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Teaching Practice of Reading Strategy Units Based on the Concept of Learning Task Groups- Taking the Reading Strategy Unit in the Fourth Grade, Volume 1 as an Example

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Abstract

The 2022 version of the Chinese Language Curriculum Standards for Compulsory Education sets out six learning task groups at three levels. Among them, the second-level developmental learning task group includes "practical reading and communication," "literary reading and creative expression," and "critical reading and expression." The critical reading and expression task group aims to guide students in graphing viewpoints, facts, materials, and their relationships through reading, comparison, inference, questioning, discussion, and other methods in Chinese practical activities. The learning content of this task group is highly relevant to the teaching of reading strategy units arranged in the unified Chinese textbooks. Therefore, the two can be integrated, and different scenarios can be set up to promote the development and improvement of students' thinking ability through various learning activities.

Keywords

Learning Task Groups
Critical Reading and Expression
Reading Strategies

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1. Introduction

The 2022 version of the Chinese Language Curriculum Standards for Compulsory Education proposes that the content of Chinese courses in compulsory education should be organized and presented in learning task groups. The curriculum sets six learning task groups at three levels. Among them, the second-level developmental learning task group includes "practical reading and communication," "literary reading and creative expression," and "critical reading and expression." The "practical reading and communication" learning task group aims to guide students to obtain and integrate valuable information through listening, reading, and observation in Chinese practical activities. Based on specific communication situations and communication objects, students can express themselves clearly and

appropriately, effectively transmit information, and meet the communication needs of family life, school life, and social life. The critical reading and expression task group aims to guide students in graphing viewpoints, facts, materials, and their relationships through various methods in Chinese practical activities[1]. The content proposed in the task group points to the reading strategy unit in the unified textbooks.

2. Critical Reading and Expression Task Group

Many scholars have analyzed and studied the "critical reading and expression" task group proposed in the Chinese Curriculum Standards for Senior High Schools (2017 Edition, 2020 Revision). Chu Shurong believes that "critical reading and expression" is equivalent to "analytical reading and expression" and proposes the value of the "critical reading and expression" learning task group. He also defines critical reading, writing, and expression separately[2].

In April 2022, the Ministry of Education released *The 2022 version of the Chinese Language Curriculum Standards for Compulsory Education*. Many scholars and frontline teachers have interpreted the "critical reading and expression" task group. Xue Fagen believes that the keyword of this task group is "critical thinking," emphasizing rational logical thinking and dialectical thinking, pointing to the "thinking ability" in the connotation of Chinese core literacy[3].

The concept of "critical thinking" was first proposed in the Western Han Dynasty's *The Book of Rites: The Doctrine of the Mean*: "Learn extensively, inquire carefully, think deeply, differentiate clearly, and practice faithfully[4]." "Thinking" and "differentiation" are regarded as two essential steps in learning. After careful consideration, analysis and discrimination show the importance of "critical thinking" in reading. Most scholars understand "critical thinking" as "criticism." Critical reading and expression should focus on students' reading experience. Teaching should be based on real situations, with students as the main body, cultivating students' rational thinking, enabling them to understand, raise, and solve problems logically and dialectically.

3. Task Groups and Reading Strategy Units

The unified edition Chinese textbooks introduces four reading strategies— "Prediction," "Questioning," "Speed Improvement," and "Purposeful Reading" —in the first semester of grades three through six. These strategies are designed according to students' developmental stages and learning characteristics, featuring a spiral progression in knowledge acquisition. Each unit's introduction, key language elements, text content, post-reading exercises, and supplementary materials all systematically build upon the unit's core "reading strategy" objectives, enabling students to master these skills progressively. For example, the third-grade "Prediction" unit begins with the introduction: "Guessing and reasoning make our reading journey full of fun," followed by the first language element: "Predict while reading, following the story's plot." The unit opener, "The Old House That Never Falls Over," demonstrates prediction techniques through marginal notes, guiding students to make multi-angle predictions and provide logical justifications. The subsequent two skimming texts apply these methods from intensive reading, encouraging bold predictions. Interactive dialogue boxes prompt students to adjust their predictions when they conflict with story developments, ensuring systematic and cohesive learning throughout the unit.

Critical reading and expression are strongly related to the teaching of reading strategies units. Take the second and third learning stages as an example:

The 2022 version of the Chinese Language Curriculum Standards for Compulsory Education summarize core literacy as cultural confidence, language use, thinking ability, and aesthetic creation. It points out that these four aspects of core literacy form an integrated whole, as the learning content to be completed by task groups also constitutes a cohesive unit, all serving to cultivate students' core literacy in Chinese. Therefore, in the teaching of critical reading and expressive task groups, we cannot focus solely on the development and enhancement of thinking but must also consider the implementation and cultivation of the other three core literacies, allowing various task groups to complement and integrate with each other.

As we can see from **Table 1**, by combining the learning content and teaching suggestions of critical

Table 1. Reading Strategy Unit Language Elements of the Second and Third Learning Stages

Stage	Reading Strategy Unit Language Elements	Key Points Corresponding to the Critical Reading and Expression Task Group	Teaching Tips
Second Stage	**Grade 3:** Learn to predict text content based on text illustrations, annotations, and specific plot points. **Grade 4:**Cultivate students to dare to ask questions during reading, pose meaningful questions, and learn to ask questions while reading.	In daily learning and life, actively record, organize, and communicate discovered problems and thoughts; learn methods for analysis, questioning, and inquiry.	The Mysteries of Nature The Wisdom in Daily Life My Fantastic Ideas
Third Stage	**Grade 5:** Guide students to learn how to increase reading speed during reading. **Grade 6:** Achieve undertaking different reading tasks based on different reading purposes; perform purposeful reading by integrating real-life situations.	Read stories about scientific discoveries and technological inventions; use methods like mind maps to assist, concisely and clearly describe the process of scientific discovery and invention; learn the creative spirit of scientists and experience thinking methods like hypothesizing, verifying, and reasoning.	Discussing Social Ethics The Marvels of the Mother Tongue Light of Science Eastern Wisdom

Table 2. Design 1: Student Activities for Critical Reading and Expression Task Groups

Content	Learning Application	Scenario Creation–Time Travelasa Social Observer	Non-continuoustextlinks
The Secret of Night Flight	Ask questions from content, writing techniques, perspectives, and inspirations.	**Time Travel Background:** In our daily lives, many things possess unique value. Through wisdom, people continuously change our world. Now, with a time machine, let's travel back over two hundred years to see what experiments scientists conducted to study the secrets of bats. Then, come to the 20th century, experience that era of rapid technological development, and become a social observer. **Time Travel Tasks:** - Talk about the content that interests you most. - Record a large number of your questions. - As a social observer, do you think you can answer these questions now? - Collect people's discoveries in daily life and the inventions made through these discoveries.	**Refrigerator**
A Century of Calling Wind and Rain	Ask questions that help understand the text content.		The History of Eyeglasses

reading and expressive task groups, we can integrate existing reading strategy unit content.

4. Integrated Teaching of Critical Reading and Expressive Task Groups with Reading Strategy Units

Taking the "questioning" reading strategy in the fourth grade Chinese textbook as an example, we can integrate it with critical reading and expressive task groups as follows:

4.1. Determine unit learning objectives and design learning activities.

The second unit of the fourth-grade Chinese textbook (compiled edition) focuses on the reading strategy unit —— "Questioning", encouraging students to "think from multiple perspectives and formulate original questions while reading". This unit includes four texts: three

intensive reading passages— "Five Beans in a Bean Pod" (a fairy tale), "Secrets of Night Flight" (an expository text), and "The Century of Wind and Rain" (another expository text)—and one extensive reading passage—"Butterfly's Home" (a prose piece). Analysis shows these texts aim to help students master the questioning strategy across different genres. The unit's assignment "Little Zoo" requires students to highlight the most memorable aspects when describing people, which serves as an internalization process of this strategy. This encourages students to explore connections between family members and familiar animals, thereby discovering the unique characteristics of characters.

By combining textbook content with critical reading and expression task groups, we designed the teaching activities of this unit with two activities as the starting point.

Activity 1 focuses on two intensive reading texts, aiming to help students experience the characteristics of expository writing and allowing them to ask questions about the texts from different perspectives. In after-class exercises, discontinuous texts can be used as a method to enable students to feel the different formats of similar texts, thereby internalizing the way of asking questions.

Activity 2 points to students' reading and expression skills, applying the thinking methods learned in Activity 1 to different types of texts and experiencing and applying them in daily life. Additionally, students will read the entire book "Chinese Wisdom Stories," experience the unique wisdom of Chinese civilization, and attempt to solve different problems in life.

4.2. Focus on students' learning experiences and encourage them to ask questions boldly

Overall, primary school students' deductive reasoning, abstract thinking, and multi-dimensional thinking have not yet fully developed. Therefore, they still rely on tangible and perceptible specific things and emotional experiences accumulated in life. Their ability to independently transfer knowledge is weak, making it difficult to reason, generalize, and understand abstract concepts in their minds. Hence, teachers must base their teaching on students' existing experiences, create situations close to their lives, and provide students with practical sensory and interest experiences. This allows students to understand the knowledge they have learned and apply it. "Learning thrives on doubt." In this unit, teaching should revolve around the word "doubt." Therefore, students should be encouraged to ask a lot of questions, whether it's about logical loopholes in textbooks or ambiguities in textbook compilation. For doubts about content, writing methods, and other aspects, students should be guided to speak freely based on positive thinking. However, instead of emphasizing rationality, we should guide students to dare to question and achieve multiple interpretations of the text. This helps students build a foundation for critical reading.

4.3. Diversified evaluation methods

In the teaching of "critical reading and expression" task groups, we should cultivate students' ability to find and solve problems. In the question-asking process, there are often inconsistencies in viewpoints between teachers

Table 3. Design 2: Student Activities for Critical Reading and Expression Task Groups

Content	Purpose	ScenarioCreation:WeAreSpirits	TextLinks
Five Peas in a Pod	Through the different lives and dreams of the five peas, experience what is called "valuable", while being able to generate questions about parts and the whole text.	The reason life is full of wisdom comes from our rich imagination. Let us enter life and become magical little spirits, transforming into pea pods, butterflies, animals to observe every move of humans. **Spirit Rules:** - We can hide in stories, become the protagonists, and feel their emotional changes - What feelings do their changes bring you? Do you like these feelings? - Think about what questions you want to ask them	Full book reading: *Chinese Wisdom Stories*
Butterfly's Home	Feel the author's love for small creatures and raise your own questions.		
"Little Zoo"	Observe similarities between family members and animals, understand their troubles and happiness, learn how they solve problems, and write about your own family.		

and students or among students. Based on full dialogue, we should also guide students to learn to listen to others' viewpoints with an equal and tolerant attitude and actively reflect on and diagnose their own viewpoints. Therefore, in peer evaluation, teachers can use various methods, such as applause or computer voting, to allow students to express their approval first and then present their opinions. Additionally, due to students' tendency to look up to their teachers, teachers' evaluations should not involve right or wrong judgments. Instead, they should respect students' views and offer suggestions or allow students to self-evaluate, thereby protecting their attitude of daring to question and ask questions.

5. Conclusion

Based on the critical reading and expression task groups, the integrated teaching of reading strategy units requires teachers to create authentic and engaging scenarios during instructional design, integrate the entire unit's teaching content, and approach lesson planning from a macro-unit perspective. In terms of student activity design, it is essential to focus on students' learning interests and initiative, fostering their creative and critical thinking abilities.

