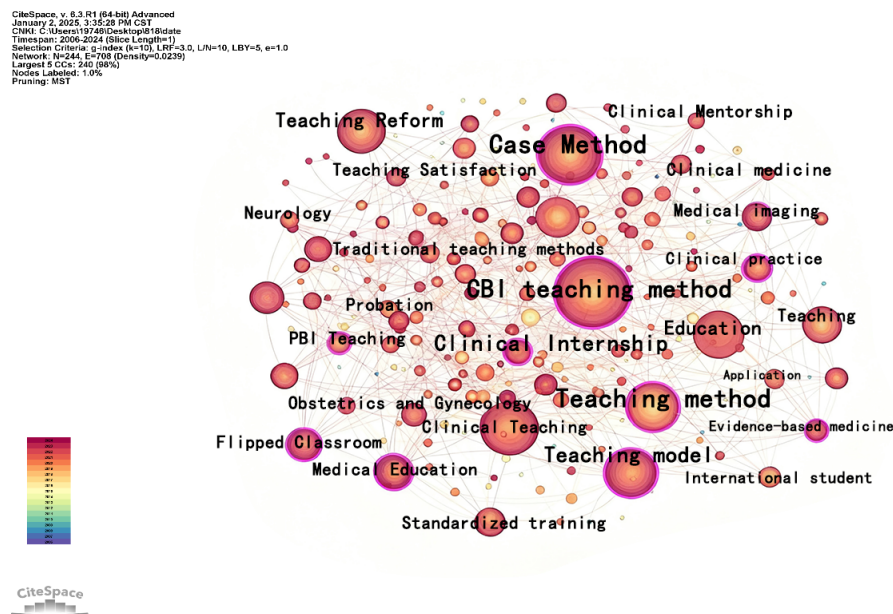


Figure 2. Keyword co-occurrence map

3.3. Keyword clustering analysis

Keyword clustering analysis reveals the knowledge structure and dynamic evolution of the field. **Figure 3** displays several important clusters: #0 focuses on the application of teaching methods; #1 explores the impact of teaching models; #2 involves content of teaching reform; #3 focuses on issues in teaching practice; #4 studies the application of information technology; #5 focuses on internships and training for medical students; #6 involves feedback on educational quality; #7 explores cross-institutional collaboration models.

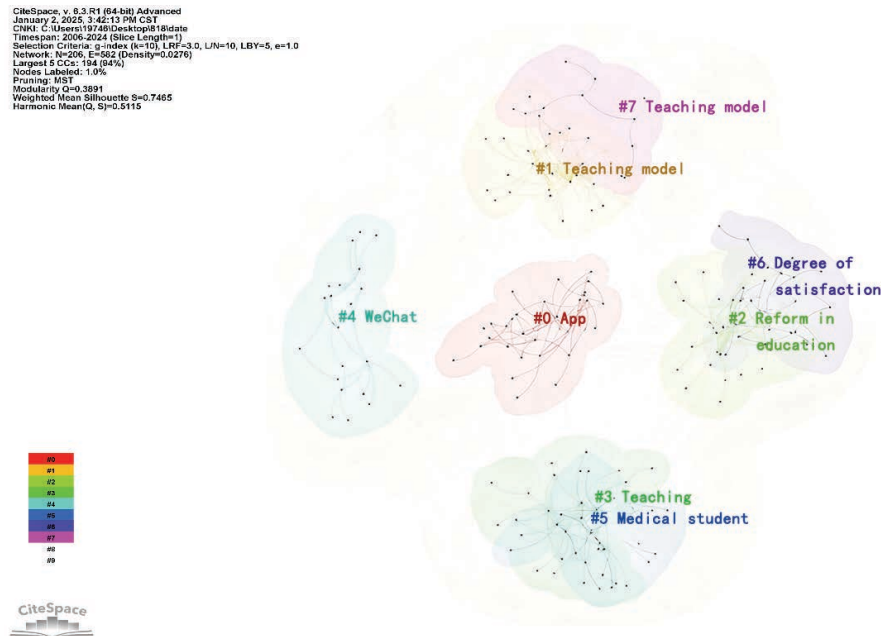


Figure 3. Keyword clustering analysis

3.4. Analysis of research frontiers

Research frontiers uncover innovation points and future trends. The timeline view (**Figure 4**) illustrates clustering relationships and the historical progression of literature, while the keyword timezone view (**Figure 5**) displays the evolution of keywords over time, revealing shifts in research hotspots and domain dynamics, thereby fostering interdisciplinary innovation. The study of CBL can be divided into three stages: from 2006 to 2012, the focus was on establishing and improving foundational teaching methodologies, incorporating the concept of evidence-based medicine; from 2013 to 2018, the emphasis shifted to evaluating teaching effectiveness, with attention given to new teaching methods and the application of information technology; from 2019 to 2024, the focus has turned to curriculum integration and professional development, emphasizing student-centered evaluation concepts and the application of the holistic health concept, reflecting the continuous exploration in medical education to enhance quality, adapt to technological advancements, and meet professional demands.

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Network: N=206, E=582 (Density=0.0276)
Largest 5 CCs: 194 (94%)
Nodes Labeled: 1.0%
Pruning: MST
Modularity Q=0.3891
Weighted Mean Silhouette S=0.7465
Harmonic Mean(Q, S)=0.5115

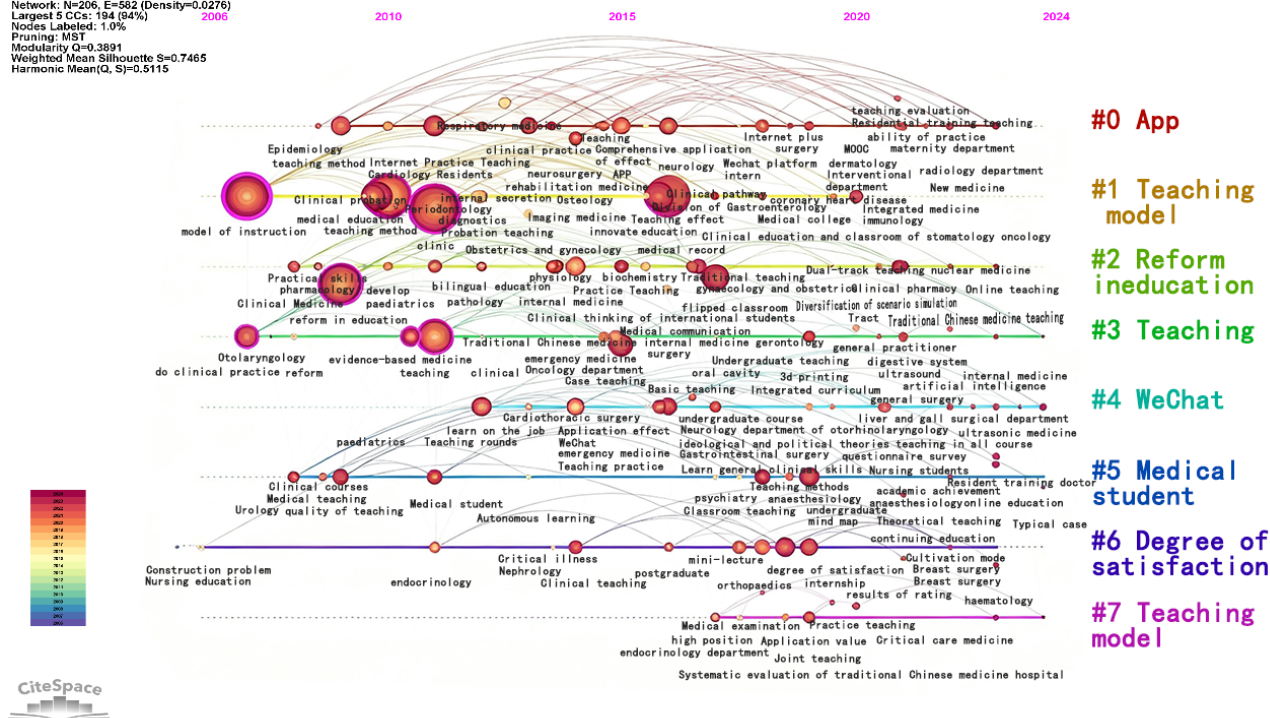


Figure 4. Keyword timeline view

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Weighted Mean Silhouette S=0.7465
Harmonic Mean(Q, S)=0.5115