Disclosure statement

The author declares no conflict of interest.

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Research on Intelligent Competency Modeling and Job-Person Matching Mechanism Based on the DeepSeek Model

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Abstract

With the rapid development of artificial intelligence, especially open-source large language models, enterprise human resource management is undergoing profound transformation. Traditional competency models for job positions largely rely on expert experience for construction, which leads to outdated updates, poor generalizability, and an inability to meet the rapidly changing strategic needs of modern organizations [1]. This paper proposes a low-cost, scalable competency modeling and job-person matching framework based on DeepSeek, a representative open-source language model. By applying natural language processing and semantic embedding techniques, the system extracts competency elements from job descriptions and resumes to construct ability vectors and compute job-person matching scores. The study also explores the application of this model in scenarios such as recruitment screening, job adjustment, and talent development, and identifies challenges such as data quality, model interpretability, and digital literacy among HR professionals, while proposing corresponding countermeasures. Experiments and preliminary applications demonstrate that the intelligent competency system based on large language models is highly feasible and commercially valuable [2].

Keywords

artificial intelligence
competency model
job-person matching
deepseek
natural language processing
digital human resources

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1. Introduction

In the rapidly evolving digital economy, enterprises are increasingly demanding precise matches between talent and job positions. Traditional human resource management methods that rely heavily on subjective experience are being fundamentally reshaped. The competency model, as a critical intermediary connecting job requirements with employee capabilities, has been widely applied in recruitment, performance evaluation, promotion assessments, and training systems.

However, traditional competency models are often constructed using methods such as the Delphi technique, behavioral event interviews (BEI), or expert workshops. These methods are time-consuming, costly, and lack general applicability, making them unsuitable for rapidly changing business environments [3]. Moreover, statically

defined competency dimensions struggle to capture the dynamic evolution of job requirements and fail to effectively identify deep-level talent capabilities.

In recent years, breakthroughs in artificial intelligence, especially in the field of natural language processing (NLP), have brought about a fundamental shift in competency modeling paradigms. Open-source language models such as DeepSeek possess powerful semantic understanding and embedding capabilities, enabling the transformation of unstructured texts—such as job descriptions, resumes, and performance records—into unified semantic vectors representing competencies. This allows for matching and analysis based on a shared "competency space" [4].

Unlike traditional systems based on keyword retrieval or rule-based matching, large language models can recognize semantically similar expressions and identify transferable skills across industries and job types, significantly improving the precision and fairness of job-person matching [5]. At the same time, DeepSeek, as a free, open-source, and fine-tunable model, offers small and medium-sized enterprises a low-barrier, high-performance AI solution that significantly reduces the deployment cost of intelligent matching systems.

Therefore, this paper aims to construct a competency modeling and job-person matching framework centered on DeepSeek, integrating natural language processing, competency vector modeling, and organizational practice needs. It explores the implementation of modules such as job modeling, talent recommendation, and competency gap analysis, and conducts in-depth analysis of challenges encountered in real-world enterprise deployment, offering targeted solutions [6].

2. AI-Driven Competency Modeling and Job-Person Matching Mechanism

The development of artificial intelligence, particularly natural language processing (NLP) technologies, is fundamentally reshaping the underlying logic of traditional competency modeling. In the past, competency models were manually constructed by HR experts using interviews, surveys, and workshops. These methods were not only inefficient and limited in scope, but also difficult to update in real time. Today, the powerful semantic processing capabilities of large language models enable the automatic extraction of competency dimensions from unstructured text.

2.1. Semantic Modeling Mechanism for Job Competency

In traditional HR practices, job descriptions (JDs) are an important source for constructing competency models. However, these documents often suffer from inconsistencies in language style and loose structural organization. Large language models such as DeepSeek can utilize multi-layer semantic representations built through self-supervised training to vectorize these texts and embed them into high-dimensional semantic spaces, enabling automatic extraction and classification of core responsibilities, skill requirements, and behavioral traits [7].

In practical application, the system first performs preprocessing on JD texts, including tokenization, named entity recognition, and dependency parsing. It then employs a deep semantic network to identify competency elements directly related to job tasks, such as "problem-solving skills," "cross-functional communication," or "Python programming." These competency labels can further be aligned with existing enterprise competency frameworks, such as O*NET or proprietary corporate models, to form a structured competency taxonomy.

Ultimately, each job is encoded into a vector representation containing multiple competency dimensions. This representation serves as the foundational information unit for subsequent job-person matching processes. This approach not only significantly reduces manual intervention but also enhances the adaptability and scalability of the competency modeling system.

2.2. Logic of Generating Candidate Competency Profiles

In a job-person matching system, candidate information must also be converted into competency vectors to enable comparison with job profiles. Candidate-related texts include resumes, cover letters, project experience, and public portfolio links. The system applies semantic embedding techniques to extract embedded knowledge, skills, experiences, and behavioral traits.

For instance, a resume stating "Led an AI algorithm transformation for an educational platform,

improving learning path recommendation accuracy" can be semantically interpreted by the system to infer competencies such as "algorithm development," "data modeling experience," and "team collaboration." These elements are then quantified and mapped into the semantic space. Importantly, the candidate need not use standardized terminology, as the model is capable of actively recognizing implicit expressions of competencies, thereby significantly improving inclusiveness and accuracy in competency extraction.

To enhance matching precision, the system must also introduce a weighting mechanism among competency dimensions. For example, if a position emphasizes communication and learning capabilities, the system should assign higher weights to these dimensions when calculating the match score. This logic can be iteratively optimized based on actual recruitment feedback.

2.3. Design of Job-Person Matching Scoring Mechanism

Once both the job and candidate competency vectors have been constructed, the system can calculate their "competency match score" using mathematical methods such as cosine similarity or Euclidean distance. In addition, it can incorporate minimum thresholds for key competency dimensions, allowing the system to filter out low-fit candidates in the initial screening phase.

For example, in a recruitment scenario where the job requires strong communication skills, project management abilities, and Java proficiency, a candidate who scores highly in communication and Java but slightly lower in project management—yet still above the threshold—can be shortlisted for further evaluation by HR.

To improve acceptability among HR professionals, the system should offer match explanation functions, such as radar charts that visualize competency comparisons, or generate concise rationales that clarify why a candidate was recommended. This helps HR professionals better understand the AI decision-making process and supplement it with their own judgment.

2.4. System Integration and Application Scenarios

Based on the modeling logic described above, enterprises can build a complete closed-loop system connecting "Job–Competency–Talent." This system includes the following functional modules:

Job Competency Library Module: Automatically parses all JD documents within the enterprise and generates structured job competency profiles;

Resume Competency Extraction Module: Semantically analyzes candidate information to produce individual talent profiles;

Matching Score & Recommendation Module: Computes job-candidate match scores and generates explanatory reports;

Feedback Learning Mechanism Module: Continuously updates model weights based on recruitment results and HR feedback, improving recommendation accuracy over time [8].

In real-world practice, this system can be used not only for external hiring but also for internal job rotation, talent inventory analysis, and succession planning. It provides organizations with a dynamic capability analysis tool that supports strategic workforce decisions.

3. Data-Driven Human Resource Management and Organizational Evolution Pathways

The application of AI-powered competency modeling not only improves the efficiency of job-person matching but also lays the groundwork for data-driven human resource systems within enterprises. Traditional HR management relies heavily on subjective judgment and fragmented information, resulting in delayed and inconsistent decision-making—an approach ill-suited for today's agile organizational demands. Once competency data is structured and embedded semantically, organizations can reconceptualize their structure and talent relationships around "capability units," thereby initiating a transformation toward intelligent HR systems.

3.1. Organizational Capability Mapping and Talent Inventory Mechanism

By encoding all positions and employees into a unified competency vector space, companies can build a comprehensive organizational capability map. This map enables the identification of competency redundancies, gaps, or critical deficiencies, which in turn supports

more informed decisions in workforce optimization and strategic alignment. For instance, a technology company may discover, via such a map, that project management and cross-functional communication are significantly underrepresented in key departments, prompting a realignment of internal training priorities and external recruitment strategies.

In addition, the system can identify high-potential talent clusters by analyzing patterns in competency growth and capability combinations. HR managers can then proactively earmark these individuals for accelerated development or strategic project assignments.

3.2. Flexible Job-Person Matching and Enhanced Organizational Agility

A data-driven matching model allows organizations to dynamically respond to shifting business requirements, such as job reassignments, structural adjustments, or the formation of temporary project teams. For example, when a company launches a new digital marketing unit, the system can rapidly scan the internal talent pool for employees who simultaneously possess "data analytics" and "market insight" capabilities, and recommend them for an initial pilot team. This competency-based resource deployment mechanism significantly enhances the organization's responsiveness.

Compared to the traditional model of position assignment based on hierarchy or tenure, AI-driven systems follow a more logical sequence of "business problem → capability requirement → talent recommendation," aligning well with project-based and task-driven organizational models [9].

3.3. The Strategic Role of Competency Data in Enterprise Decision-Making

During organizational restructuring or business transformation, many enterprises face a critical mismatch between strategic goals and actual competency reserves. By building a robust competency data infrastructure, leadership teams can leverage the system to forecast capability gaps, estimate transformation costs, and plan training or recruitment needs accordingly.

For example, in a planned expansion into international markets, the system can analyze the distribution and proportion of employees with skills in cross-cultural communication, global business practices, and foreign languages. This enables management to assess redeployment potential and formulate more precise talent acquisition or upskilling strategies [10].

4. Practical Challenges and Mitigation Strategies for AI-Driven Competency Modeling

Despite the substantial potential of AI in job-person matching and competency modeling, real-world implementation presents several complex challenges. When applying open-source large language models such as DeepSeek in human resource management, enterprises must go beyond technical compatibility and address a broader set of issues involving data ethics, organizational culture, and operational mechanisms. This section outlines four key categories of implementation barriers and provides corresponding solutions.

4.1. Data Quality and Diversity Challenges

The performance and iterative refinement of competency models are highly dependent on the quality of input data. In real-world enterprise environments, job descriptions are often characterized by inconsistent terminology, redundant information, and outdated content. Meanwhile, resumes and internal employee capability records are frequently heterogeneous and poorly structured, making it difficult for AI models to learn from reliable inputs.

Furthermore, significant variations exist in how different industries or companies define the same competency. For example, "communication skills" in sales may emphasize client orientation, whereas in technical roles it may relate more to cross-functional collaboration. This diversity challenges the model's generalizability and necessitates industry- or organization-specific fine-tuning.

Proposed Strategies:

Establish standardized annotation guidelines for job and competency data to promote consistency across JD and employee records.

Implement rule-based data cleaning mechanisms combined with machine learning models for noise correction and semantic classification [11].

Employ active learning strategies that prioritize

high-confidence samples during training, improving model robustness and learning efficiency[12].

4.2. Limited Model Interpretability and HR Trust Issues

Although models like DeepSeek can deliver high semantic similarity scores in job-person matching, their internal decision-making processes are often opaque. HR professionals may encounter the "black box" problem, struggling to understand why a candidate was recommended, whether the system exhibits bias, or whether automated decisions are trustworthy.

In practice, there is growing resistance to AI-based matching systems, particularly when recommendations influence sensitive personnel decisions such as promotions or terminations. HR practitioners tend to favor human judgment over opaque algorithmic outputs in such scenarios.

Proposed Strategies:

Introduce model interpretability modules using methods such as Shapley values, attention visualization, or vector mapping to illustrate how specific competency dimensions drive recommendations [13].

Adopt a hybrid decision-making model that combines AI recommendations with HR expert judgment, fostering greater transparency and human oversight.

Generate explanatory reports for each match, including radar charts for competency comparison, skill alignment breakdowns, and narrative justifications for recommendations.

4.3. Organizational Culture and HR Capability Fit

Implementing an AI system is not merely a technological shift—it entails a profound organizational transformation. If the HR team lacks digital literacy or prior experience with data tools, there is a risk that the system will be deployed but not adopted.

This issue is particularly pronounced in traditional industries or state-owned enterprises, where HR professionals often exhibit skepticism toward AI. Concerns about job displacement, system compatibility, and general distrust of technology can severely undermine model effectiveness.

Proposed Strategies:

Involve HR teams in system co-design through collaborative frameworks where both HR and data science teams jointly define matching rules and competency taxonomies.

Launch upskilling programs to enhance digital literacy and support the transition from transactional HR roles to data-driven HR practices.

Embed AI modules directly into existing HR platforms (e.g., ATS, OA, or HRIS systems) to lower the barrier to usage and streamline user experience[14].

4.4. Ethical Risks and Data Privacy Protection

Job-person matching systems inevitably process sensitive personal information such as education background, gender, age, and performance records. Without robust data governance and ethical safeguards, these systems can lead to:

Lack of algorithmic neutrality, causing implicit discrimination (e.g., favoring male candidates or penalizing career switchers);

Internal leakage of employee competency profiles, resulting in coercive performance monitoring;

Unconsented data circulation across systems, posing privacy risks for job candidates.

Proposed Strategies:

Integrate fairness-aware algorithms to detect and mitigate bias in model outputs, ensuring that recommendations are not distorted by non-competency factors such as age or gender[14].

Establish robust data authorization protocols to guarantee that every instance of data use is legally grounded and traceable.

Develop an "AI Ethics Usage Framework" that embeds principles of transparency, auditability, and privacy protection into the system development lifecycle[15].

5. Future Outlook: Building an AI-Powered Competency Ecosystem

With the convergence of large language models, knowledge graphs, and multimodal interaction technologies, AI-driven competency systems are evolving from standalone tools into strategic-level ecosystems.

Enterprises will no longer use AI solely for recruitment and matching, but rather as the foundation for an intelligent network centered around "capability" that spans the entire talent lifecycle.

5.1. From Static Models to Dynamic Competency Evolution Systems

Future competency models will not remain static structures defined in advance, but will evolve continuously through real-time data and automated updates. Behavioral data from employees' project participation, learning trajectories, and performance feedback will feed into the system, allowing for dynamic optimization of competency profiles. Consequently, job-person fit will evolve from a one-time matching exercise into a predictive model of long-term potential.

5.2. Deep Integration with Talent Development Systems

AI competency systems will be integrated with online learning platforms, performance management systems, and career path planning tools to form a closed loop of "gap identification → learning recommendation → competency update." For example, if a candidate lacks communication skills for a particular position, the system can automatically suggest micro-courses or mentorship resources to help narrow the competency gap.

5.3. Evolution into a Strategic Decision Support Platform

Leveraging enterprise-wide competency maps, AI can assist in designing more effective organizational structures and talent distributions. For instance, if the system identifies a lack of data-driven operational skills within a regional sales team, it can recommend adjusting organizational responsibilities or introducing new competency models. In this way, HR transitions from a support function to a strategic driver of organizational evolution.

6. Conclusion

This study explored the application of the open-source large language model DeepSeek in building intelligent competency modeling and job-person matching systems. It proposed a low-cost, highly adaptable AI-driven solution for identifying and recommending talent capabilities. Compared to traditional methods, this system offers superior semantic understanding, high matching accuracy, and strong scalability.

In terms of modeling, the system automatically extracts competency elements from unstructured job and resume texts, enabling semantic alignment between job and talent profiles. It is applicable not only to external recruitment but also to job rotation, organizational capability mapping, and talent development planning. The system further facilitates the transformation of HR from an administrative role into a data-driven, strategic partner.

Despite its advantages, practical implementation of AI competency systems still faces challenges such as fragmented data, limited model interpretability, and organizational resistance. Future systems must evolve toward multimodal capability recognition, self-supervised learning, and deep integration with talent development platforms to form a full-stack human resource management ecosystem centered on competencies.

This research illustrates that AI is not merely a tool for job matching, but a technological cornerstone for organizational design and strategic transformation. As open-source model performance improves and technical barriers decline, the widespread adoption of competency systems will become a critical pathway for enhancing enterprise talent competitiveness.

Disclosure statement

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Research on Professional Development Pathways for Foreign Language Teachers in Private Universities in the Age of Artificial Intelligence

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Abstract

In the context of rapid advancements in artificial intelligence, foreign language teachers face new challenges and opportunities for professional development. This paper draws on theories of teacher professional development, the Technology Acceptance Model (TAM), Constructivist Learning Theory and Blended Learning to systematically explore pathways and strategies for the professional development of foreign language teachers in private universities in the era of artificial intelligence. The study suggests that foreign language teachers need to continuously enhance their digital literacy and information technology application skills throughout their careers, increase their acceptance of and proficiency in using artificial intelligence technology, and transform their teaching roles to actively explore AI-based teaching models. By constructing a professional competence framework, optimising top-level design, strengthening training mechanisms, and establishing a scientific evaluation and incentive system, it is possible to effectively promote the professional growth and teaching innovation of foreign language teachers.

Keywords

University foreign language teachers; Artificial intelligence; Professional development of foreign language teachers

Online publication: June 26, 2025

1. Introduction

With the rapid development of artificial intelligence technology, the education ecosystem is undergoing profound changes, and foreign language teaching is facing unprecedented opportunities and challenges. China places great emphasis on the deep integration of artificial intelligence and education. The Ministry of Education [1-5] has explicitly stated in a series of policy documents that teachers should actively adapt to technological changes, enhance their information technology application skills, intelligent literacy, and digital literacy, and strengthen their ability to interact and collaborate with machines. They should adopt a proactive attitude towards educational transformation to achieve continuous development of their professional capabilities.

Under this contemporary context, private

universities, as an integral part of China's higher education system, face significant challenges in the professional development of the foreign language faculty. This development not only impacts the quality of talent cultivation within institutions but also influences the optimisation and diversification of higher education structures. The integration of artificial intelligence (AI) into foreign language education has become increasingly prevalent, with applications spanning automated assessment systems, neural machine translation, intelligent tutoring platforms, and beyond. The introduction of these technologies has not only transformed the teaching environment but also posed new challenges to the traditional role and professional capabilities of teachers [6], necessitating a systematic restructuring of teachers' concepts, capabilities, and development pathways. Against this backdrop, an in-depth investigation into the professional competency development pathways for foreign language teachers in private universities during the AI era carries substantial theoretical significance, while also offering practical implications for advancing educational reform and improving instructional quality.

2. Literature Review

In the current era of artificial intelligence, the field of foreign language education is undergoing profound transformations and facing significant challenges. While scholars domestically and internationally have extensively explored the applications of artificial intelligence in education, systematic investigations into the professional development pathways for foreign language educators in private universities remain comparatively limited. Current research both domestically and internationally has primarily focused on the application of AI technology in language learning, teaching assessment, and personalised education, with limited in-depth exploration of how foreign language teachers at private universities can effectively address the challenges posed by artificial intelligence technology.

Internationally, in recent years, the impact of the AI era on higher education has gained significant attention from countries worldwide and scholars, with universities in various nations beginning to prioritise the influence of information technology and digital technology on higher education. Among these, Europe and the United States have addressed this issue earlier, with research primarily proposing new AI-based professional development models for foreign language teachers, including training objectives, curriculum design, and teaching methods. Kohnke et al. [7] explored higher education English teachers' attitudes toward generative AI tools, their willingness to use them, and the institutional support and professional development needed when using and learning these tools. They proposed 10 practical insights to cultivate language teachers' digital competencies, pedagogical knowledge, and positive attitudes toward AI integration, thereby enhancing students' learning experiences. Given the pedagogical and technical advantages of AI tools, Celik [8] proposed an updated teacher knowledge framework for ethically integrating AI tools, namely the Smart TPACK framework. Additionally, researchers have suggested designing AI-based educational software to enhance teachers' qualifications, establishing AI-based training pathways for all individuals working in the education sector, creating accurate databases across all education fields (including human resources), and developing educational training environments that facilitate the application of AI in teachers' professional development to enhance their professional capabilities.

In the Chinese context, an increasing number of studies have focused on the professional development of university foreign language teachers in the AI-enhanced educational environment, with particular emphasis on conceptual frameworks, prevailing challenges, and developmental trends. Yao Lina [9] integrated the characteristics of artificial intelligence (AI) to examine its influence on foreign language teachers, and subsequently proposed a professional development framework for educators in the AI era from three key dimensions: the transformation of teacher roles, individual professional growth, and teacher training and development. Similarly, Lyu Jianxiu [10] contends that the advent of AI has introduced novel dimensions and challenges to the professional development of university foreign language teachers. The study advocates for the enhancement of teachers' professional competence through targeted training, school-based research initiatives, and reflective

teaching practices. In a related vein, Sun Qinmei [11] highlights the effectiveness of online collaborative learning communities in advancing teachers' professional cognition, broadening their knowledge base, refining pedagogical skills, and ultimately improving overall professional competence. Furthermore, Lin Xiaoling and her colleagues [12] emphasize that, within the framework of "AI + Education," the professional development of foreign language teachers should be guided by the principles of autonomy and sustainability. They propose that fostering intrinsic motivation and cultivating a supportive professional development environment are essential to advancing teacher growth in the AI era.

As can be seen, there is a relatively mature research system in the field of teacher professional development abroad, particularly in the cultivation of teachers' educational technology competencies. Despite growing interest, research that integrates artificial intelligence (AI) technologies with the cultivation of teachers' professional competencies remains in a nascent and exploratory stage. While domestic scholarship on the application of AI in education is gradually expanding, it has largely concentrated on basic education and online learning, with limited attention given to the professional competency development of foreign language teachers—particularly those employed in private universities. Overall, both domestic and international scholars have approached the cultivation of foreign language teachers' professional competencies in the AI era from diverse perspectives, offering valuable theoretical and practical insights for the present study. However, although some studies have examined the integration of AI into higher education, there is a notable lack of systematic and in-depth research specifically focused on the developmental pathways for enhancing the professional competencies of foreign language teachers in private higher education institutions. In particular, empirical studies supported by concrete case analyses and statistical data remain scarce.

3. Theoretical Foundations

This study primarily draws on teacher professional development theory and the Technology Acceptance Model (TAM), while also incorporating constructivist learning theory and blended learning theory, to explore pathways for cultivating the professional competencies of foreign language teachers at private universities in the era of artificial intelligence.

3.1. Teacher Professional Development Theory

Teacher professional development theory emphasises the continuous learning and growth process throughout a teacher's career, including improvements in knowledge, skills, attitudes, and values [13]. In the era of artificial intelligence, foreign language teachers need to continuously update their knowledge structures, enhance their information technology application capabilities, and develop their intelligent literacy to adapt to the demands of educational reform. This study will draw on teacher professional development theory to construct a professional competence framework for foreign language teachers in private universities and explore effective cultivation pathways to promote teacher professional development.