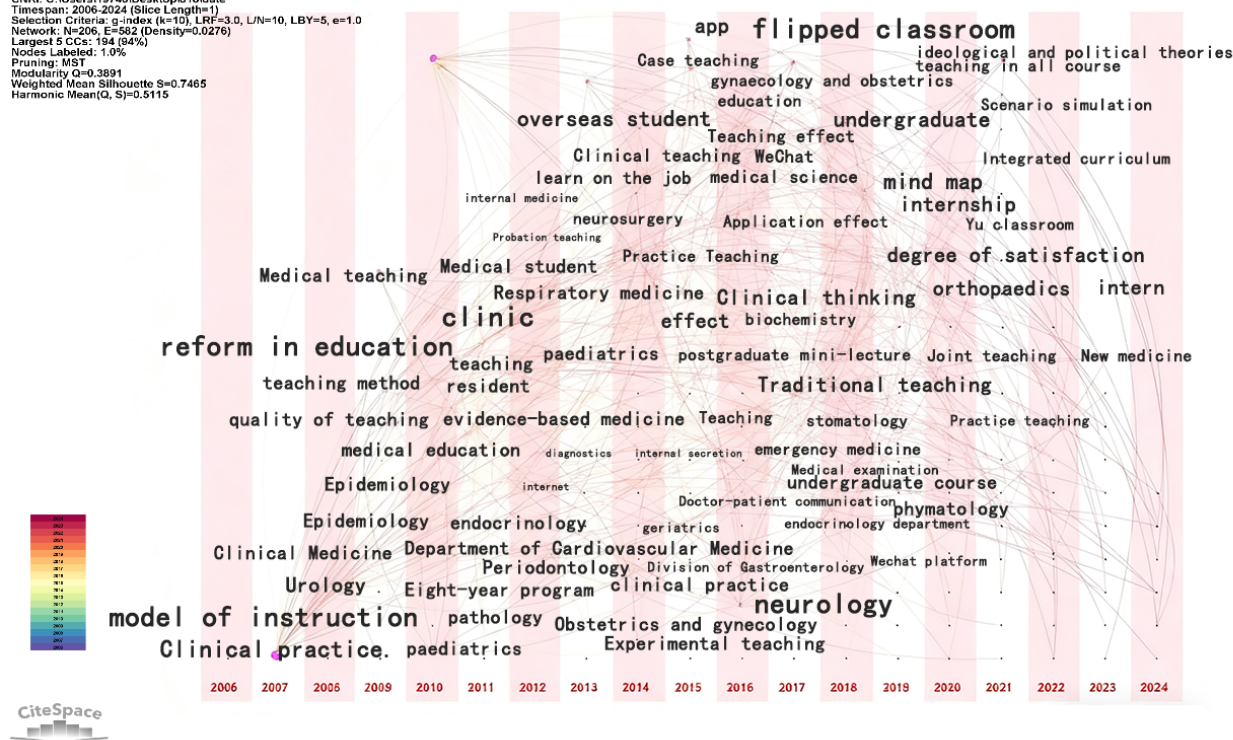


Figure 5. Keyword timezone view

3.5. Mountain chart analysis

The CiteSpace keyword mountain chart visually represents the research intensity and trends of different keywords within the CBL field across various time periods. **Figure 6** displays multiple clusters, such as “#0 Application”, which peaked in 2021, reflecting the application and effectiveness of CBL in medical education; “#1 Teaching Model” and “#2 Teaching Reform”, which peaked in 2011 and 2018, respectively, indicating exploration and evaluation of teaching methods; “#4 WeChat”, which saw peaks in 2016 and 2021, demonstrating its application research in the educational field; “#6 Satisfaction”, which peaked in 2021 and 2024, focusing on student satisfaction and educational outcomes of CBL programs; and “#7 Joint Teaching”, which gained attention in 2016 and 2021, reflecting the importance of cross-institutional collaborative teaching models.

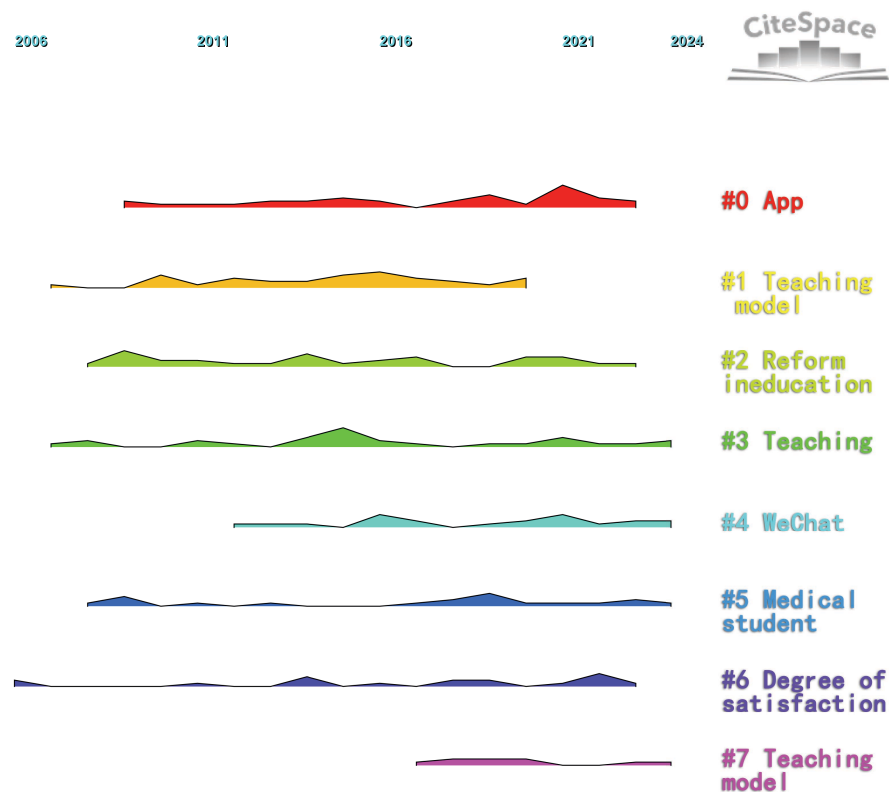


Figure 6. Keyword mountain chart

4. Discussion

This study systematically reviewed the current research landscape of Case-Based Learning (CBL) in medical education in China using CiteSpace, a visualization analysis tool. The study unveiled the application hotspots, development trends, and frontiers of CBL, providing educators and researchers with a clear research trajectory and future directions. Through keyword co-occurrence, cluster analysis, and timeline analysis, the development trajectory of CBL in Chinese medical education was summarized, highlighting research gaps and potential innovation points. This provides theoretical support and practical guidance for optimizing teaching methods and enhancing the quality of medical education.

The study found that research on CBL in Chinese medical education has undergone three distinct phases: the concept introduction and initial exploration phase from 2006 to 2012, the rapid development and teaching effectiveness evaluation phase from 2013 to 2018, and the curriculum integration and professional development phase from 2019 to 2024. Early research focused on establishing and refining the foundational aspects of the CBL teaching methodology, then shifted towards evaluating teaching effectiveness and exploring novel teaching models, ultimately converging on higher-level educational objectives such as curriculum integration, ideological and political education in courses, and professional development^[2-3]. This phased characteristic reflects the gradual advancement of medical education reform in China, aligning with both domestic and international trends in medical education reform and demonstrating the flexibility and effectiveness of CBL in adapting to changes in medical education^[2, 4].