3.2. Technology Acceptance Model (TAM)

Used to explain the degree to which users accept information technology, it posits that perceived usefulness and perceived ease of use are key factors influencing users' acceptance of new technology [14]. In the era of artificial intelligence, the degree to which foreign language teachers accept artificial intelligence technology directly impacts its application effectiveness. This study will employ the Technology Acceptance Model to analyse the factors influencing the acceptance and application of artificial intelligence technology by foreign language teachers at private universities, and explore strategies to enhance teachers' technology acceptance.

3.3. Constructivist Learning Theory

This theory emphasises the active process of knowledge construction by learners, positing that learning is a process where learners actively construct new knowledge based on their prior experiences through interaction with the environment [15]. In the era of artificial intelligence, foreign language teachers need to transition from knowledge transmitters to learning facilitators, leveraging artificial intelligence technology to create authentic learning environments and guide students in actively constructing knowledge. This study will draw

on constructivist learning theory to explore foreign language teaching models and methods based on artificial intelligence technology, thereby promoting students' deep learning.

4. Professional development pathways for foreign language teachers

In the context of artificial intelligence (AI) profoundly reshaping the educational landscape, the professional development of foreign language teachers in private universities is confronted with both emerging opportunities and complex challenges. To align with the evolving trends of educational informatization and intelligent transformation, teachers must not only continuously enhance their disciplinary knowledge and pedagogical competencies but also acquire and effectively integrate AI-related technologies into their teaching practices. This integration is essential for facilitating role transformation and fostering pedagogical innovation. Drawing upon teacher professional development theory, the Technology Acceptance Model (TAM), constructivist learning theory, and blended learning theory, the present study proposes a set of professional development pathways tailored to the needs of foreign language teachers in the AI era.

Guided by teacher professional development theory, this study proposes the establishment of a competency-oriented growth framework for foreign language educators. Teacher professional development theory underscores the significance of lifelong learning, reflective practice, and continuous professional enhancement throughout a teacher's career [14]. In the context of rapid advancements in artificial intelligence (AI), foreign language teachers are required to continuously update their pedagogical beliefs and strengthen their competencies in information literacy, the application of intelligent tools, and interdisciplinary integration. Accordingly, this study advocates for the construction of a foreign language teacher competency framework centered on three core dimensions: technology integration capabilities, smart teaching competencies, and data literacy skills. This framework aims to support teachers in transitioning from traditional instructional models to AI-enhanced smart teaching practices. Furthermore, by formulating staged developmental goals and implementing systematic training programs, professional development initiatives, and collaborative learning communities, a supportive environment conducive to sustained professional growth can be cultivated.

The Technology Acceptance Model (TAM), proposed by Davis [14], posits that users' acceptance of new technologies is primarily influenced by their perceived usefulness and perceived ease of use. Applying this theoretical framework, the present study emphasizes the importance of enhancing foreign language teachers' understanding and acceptance of artificial intelligence (AI) technologies. At present, a number of educators in private universities exhibit hesitation or resistance toward the adoption of AI tools in educational settings, which poses a barrier to the deeper integration of educational technologies into pedagogical practice. To address this challenge, it is essential to employ targeted strategies—such as the dissemination of exemplary case studies, the implementation of scenario-based simulation teaching, and the provision of experiential training—to improve teachers' awareness of the pedagogical value of AI. Concurrently, efforts should be made to simplify the operational interfaces of teaching platforms and AI tools, enhance their usability, and reduce technical barriers. These measures aim to progressively strengthen teachers' willingness to adopt AI technologies and improve their operational competence, thereby facilitating the effective integration of AI into foreign language teaching.

Grounded in constructivist learning theory, the transformation of teachers' instructional roles is imperative in AI-enhanced educational contexts. Constructivism, as articulated by Piaget [15], posits that learners actively construct knowledge through engagement in authentic, real-life contexts. In the era of intelligent education, teachers are no longer viewed merely as transmitters of information but are redefined as organizers of learning, curators of educational resources, and facilitators of student-centered learning processes. Within this framework, foreign language teachers are encouraged to leverage AI technologies—such as intelligent speech recognition, automated writing evaluation, and virtual dialogue systems—to create immersive and interactive language learning environments. These tools can effectively stimulate students' intrinsic motivation, foster

deeper engagement, and support meaningful knowledge construction. This study advocates for the integration of constructivist principles into teacher training systems to enable educators to master the design of intelligent learning tasks, reform instructional content and assessment practices, and ultimately improve students' comprehensive language competencies[16].

In parallel, the integration of blended learning theory serves as a catalyst for diversifying teachers' professional learning modalities. Blended learning emphasizes the multidimensional fusion of online and offline, synchronous and asynchronous, as well as individualized and collaborative learning approaches. In designing professional development pathways for foreign language teachers, it is essential to promote the strategic integration of diverse learning resources, including online platforms, AI-driven teaching assistants, and face-to-face training. For instance, establishing an "AI + Foreign Language Teaching" online micro-course platform can offer teachers flexible, personalized learning resources accessible at any time. Furthermore, initiatives such as problem-based collaborative learning via online communities or participation in "Teacher Growth Check-in Plans" can facilitate peer interaction and knowledge exchange. These efforts should be complemented by offline activities—including classroom observations, teaching competitions, and pedagogical workshops—to ensure the holistic integration of theory and practice, and to foster sustainable professional growth among foreign language educators[17].

In summary, the professional development of foreign language teachers in private universities in the era of artificial intelligence should be supported by theoretical guidance, based on technology acceptance, centred on a shift in teaching philosophy, and guided by innovative learning models. This should form the basis for constructing a multi-dimensional, phased, and integrated development system to achieve the comprehensive transformation and sustainable development of foreign language teachers.

5. Conclusion

In the context of the rapid development of artificial intelligence, the professional development of foreign language teachers in private universities is confronted with both emerging opportunities and complex challenges. To align with the evolving trends of educational informatization and intelligent transformation, teachers must not only continuously enhance their disciplinary knowledge and pedagogical competencies but also acquire and effectively integrate AI-related technologies into their teaching practices. This integration is essential for facilitating role transformation and fostering pedagogical innovation. Drawing upon teacher professional development theory, the Technology Acceptance Model (TAM), and constructivist learning theory, the present study proposes a set of professional development pathways tailored to the needs of foreign language teachers in the AI era.

Disclosure statement

The author declares no conflict of interest.

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Research on Teaching Reform of "Engineering Project Management Theory and Application" Course in the AI Era

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Abstract

With the rapid development of artificial intelligence technology, the field of engineering project management is undergoing profound changes. The traditional teaching mode of engineering project management courses can no longer meet the industry's demand for versatile talents, making teaching reform imperative. Focusing on the integration of artificial intelligence (AI) with the teaching of the “Engineering Project Management” course, this paper explores the impacts of the development of AI technology on the reconstruction of teaching content, the innovation of teaching methods, and the evaluation system, etc., in combination with the characteristics of the course. It also analyzes the problems existing in the integration of AI into teaching and the corresponding.

Keywords

Artificial intelligence; Engineering project management; teaching reform

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1. Introduction

Against the backdrop of a new round of global technological revolution and industrial transformation, artificial intelligence (AI) technology is penetrating into various industries at an unprecedented speed, and the engineering project management industry is no exception. Engineering projects have the characteristics of large investment scale, long construction period, multiple participating parties, high technical complexity, and multiple risk factors. Traditional management models are no longer able to meet the increasingly complex management needs. AI technology, with its powerful data processing capabilities, intelligent decision support functions, and self-learning abilities, has shown great potential for application in cost control, quality supervision, risk warning, and other aspects, providing the possibility for the intelligent upgrade of engineering project management. This development trend also puts forward higher requirements for the cultivation of engineering management talents. As a core course for engineering management-related majors, the teaching content and mode of “Theory and Application of Project Management” directly affect students’ professional qualities and career competitiveness. However, the

integration of emerging technologies such as AI in the current course teaching is not deep enough. Exploring the deep integration of artificial intelligence and engineering project management in the course teaching has become the focus of the course reform.

This article analyzes the characteristics of engineering project management courses, explores the feasibility and specific paths of integrating artificial intelligence technology with the teaching of engineering project management courses, and proposes reform measures from the aspects of teaching content, teaching methods, and practical systems; Analyzed the problems faced and proposed corresponding countermeasures and suggestions.

2. Characteristics of Engineering Project Management Theory and Application Course

2.1. The course is highly comprehensive

Engineering projects are the most common and typical type of project, aimed at forming fixed assets. The object of engineering projects is engineering technology systems with specific requirements. The task of engineering project management is to ensure the completion of projects within established constraints such as schedule, cost, and quality. Although students may only engage in a certain part of project management in actual employment environments, there are close connections between various modules of project management, such as the compression of schedules that may lead to increased costs or decreased quality. Therefore, students need to have a systematic understanding of the project management knowledge system. This is also a key requirement for studying engineering project management courses. The comprehensiveness of this course is also reflected in the interdisciplinary integration of content. Engineering project management involves various fusion technologies, including engineering professional technology, management science, information technology, law, environmental science, and other fields. By applying AI technology, knowledge graphs among various disciplines can be generated, enhancing students' understanding of the content of project management courses.

2.2. Course teaching is guided by practice

The course "Theory and Application of Engineering Project Management" has strong applicability, so the design of this course should adhere to a practical orientation, and teaching should focus on how to cultivate students' ability to solve practical problems in engineering management. This characteristic requires that teaching content must be deeply coupled with the requirements of engineering projects, breaking down complex issues involved in the entire lifecycle of engineering projects and integrating them into corresponding course modules. With changes in internal and external environments and the emergence of new problems, it must be continuously revised and improved. The integration of AI technology can create "immersive training scenarios" for practical teaching, providing assistance in cultivating students' practical abilities.

2.3. The course focuses on addressing the complexity of engineering project management

Engineering projects involve multiple stakeholders, including owners, designers, construction parties, suppliers, etc. Due to conflicting goals and information asymmetry among these stakeholders, the development of engineering projects is hindered, which increases the difficulty of communication and coordination in project management. In addition, there are multiple goals in engineering projects, including schedule goals, cost goals, quality goals, etc. These goals are not isolated and have complex relationships of mutual influence and restraint. Taking nuclear power engineering as an example, if the construction period is compressed, it may lead to insufficient frequency of welding process testing, bury equipment operation safety hazards, and fail to guarantee quality and safety goals. In the process of project management, it is necessary to consider the phased characteristics and internal and external environment of the entire project lifecycle, dynamically weigh the priority of these goals, which reflects the complexity of engineering project management. Project managers are required to have extensive knowledge and diverse skill backgrounds, be able to coordinate various links, and solve complex problems. This is also the ability that engineering project management courses need to focus on cultivating.

2.4. The course focuses on cultivating research abilities

This course is a postgraduate course, which is different from undergraduate teaching. At the postgraduate stage, in addition to mastering the knowledge system and cultivating practical abilities, it should also reflect the feature of “research”. Through learning, it aims to cultivate students’ innovative awareness and research capabilities. In course teaching, it is necessary to enable students to break away from the thinking of mechanical application and examine the applicability and limitations of the existing theoretical system and methods from an academic perspective. Guide students to explore the integration laws of technology and management with scientific methods. Project management in engineering projects requires continuous exploration of new management models and methods, and AI provides “innovative tools and perspectives” for such research.

With the rapid development of artificial intelligence technology, engineering project management is also undergoing digital transformation. In the process of project planning, resource allocation, cost, schedule, and quality control, artificial intelligence technology can be applied to analyze and process data, providing technical support for engineering project management decisions. In the planning and design stage, BIM technology can be applied to strengthen multidimensional collaboration. In the construction stage, AI technology can be used to collect real-time data, improving on-site management efficiency. As engineering project managers, one should understand the application scenarios of cutting-edge technologies such as artificial intelligence and the Internet of Things in management, and possess the core ability to transform these AI technologies into project management effectiveness. Therefore, in the context of artificial intelligence, the teaching of the course “Theory and Application of Project Management" should focus on the integration entry points of artificial intelligence technology in teaching content, teaching methods and evaluation systems.

3. Challenges Faced by Integrating Artificial Intelligence Into the Teaching of Engineering Project Management Courses

3.1. Delayed construction of teaching staff

The cross-integration of artificial intelligence and project management in engineering has put forward higher requirements for teachers’ knowledge structure and ability, and brought greater pressure to teachers’ course teaching preparation work. At present, teachers in the project management major of engineering have not yet mastered the knowledge and skills related to AI deeply enough. Professional teachers are often good at the theory and practice of project management, but their understanding of AI technology mostly remains at the level of tool usage, making it difficult to explain in depth the matching logic between algorithm principles and engineering problems[1]. Moreover, some professional teachers lack on-site engineering experience and are unable to integrate technical knowledge points with the actual pain points of engineering management. Moreover, the rapid update of AI technology requires teachers to constantly learn and update their knowledge.

3.2. Insufficient teaching resources

The application of artificial intelligence in project management is still in its infancy, and relevant teaching resources are relatively scarce, such as appropriate textbooks, case libraries, and experimental platforms. Although some textbooks have added chapters on AI, they are mostly simple listings of technical concepts and lack in-depth analysis of the adaptation of AI technology to project management scenarios[2]. Teachers’ self-compiled lecture notes are difficult to form a system, and students also lack authoritative references. There are relatively few innovative application cases of AI, and a systematic teaching case library has not been formed, which is not conducive to students’ learning of the experience of reasonable application of AI.

3.3. In terms of teaching methods, the advantages of AI have not been fully utilized

In course teaching, the rigidity and backwardness of teaching methods make it difficult to transform the technical advantages of artificial intelligence into teaching

effectiveness, which has become an important driver for promoting curriculum reform. For example, if the classroom only adopts the traditional mode of "theoretical teaching+case analysis", and teachers only emphasize that AI can be applied in engineering project management such as schedule optimization and risk assessment, students, although mastering the theoretical framework of project management, will find it hard to develop the ability to decompose problems with digital intelligence thinking[3].

At the same time, the introduction of AI technology in teaching content requires students to have certain foundations, including mathematical foundations and computer skills. However, students' current foundations are uneven, and some students have a weak grasp and understanding of AI technology, which will also affect learning effects and enthusiasm. This is disconnected from the goal of cultivating high-level engineering management talents with digital intelligence innovation capabilities.

In addition, artificial intelligence technology could support diversified methods such as case simulation and interactive teaching, but the existing teaching has not fully utilized these tools, leading to low student participation, which is not conducive to the improvement of learning efficiency.

3.4. The evaluation method is single and cannot stimulate students' initiative to use AI

The current course assessment still focuses on theoretical written tests and program design, emphasizing the evaluation of knowledge memory and conventional problem-solving abilities, but neglecting the examination of students' abilities in digital thinking, such as data-driven decision-making, cross-scenario technology transfer, and complex problem decomposition. The deviation of evaluation orientation makes students lack the motivation to actively use AI tools to innovate and solve engineering problems.

4. The Path of Integrating Artificial Intelligence and Engineering Project Management Course Teaching

4.1. Strengthen teacher training

Strengthening the construction of the teaching staff: developing a teacher training plan, organizing teachers to participate in training courses and academic exchange activities related to AI technology, big data analysis, etc., to enhance teachers' professional competence. Introduce talents with a combined background in AI and engineering project management to enrich the teaching staff. Encourage teachers to collaborate with enterprises, understand the application scenarios of artificial intelligence technology in engineering project management, participate in AI application practices in actual engineering projects, and accumulate teaching experience[4].

4.2. Intensify the development of teaching resources and integrate AI technology and concepts into teaching content

Expanding the development of teaching resources that integrate artificial intelligence with engineering project management is not only a requirement for knowledge transfer, but also a key layout for cultivating the core competitiveness of future engineers. In the teaching of engineering project management courses, modules such as integrated management, scope management, schedule management, cost management, quality management, resource management, communication management, risk management, procurement management, and stakeholder management are generally explained separately, mainly considering the input information, methods, and results of each module management. The traditional teaching content system has not taken into account the integration of artificial intelligence and cannot meet the talent cultivation goals in the era of new quality productivity. Therefore, one of the core paths of teaching reform in this course is to reconstruct the content. On the basis of the traditional teaching content system, an artificial intelligence basic knowledge module is added, and the application of big data technology, machine learning methods, etc. in various engineering project management modules is analyzed. Integrating AI with the core content of engineering project management: Deeply integrating AI technology with various aspects of engineering project management, and reconstructing the teaching content system. In the progress management section, an AI-based progress prediction model is introduced to explain how to use historical project data to train the model and achieve dynamic prediction and optimization of project progress;

Introducing cutting-edge industry cases and practices: Collecting and organizing successful application cases of artificial intelligence in engineering project management at home and abroad, such as analyzing the application of BIM technology in multi-disciplinary collaborative design in the construction of the Hong Kong Zhuhai Macao Bridge; Exploring how smart construction sites in Xiong'an New Area can achieve seamless supervision of project management through the use of technologies such as big data, cloud computing, the Internet of Things, and artificial intelligence. Through case analysis, students can understand the application scenarios and effects of AI technology in practical projects, and enhance their understanding and application abilities of knowledge.

4.3. Applying AI to enhance teaching interactivity and participation

The development of AI has strengthened teaching interaction and communication. In course teaching, more multimedia resources can be integrated to make theoretical knowledge more intuitive through animations, videos, etc. The construction of online learning platforms can facilitate teachers to send course outlines, teaching materials, online tests, and assignments in a timely manner, which facilitates course management and organization, allowing teachers to interact and communicate with students in real time. With the help of online learning platforms, AI intelligent Q&A systems can also be introduced to timely answer students' questions and improve learning efficiency. In course teaching, heuristic teaching can also be used to publish discussion topics, such as discussing the application of AI algorithms in optimizing project resource allocation, reconstructing engineering project management processes based on digital transformation, etc. Encourage students to use AI big models correctly, process massive data in engineering project management, use the advantages of AI for deep mining and expansion, break down problems from a systematic and intelligent perspective, and cultivate students' innovative ability to solve complex engineering problems with digital thinking[5].

4.4. Constructing a diversified teaching evaluation system to comprehensively measure students' abilities

Emphasize the combination of process evaluation and outcome evaluation: Apply learning platforms to record students' classroom participation, online learning progress, group discussion performance, practical project achievements, etc., and together with the final exam scores, form a comprehensive evaluation result. Process evaluation can promptly provide feedback on students' learning situations, assist teachers in adjusting teaching strategies, and also motivate students to actively participate in the learning process. Adopting multidimensional evaluation indicators: In addition to knowledge mastery, attention should also be paid to students' ability development, such as AI tool application ability, data analysis ability, problem-solving ability, teamwork ability, innovation ability, etc. Design corresponding evaluation criteria and methods for different ability indicators. For example, students' practical project achievements can be evaluated from the rationality of the scheme, the progressiveness of technology, and the application effect. At the same time, AI assisted tools can be introduced in course evaluation, such as automatic grading and analysis of students' assignments, lab reports, project results, etc. AI assisted evaluation can not only improve evaluation efficiency, but also reduce the interference of human factors and ensure the fairness of evaluation.

5. Conclusions

With the development of artificial intelligence technology, the traditional teaching mode of engineering project management courses has many problems in teaching content, methods, practical systems, and evaluation methods, which are difficult to meet the talent needs of the intelligent era industry. Therefore, teaching reform is necessary and urgent. By strengthening teacher training, restructuring teaching content, innovating teaching methods, and building a diversified evaluation system, we can promote the deep integration of artificial intelligence and engineering project management courses, and cultivate more engineering project management talents that meet the requirements of the intelligent era.

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AI-Empowered Innovative Research on Teaching Content in Fundamental Computer Courses

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Abstract

This study focuses on the teaching of Office software in fundamental computer courses, addressing issues such as repetitive basic operations and the lack of intelligent tool applications in traditional teaching. It conducts innovative research on AI-empowered teaching content. The study establishes guiding principles centered on "student-focused design, deep integration of technology and content, dynamic updates, and balanced theory-practice alignment." It designs three innovative dimensions—intelligent tool integration, scenario-based training, and personalized learning—forming an "input-process-output-feedback" holistic innovation model. By reconstructing the core modules of intelligent document processing, data analysis, and presentation design, the study achieves deep integration of AI technology with Office teaching. A three-tier evaluation framework (basic skills, intelligent tool application, and scenario-based application) combines quantitative and qualitative methods for assessment. Results show that the experimental group maintained stable basic skills while demonstrating a 3.2-fold increase in intelligent tool usage frequency, a 40% improvement in complex task efficiency, and a 32% boost in learning interest, with particularly significant benefits for low-proficiency students. The study validates the effectiveness of AI-empowered Office teaching, providing practical insights for reforming fundamental computer courses.

Keywords

AI-empowered teaching; fundamental computer courses; teaching content innovation; personalized learning; scenario-based training

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1. Introduction

As a core vehicle for developing students' digital literacy, basic computer courses are plagued by outdated teaching content and methodologies, which have become a critical bottleneck hindering improvements in teaching quality[]. In actual classroom practice, all three core modules present significant pain points, with prominent common issues.

The rigidity of content is particularly evident in Office software instruction. Most textbooks remain focused on explaining features of older versions, failing to keep pace with the software's continuous iterations,

and offer woefully inadequate coverage of AI-assisted functions such as Office Copilot[]. Teaching content overemphasizes basic operational demonstrations while neglecting in-depth exploration of practical scenarios like automated office workflows and efficient data processing. Consequently, students, despite mastering basic operations, struggle to meet the demands of complex real-world tasks, with a notable gap in developing efficient application skills[]. Furthermore, they often fail to adapt to new work paradigms in intelligent office settings—such as prompt engineering and automated content generation—resulting in a mismatch between acquired skills and job market needs[].

To overcome these challenges, a new teaching model supported by AI technology must be established[]. Intelligent dynamic content generation can ensure teaching cases remain up-to-date; personalized learning path recommendations can cater to students' diverse foundational levels; and virtual experiment environments, coupled with real-time error diagnosis, can significantly enhance the effectiveness of practical teaching. This innovation not only addresses current pedagogical shortcomings, shifting the focus from "knowledge transmission" to "ability development" but also strengthens students' practical application and problem-solving skills, laying a robust foundation for their future career growth[].