Keyword co-occurrence and cluster analyses revealed that research hotspots in CBL are concentrated in areas such as teaching models, teaching effectiveness, clinical teaching, flipped classrooms, and ideological and political education in courses^[5]. These hotspots reflect the core application directions of CBL in medical education, particularly its significance in clinical practice teaching. The emergence of emerging keywords such as “ideological and political education in courses”, “new medical discipline”, and “eight-year medical program” indicates that CBL research is expanding into broader educational philosophies and professional development areas. The timeline view and keyword time zone map revealed the dynamic evolution of CBL research, progressing from early exploration of basic teaching methods to mid-term evaluation of teaching effectiveness, and then to recent curriculum integration and professional development, reflecting the increasing depth and breadth of CBL research.

The integration of Case-Based Learning (CBL) with other teaching methods (such as flipped classrooms and Problem-Based Learning (PBL)), as well as the application of information technology (e.g., WeChat) in teaching, has emerged in CBL research. These innovative approaches have not only enriched the CBL teaching model but also enhanced the interactivity and flexibility of teaching^[6]. For instance, the combination of flipped classrooms and CBL provides students with a more autonomous learning environment, while the application of information technologies like WeChat offers a more convenient platform for communication and resource sharing in teaching^[7]. Furthermore, the exploration of cross-institutional collaborative teaching models has also provided new insights for the promotion and application of the CBL teaching method.

Internationally, CBL, as a mature teaching method, has been widely adopted in medical education, forming a relatively comprehensive theoretical framework and practical model. CBL research in China started relatively late but has developed rapidly, making significant progress in recent years in areas such as teaching effectiveness evaluation, curriculum integration, and professional development, gradually aligning with international research^[2]. In international studies, the application of CBL is more extensive, covering multiple disciplines, whereas in China, research primarily focuses on medical education, particularly in clinical teaching, clinical internships, and clinical clerkships, reflecting the specific needs of medical education reform in China. Compared with domestic related research, this study, through CiteSpace visual analysis, not only summarizes the application hotspots of CBL but also reveals research frontiers and potential innovative points.

The research data is based on Chinese literature from databases such as CNKI, Wanfang, and VIP, excluding international achievements, which may affect the comprehensiveness and international perspective of the study. While the CiteSpace analysis tool visually displays research hotspots and trends, it lacks depth

in analysis. For example, keyword co-occurrence analysis only reveals superficial associations between topics without delving into the underlying logic and theoretical foundations of the content. The discussion of research limitations and potential issues is not comprehensive enough, and specific improvement suggestions are not proposed.

Future research should deepen the theoretical foundation of the CBL teaching method and explore its role and influencing factors in medical education ^[8]. By integrating multidisciplinary theories, the impact of CBL on student learning should be analyzed to optimize teaching design. Currently, CBL is primarily applied in clinical teaching, but in the future, it should be extended to basic medicine, preventive medicine, and medical humanities courses to promote comprehensive development. Research should be conducted on the application of CBL in the interdisciplinary fields of medicine and other disciplines to cultivate versatile talents. With the advancement of educational technology, it is essential to enhance the integration of CBL with other teaching methods and technologies, such as flipped classrooms, Problem-Based Learning (PBL), virtual reality, and artificial intelligence, to improve interactivity and personalization levels ^[9]. Research on the application of CBL in online and blended learning should be carried out to support the digital transformation of medical education ^[11]. Strengthening cross-institutional collaboration, promoting resource sharing, and enhancing educational quality are also crucial. Multi-center CBL teaching experimental studies should be conducted to compare the differences in CBL teaching effectiveness across different institutions and optimize teaching models ^[10]. Drawing on international experience, the internationalization of medical education should be promoted. Attention should be paid to constructing a CBL teaching evaluation system, exploring evaluation indicators and methods, and comprehensively assessing teaching effectiveness ^[11]. Research on teaching quality assurance mechanisms should be conducted to ensure high-quality CBL teaching through measures such as teaching supervision, teacher training, and student feedback.

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To Create a Learner-centered, Communicative, Intercultural Classroom

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Abstract: This paper explores the integration of learner autonomy, communicative language teaching (CLT), and intercultural language teaching to create a learner-centered, communicative, and intercultural English language classroom. Through a review of relevant literature, the study analyzes the theoretical foundations, practical applications, and challenges associated with each approach. It highlights the roles of teachers in fostering autonomy, the balance between fluency and accuracy in CLT, and the importance of cultural awareness in language education. Based on the findings, practical implications are proposed for designing effective classroom practices in Chinese EFL contexts, emphasizing teacher roles, selective use of authentic materials, and motivational strategies to enhance students' communicative and intercultural competencies.

Keywords: Learner autonomy; Communicative language teaching; Intercultural competence; Classroom design

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1. Introduction

With the development of globalization from last century, foreign language learning is a compulsory course for every student in the 21st century, where English is the most universally accepted language. According to the British Council, there are about 1.5 billion English learners in the world, of which 750 million people learn English as a foreign language and 375 million people learn English as a second language.

Dozens of foreign language teaching methods have been proposed by scholars at home and abroad, such as grammar-translation methods, communicative language teaching, the direct method, and audiolingualism. Each method or approach owns its benefits and shortcomings in language teaching and learning. For example, communicative language learning is popular for its practice of communicative skills but loses some credits in grammar accuracy. This paper introduces and analyzes several influential and widely used teaching methods, and probes into the development trend of English teaching methods at the present stage, hoping to provide valuable reference for English teaching in China.

In this assignment, the author firstly reviewed autonomous learning which is a learner-centered learning strategy. Learner autonomy is the key subject of autonomous learning and the definition changes with the deeper research of autonomous learning. Besides, learner autonomy is identified into different categories according to its levels and types. Then, teachers' role of autonomous learning is discussed. Secondly, communicative language teaching contributes to a communicative classroom. A brief history of communicative language teaching is introduced, followed by several typical and popular activities in communicative classrooms. However, communicative language received some criticisms which should not be ignored. Thirdly, intercultural language teaching will be introduced from definitions, pedagogical principles, and challenges for teaching. Finally, implications for the future teaching are proposed by the author based on the literature review and personal experiences or understandings.

2. Literature review

To create a learner-centered classroom, communicative, intercultural classroom, the author will discuss from the following three perspectives: autonomous learning, communicative language teaching, and intercultural language teaching.

2.1. Autonomous learning

2.1.1. Introduction

Autonomous learning is the process in which learners take responsibilities for their learning and identified that teachers play a part in this process. Autonomy origins from 1960s in humanism field and was introduced to language education field in 1970s^[1]. For the past decades, autonomous learning is a popular topic to investigate and scholars have published abundant articles and books on it, though the item of autonomy origins from philosophy, rather than a linguistic concept^[2]. The most widely cited definition of autonomy is Holec's as "the ability to take charge of one's own learning"^[3]. To be more specific, learners can decide by themselves, what to learn, when to learn, where to learn, and how to learn. Much freedom is given to manage their learning.

Dam showed how autonomy principles can be combined into classrooms with no self-access or professional instructions^[4]. This research, combining autonomy and classrooms together, contributed to a renewed focus on autonomy in 1990s. Another rise in interest of autonomy is due to the popularity of self-access centers and the growth of computer-assisted language learning and teaching. Thus, in this turning period, language teachers had to accept to deconstruct the traditional language classrooms while reconstruct language pedagogy^[5]. For example, Little discussed learner autonomy and teacher autonomy in language classrooms to provoke the quality of "pedagogical dialogue"^[6]. One of the most vital developments of autonomy is that autonomy is identified as an attribute of learners rather than learning situations^[1, 3, 7].

2.1.2. Levels of autonomy: Proactive autonomy and reactive autonomy

The previous section gives a brief history of the definition of learner autonomy with three remarkable stages in the development of learner autonomy from 1980s. In this section, two levels of autonomy are introduced for deep understanding. The first one is *proactive autonomy*. Proactive autonomy refers to confirm learners' uniqueness and establish their directions in a personal timetable^[8]. To be more specific, proactive autonomy highly emphasizes on actions that are going to be done by learners, such as, taking responsibilities of their

study, deciding learning goals, choosing learning strategies, and assessing the knowledge they have gained. The other level of autonomy is *reactive autonomy*. It can be the primary step to proactive autonomy in learning or achieve goals. Learners with reactive autonomy who do not set up their own directions, can manage their own resources autonomously due to achieve aims, once they are set directions ^[9].