2. Barriers to AI-Enabled Innovation in Basic Computer Course Content

Three key obstacles currently hinder the integration of AI technology with basic computer courses:

2.1. Inadequate Adaptability Between Technology and Content

AI technology faces multiple practical barriers in innovating basic computer course content, restricting the in-depth integration of technology and teaching[]. A core bottleneck lies in the poor adaptability between technology and content: most existing AI tools are developed for general scenarios and cannot directly meet specialized teaching needs[]. They lack customized designs for modules such as Office, operating systems, and networks, leading to a disconnect between technical applications and teaching requirements, which fails to effectively support content innovation.

2.2. Insufficient AI Tool Application Capabilities Among Teachers

Teachers' inadequate proficiency in using AI tools forms a critical implementation gap. Most instructors of basic computer courses excel in traditional teaching methods but lack AI literacy. They have not received systematic training in operating AI tools or integrating them into teaching, and have limited understanding of the functional features and educational value of intelligent tools like Office Copilot[]. This makes it difficult to organically merge technology with teaching in content design, hindering the advancement of innovative practices and leaving teachers unable to guide students in using these tools to solve practical problems[].

2.3. Scarcity of Scenario-Based Resources

The lack of scenario-based resources creates a resource barrier. Most current AI teaching applications remain at the level of basic function demonstrations, lacking case libraries that reflect real-world work scenarios[]. High-quality resources such as AI-powered visual courseware and virtual simulation experiments tailored to course needs are severely insufficient. Teachers face high costs and great difficulties in independent development, making it hard to build content systems that support personalized learning and interactive experiences. This leaves AI-enabled content innovation without substantial carriers.

These barriers collectively restrict the in-depth application of AI technology in course innovation. Overcoming these bottlenecks requires collaborative efforts from technology developers and teachers—through customized development, systematic training, and joint resource building—to truly unlock AI's potential in education[].

3. Construction of an AI-Enabled Framework for Teaching Content Innovation

3.1. Guiding Principles

In constructing an AI-enabled innovation framework for basic computer courses, the following core principles should be adhered to to ensure the organic integration of

technological applications and teaching needs:

First, the "student-centered" design philosophy must be upheld as the fundamental orientation of the framework[]. The framework should be developed around students' actual learning needs and cognitive characteristics. By leveraging AI technologies to analyze learning behavior data, it can achieve precise content delivery and personalized learning pathways, addressing the contradiction between uniform teaching and diverse needs. For instance, differentiated Office cases can be recommended to students with varying foundations based on learning behavior analysis, or the difficulty of operating system experiments can be dynamically adjusted according to operation records.

Second, emphasis should be placed on the "in-depth integration of technology and content" to avoid formalistic application of technology. AI technology should not remain superficial but be deeply embedded in the course knowledge system[]. Exclusive integration schemes should be developed for the three core components of Word, Excel, and PowerPoint: Word teaching should integrate Copilot's intelligent writing and proofreading functions; Excel teaching should incorporate intelligent data analysis and visualization tools; and PPT teaching should embed AI design suggestion modules. This integration ensures AI technology becomes an organic part of content learning rather than an add-on tool, truly serving the cultivation of efficient office capabilities.

Third, a "dynamic update" mechanism should be established. This principle emphasizes the creation of a content iteration system, which uses AI to track technological developments and teaching feedback in real time, promptly incorporating new software functions and network scenarios. This addresses the issue of curriculum lag and maintains content timeliness.

Fourth, the "balance between theory and practice" principle must be maintained. At the cognitive level, AI visualization tools are used to dynamically demonstrate abstract concepts such as PPT design principles and Excel function logic. At the practical level, virtual office environments simulate real work scenarios, such as full-process training in creating annual corporate financial reports. At the innovation level, AI collaboration platforms support complex tasks, such as intelligent conflict resolution during multi-person collaborative editing. This progressive design of "theoretical cognition-simulated practice-innovative application" ensures students not only master core skills but also adapt to the development needs of the intelligent office era.

These principles collectively form the foundation for AI-enabled teaching innovation. Only through their systematic implementation can substantial improvements in teaching quality be achieved.

3.2. Core Innovation Dimensions and Pathways

In advancing the intelligent transformation of basic computer courses, breakthroughs must be achieved in the following three core innovation dimensions, with a multi-dimensional collaborative pathway established to realize in-depth integration of technology and teaching.

3.2.1. Intelligent Tool Integration Dimension

This dimension focuses on the organic integration of AI office tools with course content, transforming cutting-edge AI office tools into teaching resources[]. For the Office module, tools such as Microsoft 365 Copilot are incorporated into the Office teaching system, and a "smart prompt engineering" teaching module is designed to guide students in efficiently completing document generation and typesetting, intelligent data analysis, and automated presentation design through natural language instructions. Through a three-level teaching pathway—tool function demonstration, case-based practice, and application transfer—students master AI-assisted efficient office methods, addressing the disconnect between course content and intelligent office scenarios, and forming a closed loop for cultivating tool application capabilities.

3.2.2. Scenario-Based Training Dimension

To tackle the pain point of lacking real-world scenarios in Office teaching, this dimension prioritizes building an intelligent scenario simulation system and creating an immersive learning environment to resolve difficulties in teaching abstract content. A hierarchically progressive office scenario simulation system is constructed: the basic level simulates daily office tasks (e.g., meeting minutes drafting, data report creation); the advanced level reconstructs professional scenarios (e.g., academic paper formatting, market data analysis report generation); and the high-level designs comprehensive projects (e.g., cross-

departmental collaborative document management, large-scale conference presentation planning). Each scenario embeds an AI scenario generator that dynamically adjusts task difficulty and requirements based on students' majors—for example, adding data verification scenarios for finance students and emphasizing document standardization scenarios for literature students.

3.2.3. Personalized Learning Dimension

This dimension achieves precise teaching provision through learning behavior analysis. An AI system collects students' operation data and practice feedback to construct learner capability profiles, enabling differentiated adaptation of content delivery. Differentiated learning pathways are designed for students with varying foundations: for those with weaker foundations, content such as "operation step decomposition + basic template application" is provided to strengthen basic skills like format setting and formula application; for more capable students, advanced challenges such as "AI prompt optimization + complex scenario resolution" are offered. Combined with AI intelligent diagnosis functions, personalized guidance is provided to resolve the conflict between uniform teaching and differentiated needs, improving learning efficiency and outcomes.

These three dimensions interact synergistically: tool integration provides intelligent support for scenario simulation, scenario simulation generates behavioral data required for personalization, and personalized optimization enhances the effectiveness of tool integration—jointly driving the upgrading of Office teaching toward intelligence and efficiency.

3.3. Overall Innovation Model

This study constructs a closed-loop innovation model of "input-process-output-feedback" to systematically promote the intelligent transformation of basic computer courses.

In the input phase, the model integrates multi-dimensional data sources: The teaching resource library provides standardized Office cases, including operation guides for various versions of Word/Excel/PPT, industry template libraries, and intelligent tool manuals; real-time collection of students' operation data—such as software usage trajectories, experiment error records, and practice completion status—lays a data foundation for personalized teaching.

The process phase serves as the core of the model, relying on AI technology to achieve in-depth transformation of Office teaching. Through the tool integration pathway, Copilot's intelligent functions are embedded to provide real-time guidance in document creation, data processing, and other links; The scenario simulation pathway builds a hierarchical office scenario system, dynamically generating practical tasks matching students' majors; The personalized pathway pushes differentiated content based on capability portraits—for example, step-by-step tutorials for beginners and AI prompt optimization schemes for advanced learners. AI algorithms analyze learning behaviors in real time, dynamically adjusting content difficulty and presentation methods to form an intelligent teaching flow.

The output phase focuses on improving application capabilities. Through intelligent training, students master

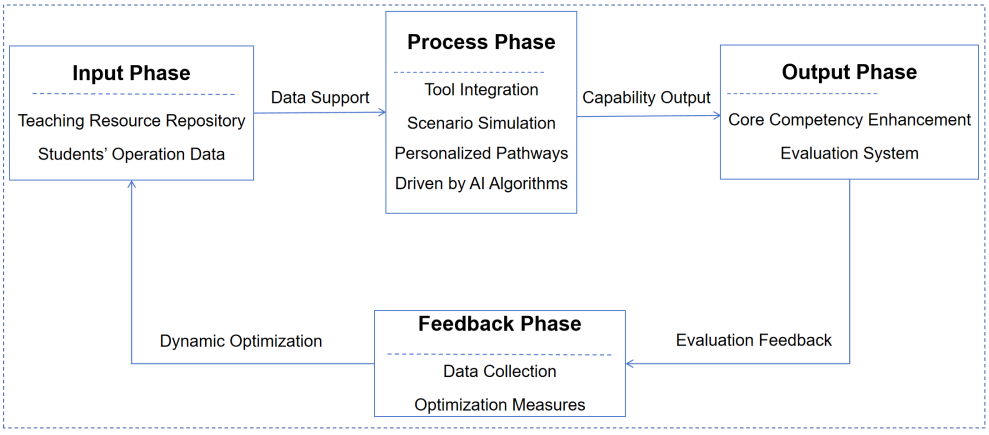

Figure 1. Overall Innovation Model of AI - Empowered Office Teaching

three core competencies: AI-assisted efficient document creation, intelligent data processing and visualization, and professional scenario presentation design. The evaluation system quantifies results from dimensions such as operation efficiency, document standardization, and tool application proficiency, with emphasis on monitoring the actual application level of AI tools in collaborative office work.

The feedback phase forms a continuous optimization mechanism. Based on output evaluation data and feedback from teachers and students, the teaching case library is dynamically updated, and AI recommendation strategies are adjusted to ensure the continuous evolution of teaching content. Through data-driven and continuous iteration, this model achieves a spiral improvement in teaching quality and learning efficiency.

4. Innovative Design of Core Teaching Content Modules

Aiming at the pain points in the teaching of Office software, such as repetitive basic operations, lack of intelligent tool applications, and detachment from actual scenarios, this paper reconstructs the teaching content of three core modules through AI technology, and builds an innovative system of "Tool Integration + Scenario-based Practice + Competency Advancement", so as to reshape the teaching paradigm of basic computer courses.

4.1. Innovation of the Intelligent Document Processing Module

The Word module focuses on cultivating the ability of intelligent document creation and breaks through the limitations of traditional typesetting teaching. An innovative "AI + Document" teaching unit is designed. At the basic level, the necessary format - setting teaching is retained, while the content of integrating Copilot is mainly developed: New "Intelligent Writing Assistant" teaching content is added to guide students to realize manuscript generation, style adjustment, and multi-version iteration through precise prompt words; A practical project of "Document Automation Processing" is designed, such as using AI to batch-process contract documents and standardize the format of academic papers. A supporting intelligent proofreading tool is developed to detect format errors and content logic problems in real time.

4.2. Innovation of the Intelligent Data Analysis Module

The Excel module solves the difficulties in data teaching through intelligent analysis tools and reconstructs the teaching content system. In the basic operation link, repetitive content is streamlined, and the focus is shifted to the teaching of AI data tools: A core unit of "Intelligent Data Analysis" is developed to teach students to use Copilot to realize data cleaning, automatic function generation, and trend prediction; A practical project of "Automated Visual Report" is designed. Combined with the AI recommendation function, students learn about the adaptation of chart types and the production of dynamic graphs. "Scenario-based Data Tasks" are innovatively introduced, such as real cases like year-on-year sales data analysis and student performance statistics. An AI diagnosis function is embedded to provide real - time feedback on formula errors and optimization suggestions. For students with different data foundations, hierarchical practice materials are provided to realize the progression of abilities from basic function application to complex data modeling.