2.1.3. Versions of learner autonomy: Technical, psychological, and political

Benson first introduced the idea of *versions of learner autonomy* and identified versions of learner autonomy into three types: *technical*, *psychological* and *political* ^[10]. Firstly, the technical versions are identified as the action of learning a language but not enrolling in formal classes or hiring instructors. Secondly, psychological versions shows that autonomy is a concept of attitudes and abilities that enables learners to take control of education. Thirdly, political versions of autonomy centers on how to set up conditions which give learners power over own learning and institution backgrounds. These three versions of autonomy offer a preliminary beginning for analyzing connections between autonomy and other theories in learning ^[1].

2.1.4. Teachers' roles in autonomous learning

There are several variants on the core concept of autonomy, based on the review of learner autonomy. From teachers' view, autonomy is mostly associated with institution and classroom learning plans within defined curriculum ^[11]. According to Little, instructors "get started with themselves" by assessing beliefs, pedagogical methods, and expectations for the classroom, to foster more learner autonomy ^[6]. Thus, teachers play a part in the classrooms. Fumin and Li conducted empirical research to discover what role teachers play in language classrooms to develop learner autonomy ^[12]. In the setting of learner autonomy at the college level, teachers' roles have expanded beyond that of mere lecturers transferring information from the pages of a textbook. They need to step up to bigger and better responsibilities. In their valid sample of experiment, 1308 samples in China were freshmen while 1181 were sophomores. None of them were English majors but all of them studied English for at least 6 years. Participants were required to answer a questionnaire designed in the frame of five-point Likert scale to investigate teachers' role in regulating learning, facilitate resources, organizing classrooms, and instructing learning. The results of this research confirmed the four roles that teachers have played in teaching. In addition, teachers' role as "*learning regulators*" received high agreement in the questionnaire and analysis, that is, learning regulators are the most significant role that teachers have in fostering learner autonomy in learning. Other researchers have the same results with Fumin and Li's that teachers' role as learning regulators are the most crucial one ^[13-15]. In the implication part, the author will discuss some strategies of improving learner autonomy to create a learner-centered classroom ^[12].

2.2. Communicative language teaching

Learner autonomy is the focus of communicative language teaching. The author will discuss communicative language teaching approach in this part.

2.2.1. A brief introduction of communicative language teaching

In the 1960s, fast globalization development made difference in various fields, e.g. travelling, education, business, etc. This situation challenged the language educators reviewed teaching approaches at that time. Thus, communicative language teaching rose to meet the needs ^[16]. Communicative language teaching

intends to assess language competences through the context of social interaction and anticipates growth via deep learning ^[17]. The idea of communicative language teaching can be dated back to Hymes, who raised the concept of *communicative competence* to make effective use of language ^[18]. Communicative competence refers to capacity to effectively apply the language they are currently studying in a particular social situation ^[18]. The most remarkably further research of communicative competence in communicative language teaching was elaborated by Canale and Swain ^[19]. They continued that communicative competence consists of a) grammatical competence, b) sociolinguistic competence, c) discourse competence, and d) strategic competence. Since focusing on real life and focusing on authentic materials are two of the typical characteristics of communicative learning, some scholars disputed that practice/materials in a communicative language teaching classroom should confirm with the real life while some scholars held the view that authentic materials in communicative language teaching classrooms were not necessary if keep authentic learning processes in mind for special designs ^[20-21].

2.2.2. Classroom practice in communicative language teaching

As to communicative language teaching, teaching materials are mainly from authentic texts, so a task for language teachers is to design proper activities for language learners in the classrooms. Oral activities are trendy in communicative language teaching classrooms, rather than focusing on grammar features through reading or writing. Based on previous theoretical and empirical studies, some typical teaching activities can be applied in the language classrooms as following ^[16, 22]. Here the author will introduce two types briefly.

Information-gap activities: The information gap is an interactive activity in which students successfully acquire previously unknown material in the target language. This activity requires learners to talk with somebody for their unknown information. Jigsaw is a typical information-gap activity. Each attendant or each group is given part of information from reading or listening, and they need to exchange this information by using the target language.

Role play: It is usually a pair work for learners to improve their oral proficiency in a given context. Learners are assigned to play a role in a context with some hints or clues to communicate with others.

2.2.3. Criticisms on communicative language teaching

Though it is a new trend method meeting current needs at that time, communicative language teaching approach received a lot of controversial opinions. Scholars who support the application of communicative language teaching hold view that, for one thing, communicative language teaching encourages learners to develop their ability to use English independently by emphasizing fluency in the language they learnt ^[23]. For the other thing, Communicative language teaching prioritizes allowing learners to utilize the language in a communicative environment to meet their requirements in real-life conversation ^[24-25].

However, communicative language teaching received various criticisms, though it benefits learners' usage of target language. Firstly, Swan revealed that the theory of communicative language teaching resulting in confusing in the application of communicative language teaching, because plenty of confusing vocabulary inputting to learners based on authentic materials for teaching ^[26]. Thus, from the author's perspective, communicative language teaching is more suitable for language learners who are in intermediate or advanced levels because they are able to deal with difficult words or complex structures from the authentic materials.

Secondly, communicative language teaching gives priority to fluency rather than grammar and

pronunciation ^[27]. As Hughes states that communicative language teaching produce language learners with fluency but inaccuracy ^[28]. In other words, language learners who are taught by communicative approach focus on fluently communicating but pay less attention on grammar rules or accurate pronunciations.

Thirdly, communicative language teaching may be difficult to put into practice due to teachers' ability and requirement of teaching equipment and enough authentic sources ^[27, 29]. In other words, this kind of situation emphasizes on language teachers' own ability and proficiency in language. Multiple teaching materials are attractive for learners to concentrate on the classrooms and enough authentic sources assure the input of target language, but it is a challenge for language teachers to find source texts and design them for classes.

2.2.4. Personal reflection

Communicative language teaching which benefits for creating a communicative classroom, has its own challenges for both teachers and learners, but its advantage should not be ignored. For one thing, It is an effective teaching approach for teachers to practise language learners' oral communicative skills, but grammar drills need to be developed as supplementary ^[30]. For the other thing, language teachers are required to discover various authentic materials and do curriculum design, which implies that getting assistance from searching engines or open AI are effective for class designing ^[31].

2.3. Intercultural language teaching

Culture is quickly becoming one of the most important topics to discuss when it comes to the teaching of languages. On the other hand, there is a broad spectrum of approaches to both the study of culture and the instruction of culture as a component of language acquisition. A growing number of individuals have started to formulate a multicultural approach to the instruction of language ^[33–35]. The goal of intercultural language education is to teach culture in a manner that simultaneously enhances one's language abilities as well as one's ability to communicate effectively across cultural boundaries.

2.3.1. An introduction of intercultural language teaching

There are two approaches to the teaching of culture that may be discovered in conversations about language education. These approaches are referred to as a cultural orientation and an intercultural orientation respectively ^[36]. The purpose of language learning has shifted in response to recent developments in global mobility, and interconnectivity. According to Portera, the current learners must develop numerous international abilities in order to handle and learn from all intercultural contacts ^[37]. Intercultural language teaching was a necessity to meet the shift of aims of language teaching. Intercultural teaching demands merely mutual respect and a desire to share ideas and learn from one another. The term "intercultural language teaching" refers more to a general "intercultural perspective" from which languages are taught and learnt than to any specific technique or strategy to doing so ^[35]. According to Hyde, intercultural competence refers to the capacity to engage in conversation with members of other cultures, which we are aware to be distinct from our own ^[38]. Because of the urgent need for intercultural competence, it seems to reason that language educators would react to this need by focusing more on intercultural language education. If we are serious about preparing the next generation of global citizens, we must engage in intercultural language teaching and learning ^[39]. Intercultural language teaching's overarching objective is to guide students step-by-

step toward intercultural competence by guiding them through the process of learning a foreign language and culture ^[34]. This will ultimately help students transcend their own limited worldview.

2.3.2. Principles for teaching and learning languages from an intercultural perspective

The teaching of international language competence in the classroom revolves primarily around five overarching themes ^[40].

Active construction is the idea that in order to get a nuanced understanding of both their own and the culture they are studying, students must build their own knowledge of the subject. Learners must acquire the skills necessary to identify cultural differences, consider their significance, and craft individual responses to intercultural problems. Instead of presenting culture as an already-completed body of knowledge, the teacher's goal in active creation is to encourage students to observe, examine, and reflect on differences.

Making connections: Students are pushed to draw their own conclusions about the relationships between the classroom materials and their prior cultural, linguistic, and knowledge bases. Developing a viewpoint that compares and contrasts the new with the established might help achieve this goal. This also implies that students' native cultures need to be considered while they study foreign civilizations.

Social interaction: By interacting with others, one may learn about and understand their culture. The learner may encounter differences in communication, exchange perspectives, and explore and practice different answers via social interaction.

Reflection: Having the chance to consider one's encounters with diversity is an important aspect of the intercultural language teaching process. Students must be given opportunity to reflect on how their perception of themselves and others has changed as a result of their exposure to different cultural perspectives. They must also consider how their prior beliefs and values influence their communication style and the outcomes they want.

Responsibility: Students learn that it is their job to communicate well in all of their languages and to create a worldview that respects other languages, countries, and people.

2.3.3. Challenges in intercultural language teaching in China

Government attitude: China government's careful attitude towards culture invasion stopped the development of intercultural language in China. Culture relativity theory (CRT) views that cultures cannot be judged as beneficial or bad ^[40]. The diversity of human experience is the subject matter to be mastered. This dualistic view of culture, with its emphasis on what is superficial and what is essential, distorts what pupils learn about other societies and leads them astray. This is a contributing factor to the fact that intercultural education in China is behind that in the West ^[41].

Textbooks: The textbooks in China are customized to fit local contexts, which only reflected a part of culture. In addition, after-class exercises aim to assess the linguistic knowledge, such as, grammar, gap filling, single choices. Moreover, instead of being systematically structured in the text books, culture knowledge is placed in the cultural note section as background information for students to memorize and recognize rather than practices.

Teacher qualification: English teachers at Chinese universities have extensive training and experience in language instruction. However, it is undeniable that the vast majority of instructors have never even traveled abroad, much less experienced the culture they are supposed to be teaching about. The lack of cultural

training and instruction these educators acquired as students means they lack cultural sensitivity. Most educators rely on the textbook's cultural notes to help their students understand and appreciate the text's cultural context; this is a long cry from fostering students' intercultural communicative competence.

Student motivation: The key elements impacting motivation are the substantial linguistic and cultural differences between Chinese and English. Different students' reasons for learning lead to divergent perspectives on cultural tensions and levels of classroom collaboration. It's not easy to get pupils involved in classroom discussion on cultural differences and similarities.

3. Implications for future class design

Based on the literature review and the author's experience of language learning and teaching, some strategies to create a learner-centered, communicative, and intercultural classroom.

3.1. Identify teachers' roles to create a learner-centered classroom

The term "student-centered learning" is used to describe a wide range of instructional strategies that are designed with the learners in mind. The goal of student-centered teaching is to revitalize the educational experience for both students and teachers. A teacher's role is analogous to that of a "guide on the side", providing help and direction while pupils work toward common objectives ^[42]. The duties of English instructors should not be diminished in an environment where student agency is emphasized, but rather expanded upon ^[43]. Teachers have a variety of responsibilities, including but not limited to: answering students' questions; providing a variety of resources related to English study; encouraging students to make full use of these resources; planning engaging classroom activities to maximize students' initiative in learning English; assisting students in developing and implementing realistic and individualized study plans and objectives; and using a variety of assessment strategies to evaluate students' progress.

Teachers may fulfill a variety of functions, especially in the provision of curricular materials. Teachers may play an important role as learning regulators and study aides. The importance of these two roles in encouraging student initiative in the classroom significantly outweighs that of classroom organizers. Teachers may help students develop their capacity for independent learning by providing them with direction in self-monitoring and self-regulating their academic work, as well as by instructing them in the use of learner-autonomous practices. The easiest way to fix this is to limit English sessions to a size of no more than 20 students, and ideally no more than 10. By doing so, educators may better cater to their pupils' unique needs while also encouraging more independence in the classroom.

3.2. Strategies to create a communicative classroom

As discussed above, the appearance of communicative language teaching approach followed the development of the times, though it has its own shortcomings. Thus, it is challenge for teachers to adapt this in the future teaching practice.

First, each grammar as a supplementary for communicative language teaching. Communicative language teaching gives less priority to the accuracy of speaking proficiency. Thus, teaching grammar is a need for communicative language classrooms.

Second, be selective to authentic materials for communicative language teaching. Authentic materials

contain a bulk of confusing or difficult words for EFL learners. It upgrades the difficult level of foreign language learning. In this situation, language teachers are required to select or adapt the materials which is suitable for the learners in a certain level.

Third, corporate with multimedia sources and technologies. For a communicative classroom, teaching with materials from different sources and with the help of information and communication technology, can attract learners to keep paying attention on teachers' talk.

Fourth, make good use of activities. Two types of typical activities in communicative language classrooms were introduced. If teachers try their best to make best use of the activities, activities can provide students with additional opportunities to use English in given contexts. In addition, conversational exercises like "small talk" are great for fostering interpersonal understanding and familiarity via the use of idioms.

3.3. Start an intercultural classroom in Chinese EFL contexts

According to challenges mentioned, some implications as a pre-service teacher will be introduced to start an intercultural classroom in Chinese EFL contexts.

Firstly, design supplementary exercises for language learners to do after class. What cannot be changed is that language teachers and learners have to follow the certain curriculum given by Education Bureau or Schools. Teachers can supplement cultural background knowledge by designing appropriate exercises.

Secondly, immersing in the target language environment is crucial for future language teachers in China. Not only studying or living aboard for a period but also listening and reading via target languages are beneficial for immersion.

Thirdly, arousing language learners' motivation contributes to language proficiency development. If learners' motivation is stimulated, learners are voluntary to get more information of language learning, such as, reading newspapers, watching movies, listening to music in target languages.

4. Conclusion

To conclude, this assignment focuses on the origin and challenges of autonomous learning, communicative language teaching, and intercultural language teaching. After that, series of strategies are proposed to create a learner-centered, communicative, and intercultural language classroom.

Disclosure statement

The author declares no conflict of interest.

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Innovative Research on English Reading Teaching in Universities under the Background of Intercultural Communication

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Abstract: The globalized era has posed new demands on English teaching in universities, emphasizing the cultivation of students' intercultural communication skills and the delivery of innovative, practical, and high-quality English talents needed in the new era. Based on this, English reading teaching in universities should transform educational concepts, innovate educational models, enrich the cultural attributes of reading teaching, and guide students to understand cultural backgrounds and differences, so as to showcase their talents in intercultural communication. This article explores the innovation of English reading teaching in universities against the background of intercultural communication, analyzes the connotation and importance of intercultural communication, and further proposes practical strategies for the innovation of English teaching in universities.

Keywords: English reading teaching in universities; Intercultural communication; Innovation

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1. Introduction

Language is the most direct tool for humans to express thoughts and disseminate knowledge, and it is a necessary means for humans to communicate and exchange with each other. As an international language, English plays an important role in international communication. English reading teaching in universities should enable students to understand English, experience cultural differences, and better participate in international exchanges. However, in traditional reading teaching, teachers focus on imparting language knowledge points while ignoring intercultural communication in reading, which affects students' reading quality. In order to meet the new challenges faced in the new era, English reading teaching in universities should update concepts, transform traditional teaching methods, and carry out reading teaching from the perspective of intercultural communication, allowing students to recognize cultural differences, improve language skills, consolidate learning achievements, and become high-quality talents.