4.3. Upgrade of the Intelligent Presentation Design Module

The PowerPoint module realizes teaching upgrade relying on AI design tools and solves the pain points of poor presentation effects and low production efficiency. The teaching content of "Presentation Design" is reconstructed, and a new unit of "AI Layout Planning" is added. Students learn to generate PPT frameworks that conform to the theme through prompt words; The teaching content of "Intelligent Visual Element Matching" is developed, so that students can master the skills of AI-assisted picture screening, color scheme recommendation, and animation design. An innovative "Full-process Presentation Project" is designed. From demand analysis, content architecture to final presentation, functions such as AI-generated speech notes and time-control reminders are integrated.

The innovative design of the three modules all takes AI tools as support and scenario-based practice as the carrier, realizing the ability to leap from basic operations

to intelligent applications, and significantly improving the practicality and advancement of teaching content.

5. Evaluation and Analysis of Application Effects

5.1. Evaluation Scheme

To verify the innovative effects of the AI-empowered teaching content for the Office software module, a multi-dimensional evaluation scheme has been constructed. For the evaluation subjects, a comparative study is conducted between an experimental group and a control group. The experimental group adopts AI-integrated teaching content, while the control group continues with the traditional teaching model. The two groups of students are consistent in terms of their basic academic level and major distribution to ensure the scientificity of the evaluation. The evaluation cycle covers the entire teaching phase, including three stages: pre-class basic testing, in-class formative assessment, and post-class comprehensive evaluation.

The evaluation index system focused on core Office competencies, with three levels of evaluation dimensions: The basic competency dimension assessed foundational indicators such as document format standardization and data calculation accuracy; the intelligent tool application dimension evaluated proficiency in using AI features (e.g., Copilot) and the precision of prompt words; the scenario application dimension measured the quality and efficiency of completing complex office tasks. Learning experience indicators were also included, with questionnaire data on interest, satisfaction, and autonomous learning willingness to comprehensively reflect teaching effectiveness.

The evaluation method combined quantitative and qualitative approaches: Quantitatively, objective data such as students' document completion efficiency and AI tool usage frequency were analyzed through operation logs; an automated scoring system was developed to accurately assess quantifiable content (e.g., Excel function application, PPT layout design). Qualitatively, comprehensive abilities such as document logicality and data visualization effects were evaluated through work analysis; focus group interviews were conducted to collect feedback from teachers and students on AI teaching content and suggestions for improvement.

The evaluation process emphasized data tracking. An AI system recorded students' operation trajectories and tool usage preferences to generate personal competency development curves. Differences between the two groups in task completion quality and intelligent tool application ability were compared to verify the actual effect of AI-empowered teaching content on improving Office application skills.

5.2. Result Analysis

Based on data from the multi-dimensional evaluation scheme, the application effects of AI-empowered Office teaching content showed significant advantages, specifically reflected in the differential improvement between the experimental and control groups.

In terms of core competencies, the experimental group maintained stable performance in basic competency indicators, with no significant differences from the control group in document format standardization or data calculation accuracy—indicating that AI-integrated teaching did not weaken the cultivation of basic skills. Significant differences were observed in the intelligent tool application dimension: The experimental group's average Copilot usage frequency was 3.2 times that of the control group, with prompt word precision scores 28% higher, and 85% of students could independently complete AI-assisted document optimization—demonstrating that AI teaching content effectively improved intelligent tool application abilities. The scenario application dimension showed the most notable improvement: The experimental group reduced the average time to complete complex office tasks by 40% and achieved 35% higher task quality scores, with outstanding performance in comprehensive scenarios such as data visualization and multi-document collaboration.

Learning experience data showed that the experimental group's interest score was 32% higher than the control group's; 91% of students reported that AI-assisted features enhanced their learning confidence, and their average autonomous learning time increased by 2.1 hours per week. Qualitative feedback indicated that students generally recognized scenario-based cases and real-time feedback functions, believing AI tools helped them overcome the bottleneck of "knowing how to operate but not how to apply." Teacher interviews revealed that the experimental group's after-class

consultation frequency for office tasks decreased by 50%, with significantly enhanced autonomy in problem-solving.

Competency development curves showed differentiated characteristics: The experimental group experienced a competency leap in the middle of the teaching phase, while the control group progressed steadily. Students with weaker foundations showed the largest improvement in the experimental group, as intelligent prompts and tiered guidance effectively addressed their baseline deficiencies; students with stronger foundations excelled in advanced AI tool applications, forming a development path of "basic consolidation—competency leap—innovative application." Overall data verified the effectiveness of AI-empowered teaching content in improving Office application abilities and learning experience.

6. Discussion and Outlook

This study verifies the significant value of AI-empowered Office teaching content, providing practical references for the reform of basic computer courses. Research shows that the in-depth integration of AI technology and Office teaching can significantly improve students' ability to apply intelligent tools and solve scenario-based problems without weakening basic skills. In particular, it has a prominent supportive effect on students with weak foundations, effectively alleviating the challenges of personalized teaching. However, the research still has limitations: AI tools iterate rapidly, and the lag in updating teaching content has not been fully resolved; the teaching of AI prompts in complex scenarios lacks depth, leaving some students still deficient in advanced application capabilities.

Future research plans to deepen in three aspects: first, establish a dynamic update mechanism for teaching content to keep pace with Office AI function upgrades in real time; second, develop a hierarchical prompt training system to strengthen the teaching of intelligent tool applications in complex scenarios; third, expand cross-software collaboration scenarios, explore the teaching application of AI in the integration of Office and other office tools, and build a more comprehensive training system for intelligent office capabilities.

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Developing Multiple Intelligences through Dance: An Inclusive Teaching Model for Vocational Students with Special Educational Needs

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Abstract

This paper explores the application of Howard Gardner's multiple intelligences theory in dance teaching within higher vocational special education. The research aims to break away from the traditional educational model that emphasizes linguistic and logical intelligences, and to construct a more personalized and multi-dimensional teaching system. By combining literature analysis with classroom practice, the study analyzes the positive impact of multiple intelligences on the development of students with special needs through case studies of dance courses, focusing on aspects such as bodily, musical, spatial, and interpersonal intelligences. The findings reveal that dance, as a non-verbal and interdisciplinary form of education, can effectively stimulate students' intellectual potential, and enhance their physical coordination, social skills, and emotional expression. Additionally, personalized curriculum design and group collaborative teaching models contribute to boosting students' self-confidence and learning motivation. The conclusion indicates that the multiple intelligences theory provides a scientific basis and practical pathways for dance teaching in special education, possessing extensive promotional value, and aiding in the transition of special education from "compensatory teaching" to "developmental education."

Keywords

Multiple Intelligences Theory; Special Education; Dance Teaching; Personalized Education

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1. Introduction

With the increasing social concern on educational equity and quality, the government has continuously introduced relevant policies to promote the development of special education in recent years[1]. According to documents such as the Special Education Enhancement Plan (2021-2025) and the Special Education Development Plan Second Session (2017-2020), there is an emphasis on innovating educational models in special education, improving educational quality and meeting the personalized needs of special students. Traditional special education models often concentrate too much on the cultivation

of basic skills while neglecting the development of students' overall qualities and multiple intelligences. Therefore, breaking away from traditional educational models and utilizing innovative theories and methods to achieve an effective transformation in special education has become an important issue in current educational reform[2]. This paper aims to promote the development of special education towards a more comprehensive and personalized direction by exploring the application of multiple intelligences theory in dance teaching.

2. Problem analysis

2.1. Limitations of traditional special education

For a long time, China's special education system has exhibited significant limitations in curriculum design and teaching methods. Traditional special education primarily centers on "remedial education," emphasizing the training of foundational knowledge and skills, particularly focusing on the development of "hard skills" such as language expression and mathematical logic, while neglecting the individual differences among students in terms of their intelligence structures. Although this "uniform standard" teaching model addresses basic learning issues for students with special needs to some extent, it is insufficient in meeting their diverse developmental needs related to cognitive styles, emotional expression, and social interactions. Specifically, the traditional teaching model overly emphasizes the imparting of subject knowledge, employs a singular teaching approach, and mostly bases evaluation systems on assessments of language and logical abilities. This educational tendency not only suppresses the development of other intelligences in students but also marginalizes those who may be weaker in language and logic yet possess potential in areas such as music, physical movement, and spatial awareness. Moreover, due to the traditional education's focus on results over processes, students with special needs often lack a sense of participation and achievement during their learning processes, which can lead to diminished motivation, reduced self-confidence, and even a dependency mindset. The special education population inherently encompasses cognitive, emotional, and physical diversities, and their learning characteristics necessitate individualized and flexible teaching support. However, in practice, many special education teachers find it difficult to address students' intelligence differences due to constraints imposed by curriculum standards, limited teaching resources, and rigid assessment systems. Teachers often lack the sensitivity to recognize individual differences and the ability to tailor their instruction accordingly, resulting in students not being able to fully utilize their strengths during the learning process. Therefore, it is imperative to re-examine the issues of "standardization" and "uniformity" prevalent in traditional special education and to introduce more inclusive and developmental educational concepts to address the prevailing bias toward certain types of intelligence. Only through systematic reforms across multiple dimensions—teaching philosophy, content, and methods—can we break the misconception that has historically prioritized skill development while neglecting potential, thus providing a broader developmental space for students with special needs.

2.2. Theoretical value of multiple intelligences theory

The multiple intelligences theory was first proposed by American psychologist Howard Gardner in 1983, representing a profound reflection on and subversion of traditional views of intelligence. This theory posits that human intelligence extends beyond logical-mathematical and linguistic abilities to encompass multiple dimensions, including bodily-kinesthetic, musical, spatial, interpersonal, intrapersonal, and naturalistic intelligences. Each individual develops at different levels across these types of intelligence, suggesting that education should respect and leverage students' intelligences rather than judging all students' learning abilities according to a uniform standard. The introduction of this theory provides new theoretical foundations and practical directions for special education, significantly promoting the development of educational equity and personalized teaching. In the field of special education, the incorporation of multiple intelligences theory has significant practical importance. Students with special needs often find themselves at a "disadvantage" under traditional standards, yet they may possess remarkable strengths in certain non-

mainstream intelligences, such as bodily-kinesthetic or musical intelligence. The multiple intelligences theory emphasizes that "every type of intelligence has its value," effectively breaking the previous labeling mindset of "superior and inferior intelligences" and allowing for the rediscovery and exploration of the potential of students with special needs. It advocates for a shift among teachers from "deficit compensation" to "strength enhancement," thereby constructing a student- centered teaching model that meets their developmental needs based on diversity. Theoretically, multiple intelligences theory is highly inclusive and adaptable. It not only highlights the variety of intelligences but also asserts that intelligence can develop continuously through environmental factors and teaching strategies. Therefore, education should not perceive students' intelligences in a static manner; instead, it should utilize diverse teaching designs and assessment methods to help students grow in different areas of intelligence. This dynamic view of development is particularly suitable for special education environments, providing teachers with theoretical support for individualized instruction and making teaching more scientific and precise. Furthermore, the multiple intelligences theory offers new ideas for constructing educational assessment systems. Traditional grading often overlooks students' capabilities in non-cognitive areas, whereas assessments from a multiple intelligences perspective are more comprehensive and development-oriented, emphasizing process evaluation combined with diversified assessment methods. This approach not only helps students form positive learning attitudes but also enhances their self-awareness and sense of achievement.