2. Analysis of the connotation of intercultural communication

Intercultural communication refers to the interactive process between individuals or groups with different cultural backgrounds (such as language, values, customs, beliefs, etc.). It includes both cross-border exchanges (such as international business, diplomacy) and cultural collisions arising from differences in geography, ethnicity, occupation, etc.^[1]. Its essence is to cross the boundaries of cultural systems, transmit information through verbal and non-verbal symbols, and understand each other's thinking patterns and behavioral logic. In other words, intercultural communication involves not only language interactions between people from different cultural backgrounds, but also interactions in multiple fields such as concepts, customs, and social norms. When individuals or groups come from the same cultural environment, shared values and behavioral guidelines usually make communication smoother. However, when individuals or groups come from different cultural environments, differences in cultural concepts, behaviors, and values become apparent, leading to cultural collisions. Through these collisions, a deep interpretation of culture is generated, enabling "cultural translation" and effective communication.

In college English reading instruction, students also face difficulties in cultural understanding. Cultural differences and discontinuities have a non-negligible impact on students' reading comprehension. The lack of cultural knowledge can lead to reading obstacles and even misinterpretations. Therefore, college English teaching in the context of intercultural communication requires students to deeply understand communication norms and habits in different cultural backgrounds, flexibly adjust their communication strategies in intercultural exchanges, effectively communicate in English with people from different cultures, and respect multiculturalism. Based on this, reading instruction also needs to emphasize cross-cultural teaching to enhance students' learning outcomes.

3. The significance of conducting college English reading instructional practices in the context of intercultural communication

3.1. Cultivating students' intercultural communication skills and enhancing international competitiveness

In the current globalized context, international exchanges and cooperation are increasingly close, and English talents with intercultural communication skills have become an important force in international exchanges and cooperation. Intercultural communication promotes the integration and innovation of different cultures, forming a diverse and symbiotic global cultural ecology. Integrating into this cultural ecology is a prerequisite for effective exchanges and cooperation. College English reading instruction in the context of intercultural communication can cultivate students' reading skills while guiding them to understand textual content from an intercultural perspective, fully interpret different cultural backgrounds, and implicitly cultivate intercultural communication skills. This way, students can showcase themselves in international cultural exchanges, possess distinct advantages, effectively adapt to the current multicultural ecology, interpret cultural information, enhance their international competitiveness, and become talents with comprehensive literacy, prominent abilities, and intercultural communication skills.

3.2. Cultivating students' cultural tolerance and establishing correct values

UNESCO emphasizes that "cultural diversity is the common heritage of humanity and is crucial for development." On the one hand, cultures have their respective differences, forming a diverse landscape. On

the other hand, cultures are also in a gradual process of integration. Research on cultural evolution theory indicates that the main trend of cultural evolution is convergence, meaning that as cultures develop, they increasingly tend to unify. Therefore, it is essential to cultivate students' awareness of cultural tolerance, which can promote cultural development. Conducting college English reading instruction in the context of intercultural communication allows students to encounter different cultures in their reading, experience cultural diversity, and also seek cultural commonalities, appreciate the charm of multiculturalism, gradually recognize the uniqueness of other cultures, and develop a deeper understanding of their own cultural attributes, fostering a sense of cultural identity. Additionally, it enables students to respect, appreciate, and tolerate multiculturalism, cultivating cultural tolerance. By drawing nourishment from culture, students can establish correct values and achieve personal growth ^[2]. Simultaneously, in an educational environment that embraces multiculturalism, students develop a broader global perspective, significantly enhancing their intercultural communication skills and better adapting to the diversified society of the future.

3.3. Enrich the connotation of reading teaching and enhance educational effects

Traditional reading teaching often focuses on vocabulary and grammar instruction, emphasizing the explanation of knowledge points and the improvement of reading ability, while ignoring the interpretation of cultural backgrounds and lacking in-depth exploration. This leads to students having a one-sided understanding of the content of reading texts, without a comprehensive analysis of cultural connotations, and thus obtaining limited nutrients from it. From the perspective of cross-cultural communication, college English reading teaching places greater emphasis on cultural understanding, thereby filling the “skeleton” of reading with the “flesh and blood” of culture, making the entire teaching process become three-dimensional, transparent, and richer in connotation. The integration and mutual complementarity of language knowledge, learning, and cultural experience significantly enhance students' interest in learning, enabling them to participate in cultural exploration and cross-cultural communication, and cultivating their language ability and cultural awareness.

4. Practical strategies for innovating college English reading teaching under cross-cultural communication

4.1. Create cultural context conflicts, stimulate reading motivation, and prepare for reading

Reading preparation includes aspects such as language preparation, psychological preparation, and reading motivation, among which motivation is the key. Teachers should be guided by addressing reading difficulties, starting from students' academic situations, and helping them prepare for reading ^[3]. Before designing reading teaching activities, teachers need to understand learners' schematic knowledge, diagnose, activate, or fill in gaps, while cleverly stimulating students' reading motivation and interest in learning. In the context of cross-cultural communication, teachers can activate students' reading motivation from the perspective of “cultural conflict”, transforming traditional reading teaching modes, innovatively introducing cultural situations, creating cultural context conflicts, and activating students' cultural awareness. Cultural context conflicts that are not obviously related to the reading content, in essence, can stimulate students' cross-cultural communication awareness, making them pay attention to cultural content in subsequent reading. This teaching method also promotes innovation in reading teaching, effectively introducing case analysis and situational teaching, enriching educational content, innovating educational modes, and injecting new vitality into English reading.

In college English reading instruction, after realizing that students lack experience in cross-cultural communication before class, teachers have set a new teaching objective: “Helping students understand cultural differences and improving their cross-cultural communication skills.” Before reading instructions, teachers introduce authentic cross-cultural communication scenarios, create cultural context conflicts, and stimulate students’ reading motivation. Teachers first introduce problems or phenomena through cross-cultural cases, such as communication barriers caused by accents and cultural differences, conflicts arising from different cultural customs, and frustrations encountered during cultural transmission. This progressively guides students to deeply consider issues and key points in cross-cultural contexts, enhances their awareness of cross-cultural communication, and sharpens their cultural sensitivity. Teachers also design scenario simulation activities before reading, allowing students to role-play people from different cultural backgrounds and enact problems that arise during communication, thereby understanding the importance of cross-cultural communication. After preparing for the reading, the teacher conducts a creative reading class with the theme “Crossing the cultural divide”, guiding students to think and communicate cross-culturally while reading, improving their communication skills in a multicultural environment, and boosting their confidence in cross-cultural communication. After reading, teachers design a role-playing activity called “Cultural Conflict Mediator”, connecting it to the cultural context conflict before reading. This allows students to apply what they have learned from reading to mediate cultural conflicts, achieving continuity before and after class. This approach innovates English reading instruction, enabling students to experience the importance of culture and the charm of multiculturalism through an integrated learning experience.

4.2. Enrich English reading materials and build a multicultural reading classroom

From the perspective of cross-cultural communication, college English reading instruction should innovate reading content by introducing multicultural reading materials. Starting from the reading content, teachers should further innovate reading instruction and build a multicultural reading classroom. This allows students to understand different cultural knowledge, read texts with different cultural backgrounds, experience cultural diversity, and improve their cross-cultural communication skills. Teachers can collect relevant reading materials from various aspects, such as cultural customs, cultural values, and ways of thinking, to build a cross-cultural reading classroom. Simultaneously, teachers can encourage students to compare Chinese and foreign cultures while reading, fostering a sense of cultural inclusivity, further cultivating cultural confidence, and actively promoting Chinese culture in future cross-cultural communication.

In the practical implementation of English teaching in higher education, traditional teaching methods have been reflected upon, and diverse cultural reading materials have been introduced to construct a new reading paradigm and achieve innovation, starting from the perspective of cross-cultural communication. Schools have innovated at the curricular level, designing courses for cross-cultural reading, supplementing relevant cultural knowledge, and introducing learning practices for cultural comparison and cultural exchange. In specific course teaching, teachers emphasize the improvement of students’ reading comprehension skills and comprehensive language application abilities. Through multicultural texts and supporting activities, students’ awareness of cross-cultural communication is enhanced. Teachers provide students with cross-cultural reading materials, such as articles introducing culture, English literary works related to culture, and news reports with cultural topics. For example, teachers introduce a theoretical article titled “Identity and Culture” to enable students to deeply reflect during reading, understand the connection between identity and culture, and cultivate

a sense of cultural identity. Teachers also introduce relatively vivid and intuitive cultural reading materials. For instance, by connecting Chinese tea culture with English tea culture, teachers introduce two texts, “Chinese Tea Culture” and “The British Tea Culture: More Than Just a Drink”, allowing students to engage in cross-cultural communication and generate their own thoughts while reading. Teachers provide guidance such as “Pay attention to the similarities and differences between the two cultures” and “Focus on the concluding sentences after transitional conjunctions”, enabling students to master reading skills and improve their reading abilities based on cultural understanding. With the help of reading materials, students recognize the profoundness of Chinese culture, experience the role of cross-cultural communication, understand cultural dissemination and integration, and thus view different cultures with a more tolerant attitude.

4.3. Effectively utilizing information technology to fully innovate reading teaching models

In college English reading teaching, the utilization of information technology is crucial as it can enhance the quality of education, promote independent learning and thinking among students, and improve reading efficiency. In the context of cross-cultural communication, teachers can maximize the use of information technology, fully realize technology-driven innovation in reading teaching, and enable students to understand culture and improve their reading abilities through intelligent and immersive learning ^[4]. Teachers can allow students to participate in reading practices with the help of online dictionaries, online search tools, and artificial intelligence, solving vocabulary problems and promptly understanding relevant cultural content, thereby improving reading efficiency. On the other hand, multimedia technology and virtual reality technology can also create rich cultural contexts for students, display diverse reading content, and assist students in experiential learning. Teachers can also organize online cross-cultural communication activities, allowing students to experience culture in real language practice, transfer and apply what they have learned from reading, and enhance their English proficiency.

For example, in the innovation of college English reading teaching under cross-cultural communication, schools actively update teaching tools in foreign language institutes, repair multimedia facilities, introduce new equipment, build an intelligent educational environment, and promote a three-tiered teaching ecology that is “student-centered, teacher-guided, and practice-driven.” This optimizes traditional teaching methods and brings students a new and highly immersive learning experience. Teachers use the internet to present intuitive reading content to students, while also allowing them to read using online tools. For instance, while reading texts about “Western festival culture”, students recognize the close connection between Western festival culture and their religious customs. They inquire with artificial intelligence online to learn relevant cultural knowledge, independently solve doubts during the reading process, and expand their learning of cultural knowledge. Teachers also effectively use multimedia technology to show students clips from movies like “The Joy Luck Club”, “Gua Sha”, and “Crash”, allowing students to recognize the importance of cultural communication through concrete experiences. Through sensory experiences, students become more active in reading English texts and offer their own suggestions from the perspective of cross-cultural communication, promoting cultural exchange. Teachers not only impart language knowledge but also cultivate students’ cross-cultural thinking. Teachers also utilize diverse online tools, such as the campus smart teaching cloud platform, to construct a multi-dimensional, comprehensive, and multi-modal virtual teaching space. This simulates specific scenes of cultural exchange, enabling students to travel through time and space with the help of technology for cross-cultural communication. Through profound experiences, students recognize the charm of Chinese culture and

become aware of the unique characteristics of different cultures through exploration.

4.4. Innovating interactive learning models and integrating cultural experience activities

The essence of the reading teaching process is interaction, requiring organized cooperative learning. In the process of reading teaching, teachers should innovate teaching methods, introduce interactive learning models, and improve the effectiveness of reading teaching through student communication. From the perspective of cross-cultural communication, teachers can innovate interactive learning models and integrate cultural experience activities. This allows students to participate in learning practices and cultural exchanges through cooperation, showcasing their personalized learning achievements. In collaboration, students complement, communicate, and help each other, applying their English reading knowledge to participate in cross-cultural communication. Teachers should also adjust teaching activities in a timely manner based on students' learning situations, promoting the construction of a new-style reading classroom through effective teacher-student and student-student interactions.

Reading comprehension is a highly individualized thought process, and effective interactive and group activities can foster mutual inspiration and assistance among students, as well as cultivate their sense of cooperation. In English reading instruction, teachers innovate effectively from traditional cooperative teaching models, integrating various cultural experience activities to enable students to engage in diverse interactions. For instance, a teacher might conduct a reading lesson themed “A Culinary Journey”, introducing reading materials about world cuisine. This allows students to embark on a journey of cultural exploration through food, experiencing the charm of multiculturalism. Teachers encourage students to express their viewpoints and design practical activities such as introducing hometown cuisine or experiencing Western cuisine, enabling them to understand culture through immersive experiences and diverse interactions.

Higher education institutions also design international cooperation and exchange programs based on the backdrop of international exchanges, offering short-term study visits and internship opportunities. These programs enable students to participate in international collaborations, conducting cross-cultural communication through authentic practices and broad interactions. Students can engage in a wider range of cultural exchanges and experiential activities, elevating their reading skills and English proficiency in real-life language situations. On the foundation of understanding and respecting diverse cultures, students contribute to cultural exchange and integration. Through diversified interactive learning practices, students gain a deep understanding of the linguistic logic, thinking patterns, and behavioral habits of different cultures, showcasing their talents in cross-cultural communication.

5. Conclusion

In summary, cultivating students' intercultural communication skills in college English reading teaching is of great significance and is an important topic in the new era. This article proposes innovative strategies for college English reading teaching from a cross-cultural perspective. Teachers should actively innovate teaching methods, stimulate students' subjectivity and creativity, enhance their intercultural communication awareness and cultural perception abilities, and further cultivate high-quality talents in the new era with solid basic English skills, strong intercultural communication skills, and a broad international perspective.

Disclosure statement

The author declares no conflict of interest.

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Innovations and Challenges of AI-empowered Career Education for College Students

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Abstract: Amid the rapid advancement of AI technology, career education for college students urgently requires transformation. Generative AI offers a novel approach to innovating career education: personalized career planning is achieved through precise profiling systems based on big data, learning experiences are enhanced via immersive scene reconstruction (such as virtual simulation technology), and traditional didactic methods are supplanted by coaching guidance to foster students' independent exploration. AI-driven career education encounters significant challenges, such as data privacy and ethical concerns, algorithmic bias leading to compliance issues, and threats to educational equity due to unequal distribution of technical resources. Future career education must balance technological advancement with humanistic values, leveraging AI's efficiency and intelligence while maintaining a "people-oriented" educational approach. This balance aims to nurture well-rounded individuals who possess both professional expertise and social responsibility.

Keywords: AI empowerment; Career education innovation; Generative artificial intelligence; Ethical risk; Algorithm compliance

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1. Introduction: The urgency of the transformation of college students' career education in the AI era

The rapid development of artificial intelligence technology is profoundly reshaping the global occupational ecosystem and the logic of talent cultivation. According to the prediction of the McKinsey Global Institute, by 2030, nearly 375 million workers worldwide will face career transformation, among whom cognitive abilities and social-emotional abilities have become the core competitiveness of workplace professionals^[1]. Against this backdrop, the career education system in universities is facing unprecedented shocks and challenges: the traditional standardized and group-oriented guidance model struggles to meet the personalized and dynamic career development needs driven by AI. In traditional career education, the formulas of career planning theories

are applied rigidly, resulting in a “one-size-fits-all” planning path. The content of career education lags behind the pace of industrial transformation and can no longer meet the current needs of university students.

In the face of these challenges, major domestic universities are carrying out exploratory work on empowering career education with artificial intelligence. Wang Huifeng, the vice-president of East China University of Science and Technology, pointed out that “AI should neither be regarded as a ‘tool appendage’ nor allowed to become the ‘dominant force.’ Instead, with ‘educating people’ as the core, we should break down barriers through interdisciplinary training models, consolidate the foundation with a hierarchical curriculum system, and improve efficiency with intelligent platforms, ultimately achieving the unity of ‘value guidance’ and ‘technological empowerment’.”^[2] This concept encapsulates the prevailing perspective of many leading domestic universities regarding AI technology’s role: technological empowerment should prioritize educational core values. Thus, this paper examines the transformation pathways, key challenges, and future directions for career education in the AI era, drawing from an analysis of innovative practices at various domestic universities.

2. Innovative practice of career education driven by generative artificial intelligence technology

Artificial intelligence is categorized into Analytical and Generative AI. Generative AI warrants particular attention due to its capability to autonomously produce content like text, images, videos, and audio through various algorithmic models. Additionally, it can refine its outputs by learning from user feedback^[3]. Incorporating generative AI into career education enables the simulation of real-life occupational scenarios for students, allowing them to experience various work environments virtually and gain insights into potential career paths. Furthermore, generative AI can generate personalized career exploration reports tailored to students’ interests, skills, and aptitudes, recommending majors and career trajectories that align with their development. Many universities are actively exploring the use of generative AI to enhance career education.

2.1. Precision career portrait system based on generative artificial intelligence

Generative artificial intelligence revolutionizes career planning by creating dynamic talent profiles through multi-source data integration, moving beyond traditional methods reliant on subjective assessments and personal data. This shift enables personalized, one-on-one career guidance. At Northwest A&F University, an AI-driven growth record system has generated ability profiles for over 10,000 students, combining professional course grades, general skills, and career interest evaluations into six major categories with over 30 detailed indicators, forming a quantitative “talent map.” Additionally, the system employs large-model algorithms to daily extract recruitment data from over 300,000 enterprises nationwide, storing it in a “demand database.” This facilitates precise two-way matching between the talent and demand databases^[4].

Not only are universities beginning to leverage generative AI to build a precise career profiling system, but primary and secondary schools are also starting to introduce new technologies to empower career education. The Education College of Minhang District in Shanghai has implemented a system that creates personalized career profiles for 1,396 Grade 10 students from seven high schools and 3,405 Grade 6 students from 15 junior high schools. This system analyzes students’ interests and inclinations in junior high and evaluates professional positioning in high school, offering comprehensive career development services across educational levels.

2.2. Reconstructing the learning experience through immersive scenarios

The integration of virtual reality (VR) and augmented reality (AR) technologies provides an interactive and experiential approach to conceptualizing career trajectories. For instance, the “Career Blind Box” project at Chongqing Technology and Business University allows students to input keywords related to their interests, which then automatically generates dynamic reports detailing job requirements and potential development paths. Additionally, the “Career Portrait Generation” system transforms students’ 15 ability items into personalized 3D character models, enabling them to visually conceptualize how their abstract career plans may materialize.

The “Business Career” program at Southwestern University of Finance and Economics integrates disciplinary characteristics with innovative scenario-based learning. The university leverages digital resources, including simulated banks, securities laboratories, and VR environments, to create a business world that closely mirrors reality. Furthermore, over 30% of the career-related curriculum comprises practical instruction. The teaching process incorporates diverse methods, such as job-hunting training camps, corporate open days, and entrepreneur-led classroom lectures, to seamlessly connect in-class and out-of-class learning. This comprehensive approach achieves a complete closed-loop integration of the “Business Career” program ^[5].

2.3. Replacing one-way indoctrination with coaching-style guidance

The core innovation of AI-based career consulting lies in shifting from providing prescriptive answers to stimulating students’ independent thinking and self-discovery. The “Awu” career planning AI system, developed by Southwest Jiaotong University, exemplifies this approach. Grounded in an interdisciplinary knowledge base spanning career studies, computer science, psychology, and linguistics, “Awu” represents a significant departure from traditional trait-factor theories of career development. Theoretically, it is underpinned by the dynamic concept of career adaptability, rather than static trait-matching. In terms of consulting methods, “Awu” employs a coaching approach, eschewing directive advisory models in favor of Socratic questioning to promote students’ self-awareness and autonomous decision-making. The system’s underlying logic is centered on facilitating students’ own reflections, rather than providing prescriptive recommendations ^[6].

The “Know-it-all” intelligent Q&A system developed by the Zhejiang Business Technology Institute has expanded its capabilities beyond factual information retrieval. By integrating the large-scale DeepSeek-R1 model, the system can now provide students with personalized academic and career development recommendations based on their majors, extracurricular activities, and internship experiences. When addressing queries about transitioning from junior college to undergraduate studies, the system not only links relevant learning resources but also mobilizes appropriate psychological support services, thereby achieving a synergistic integration of technological capabilities and humanistic care.

The integration of generative artificial intelligence (AI) in career education offers several distinct advantages. Foremost, it enables a highly personalized approach, allowing for the customization of career planning strategies tailored to the unique circumstances and needs of each student. By simulating authentic professional scenarios, generative AI provides immersive experiences that deepen students’ understanding of various occupations and strengthen their career awareness. Furthermore, the ability of generative AI to rapidly process vast amounts of information empowers students with up-to-date industry trends and career development outlooks, broadening their perspectives and facilitating more forward-looking career planning.

3. Core challenges in AI-enabled career education

The integration of generative artificial intelligence (AI) into career education presents several critical challenges. First, over-reliance on AI-generated content may undermine students' independent thinking and exploration skills. There is a risk of students becoming accustomed to directly seeking AI-provided answers, neglecting in-depth personal reflection and practical investigation. Secondly, data security and privacy protection are paramount concerns. Improper handling of student data during collection and utilization could result in serious breaches, compromising individual rights and interests. Finally, the accuracy and reliability of AI-generated content require rigorous validation. Algorithmic biases may lead to the provision of unreliable or inappropriate career guidance, necessitating careful evaluation of the system's outputs.

3.1. Ethical risks

The primary ethical challenge in AI career systems is safeguarding data privacy. Over-collection of multi-source data, including students' classroom behaviors, social dynamics, and psychological assessments, coupled with improper storage of un-desensitized data, can lead to information leaks and legal violations. During data processing, it is crucial to filter out inappropriate content, such as material inconsistent with core socialist values, as well as discriminatory or prejudiced information. The use of low-quality training data can result in AI systems that perpetuate social biases and produce inappropriate content. Such outcomes not only conflict with core socialist values but also negatively affect college students' career planning ^[7].

3.2. Algorithm compliance risks

Artificial intelligence-generated content (AIGC) involves AI autonomously producing diverse content types by processing extensive datasets. This process compresses vast pre-trained data into a parameter space, where interpolation grants AI a degree of generalization or hallucination, resulting in numerous ambiguities. College students outside the field of artificial intelligence may struggle to discern AI-induced hallucinations, potentially leading to misguided career planning decisions.

3.3. Ensuring educational equity

AI-driven career education lacks sufficient adaptability, particularly in universities located in third- and fourth-tier cities, where a technological application gap persists. The prohibitive cost of local server deployment for AI contributes to the limited reach of AI career platforms in these institutions. Additionally, algorithmic bias leads to digital discrimination. How can we guarantee that AI in career education provides equitable treatment to all students during training, regardless of gender or institutional ranking?

A shortage or quality disparity in training samples can lead to homogenized outputs and inadvertently embed developers' biases. This can result in "algorithmic discrimination", where the system unfairly treats certain groups during data processing ^[8]. A study by Soochow University on Microsoft's chatbot Xiaoice revealed significant gender biases. Introducing such biased algorithms into career education could compromise educational fairness.

4. Conclusion: The dialectical unity of technological empowerment and humanistic core

In the AI era, the core of career education for college students lies in reaffirming and elevating educational

values, rather than simply replacing them with technology. As algorithms handle repetitive tasks, education can refocus on its fundamental mission of nurturing individuals. Educators must enhance their digital literacy and teaching skills, guiding students to effectively and safely harness generative AI, while also mitigating its risks. This approach aims to advance high-quality career education in the age of artificial intelligence.

Universities must prioritize ethical considerations as they advance the application of generative AI technology, creating a career education ecosystem that emphasizes “using algorithms for education and prioritizing student development.” Within a framework of compliant use, AI should genuinely enhance career education, fostering future talents equipped with both innovative capabilities and a strong sense of responsibility.

Disclosure statement

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Foreign Researchers



Hospital



University



Scientific institutions

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