In summary, as a theoretical system that signifies educational reform, the multiple intelligences theory provides a theoretical tool for breaking the traditional framework in special education. Its core concepts closely align with the principles of "respecting differences and developing potentials" in special education, demonstrating extensive theoretical value and practical application prospects across multiple dimensions, including teaching philosophy, curriculum design, classroom practice, and assessment methods.

3. Practical pathways: constructing a personalized dance teaching model

3.1. Tailoring dance curricula based on individual students' intelligence strengths

In vocational special education, each student possesses different strengths in intelligence, which necessitates the customization of dance curricula to accommodate individual differences and maximize student potential. Grounded in the multiple intelligences theory, educators should conduct an in-depth analysis of students' intelligence structures and design curricula across multiple dimensions—such as bodily-kinesthetic, musical, spatial, and logical intelligences—to stimulate holistic development. Personalized instruction is especially critical in special education, as it enables students to learn at their own pace and in ways best suited to their abilities, thereby achieving optimal learning outcomes.

Students with strong bodily intelligence can quickly grasp dance movements and enhance their bodily coordination and rhythmic sense through imitation and practice. These students may be encouraged to participate actively in dance rehearsals and choreography creation. Teachers can employ high-intensity movement training and skill enhancement to provide them with a sense of achievement in dance expression. For students who excel in musical intelligence, teachers can foster their sensitivity to music through activities centered on rhythm and melody perception, allowing them to harmonize accurately with the rhythm during dance performances, thereby showcasing the organic combination of music and dance. Students with strong spatial intelligence have a good perception of the relationship between space and movement. Their ability to utilize space effectively and convey a sense of ethereal movement is a key strength in dance. Therefore, during instructional processes, teachers can guide students by engaging them in activities that involve dance formations and spatial transitions, helping them better understand and leverage space, ultimately enhancing their expressiveness in group dances. "Tailored" personalized course design is key to leveraging students' strengths based on their intelligence specialties while minimizing weaknesses. Customizing both teaching content and teaching methods not only enhances students' motivation and confidence but also allows them to feel respected and valued in the learning process[7]. Through

personalized dance courses, special education students can overcome physical and mental barriers, find their own place in the world of art, and gain a sense of self-identity that dance brings.

3.2. Strengthening collaboration and interaction to foster students' interpersonal intelligence

Collaboration and interaction are essential components of dance instruction, particularly in the context of special education. As a collective art form, dance inherently emphasizes cooperation and interactivity. Through rehearsing and performing group dances, students can not only promote physical coordination but also significantly enhance their interpersonal intelligence. Interpersonal intelligence refers to an individual's capability for effective communication and interaction with others in a group, encompassing various abilities such as cooperation, leadership, conflict resolution, and emotional understanding. In dance classes for special education, through teamwork, students are better able to understand others, express themselves, and strengthen their sense of belonging to the group.

Teachers can design group cooperative dances, requiring each student to play different roles within the team and participate in the entire process of creation, rehearsal, and performance. Through interaction with others, students learn how to leverage their strengths within a group and collectively complete an artistic task. In this process, they not only need to coordinate their own body movements but also engage in effective communication and cooperation with their teammates, thereby enhancing their interpersonal intelligence. "Dance is not just a collection of movements; it is a bond of emotion and trust between people." Through collective dance, students can feel the power of the group and enhance their ability to collaborate with others. In some special education classes, students often face feelings of loneliness and low self-esteem; however, the interactivity of group dance provides them with an opportunity to showcase themselves and integrate into the collective. Cooperative dance can not only improve students' social skills but also help them build trust and facilitate emotional exchange, allowing them to find a sense of belonging and confidence within the group. Through interaction and collaboration, special education students can understand the importance of teamwork, learn how to communicate with others, handle conflicts appropriately, and comprehend the emotions of others. These abilities are not only beneficial for their dance learning but also play a positive role in their future social adaptation and career development.

Table 1. Relationship between dance curriculum design and students' intelligence specialties

Student intelligence specialty	Teaching content	Course design focus
Bodily-kinesthetic intelligence	Dance movement imitation and skill training	Enhance body coordination and movement expressiveness
Musical intelligence	Rhythm training and music perception	Integrate music with dance to enhance rhythm perception ability
Spatial intelligence	Dance formations and space utilization	Training in spatial awareness and layout
Interpersonal intelligence	Group cooperative dance and collective performance	Strengthen teamwork and interpersonal communication skills

Table 2. Impact of collaboration and interaction on students' interpersonal intelligence

Collaboration type	Interaction form	Aspects of improved interpersonal intelligence
Group cooperative dance	Joint creation, rehearsal, and performance	Enhance teamwork, communication, and emotional expression abilities
Cooperative tasks	Division of labor and mutual support	Increase trust and conflict resolution abilities
Collective activities	Group dance performance and team interaction	Strengthen sense of belonging and group consciousness

3.3. Innovative classroom practice: the integration of interdisciplinary teaching and dance

Innovative teaching is at the core of educational development, especially in special education, where interdisciplinary integration can not only broaden students' perspectives but also help them grow in multiple areas. In dance teaching, interdisciplinary integration is particularly important; elements from subjects such as music, language arts, and psychology can enrich classroom content and enhance students' overall quality. The combination of dance teaching with other disciplines can not only expand students' cognitive and expressive abilities but also provide them with a more comprehensive learning experience. Teachers can introduce basic concepts of music into dance courses, such as rhythm, melody, and harmony, allowing students to understand the fundamental structure and forms of expression in music while learning dance [8]. The combination of music and dance can help students improve their sense of rhythm, enhance their musical intelligence, and also provide more inspiration and motivation for choreography. At the same time, the introduction of language arts can enhance students' verbal expression skills and literary literacy, particularly in emotional expression during dance performances, where linguistic assistance often helps students better understand their roles and emotions. Knowledge of psychology can also support dance teaching by helping students regulate their emotions, relieve stress, and increase their self-identity and confidence through dance activities. In the process of dance performance, the principles of psychology can help students adjust their mindset, learn to cope with stage pressure, and enhance psychological resilience. The interdisciplinary combination makes dance teaching extend beyond just movements and performance, promoting comprehensive development in various aspects for students.

4. Case analysis: practice of multiple intelligences in dance classes

4.1. Course design and implementation: successful practices of personalized teaching

In vocational special education, the successful implementation of personalized teaching models can not only increase student participation and learning outcomes but also enable students to learn more effectively according to their individual intelligence specialties. Dance curriculum design grounded in multiple intelligences theory emphasizes customization according to students' individual differences and unique needs, providing one-on-one or group-oriented customized instruction to ensure that every student can progress in a way that suits them best. By integrating students' intelligence specialties, dance courses can stimulate students' intrinsic potential and enhance their capabilities in various areas.

In our school's dance curriculum design, a course module focused on body training and dance techniques has been developed specifically for students with strong bodily-kinesthetic intelligence. Through regular basic dance training, enhancing rhythm and coordination, students are able to master fundamental dance movements in the shortest possible time, which helps them excel in group performances. For students with strong musical intelligence, the curriculum emphasizes the integration with music, incorporating extensive rhythm training and melody perception exercises. By sensing the melodies and rhythms in music, students can better synchronize their

Table 3. Teaching effects of combining interdisciplinary teaching with dance

Combined discipline	Teachingactivity	Teaching effect
Music	Integration of musical rhythm, melody, and dance movements	Enhance sense of rhythm, improve musical intelligence
Language arts	Emotional expression in dance and language integration	Improve verbal expression, emotional understanding, and literary literacy
Psychology	Emotional regulation and psychological adjustment through dance	Increase self-confidence, reduce psychological stress, promote emotional well-being

dance movements, thus improving their expressiveness and artistic perception abilities in dance. On the other hand, for students with strong spatial intelligence, the course design includes more challenging dance formation designs and spatial movement training. Teachers create various dance formations and spatial transition exercises to develop students' spatial awareness and coordination skills [9]. In these courses, students not only need to position themselves in specific spatial locations but also consider the distance and cooperation with other classmates, thereby enhancing their spatial perception and teamwork abilities. "Personalized course design can truly meet each student's needs, allowing them to leverage their strengths and address their weaknesses in dance learning." This customized teaching based on multiple intelligences theory not only helps special education students achieve breakthroughs in dance skills but, more importantly, boosts their self- confidence, social skills, and problem-solving abilities. By aligning with students' individual strengths, the design and implementation of the dance curriculum facilitate the maximization of each student's development.

4.2. Practical effects and changes in students

In the practice of personalized dance courses guided by multiple intelligences theory, the changes in students are reflected not only in the improvement of dance skills but also significantly in their growth in emotional, social, and psychological aspects. Through long-term classroom practice, students' personalized needs have been met, their intelligences stimulated, and particularly profound impacts have been made in areas such as self-confidence, teamwork, and emotional expression.

The personalized design of the dance curriculum allows each student to develop in their strengths. For students with strong bodily-kinesthetic intelligence, their progress in basic skills and dance techniques is very significant; many have been able to break through their movement bottlenecks in a short period, showcasing excellent dance performances. At the same time, students with strong musical intelligence, through the integration with music, have not only enhanced the artistry of their dance but have also learned how to express emotions in their performances. Dance has transformed from simple movement imitation into an expression of emotion and a manifestation of art.

Students with strong spatial intelligence demonstrate exceptional spatial awareness and teamwork abilities through practicing dance formations and spatial transitions. These students are able to accurately grasp their positions in space during group dance performances, maintaining a harmonious collaboration with their teammates. Their performance is reflected not only in the enhancement of dance skills but, more importantly, in their ability to develop interpersonal communication and teamwork skills during collective activities.

"Through the practice of multiple intelligences in dance classes, students have not only improved in artistic expression but, more importantly, their overall qualities have developed comprehensively." For example, a previously introverted student A gradually integrated into the group through collective dance rehearsals, learning to communicate and collaborate with others. Through the study of dance courses, he has become more confident in social interactions and has demonstrated stronger social skills in daily life. The dance curriculum also

Table 4. Matching of personalized dance curriculum design with students' intelligence specialties

Student intelligence specialty	Curriculum design content	Key training areas
Bodily-kinesthetic intelligence	Basic skills training, dance techniques, and bodily expression	Physical coordination, movement fluidity
Musical intelligence	Music rhythm training, melody perception combined with dance	Rhythm perception, integration of movements with music
Spatial intelligence	Dance formation design and spatial transitions	Spatial awareness, coordination among formations and participants
Interpersonal intelligence	Group cooperative dance, collective performances	Teamwork, social interaction, emotional expression

plays a positive role in students' mental health. Many special education students are able to gradually overcome feelings of loneliness and inferiority through interactions with peers and by mastering each dance movement [10]. Through training in emotional expression via dance, students have found self-identity in their performances, with many becoming more optimistic and experiencing significant improvements in their mindset.

5. Conclusion

This study explores the application paths and practical outcomes of multiple intelligences theory in dance education for vocational special education. Through problem analysis and practical exploration, it has been discovered that traditional teaching models in special education tend to emphasize skills while neglecting potential and individual differences. The introduction of multiple intelligences theory provides both theoretical foundations and methodological support for educational reform. Dance, as an interdisciplinary art form that integrates bodily, musical, spatial, and interpersonal intelligences, not only aids in the healthy development of students' physical and mental well-being but also offers a robust framework for personalized teaching. The study indicates that constructing a personalized dance curriculum oriented towards intelligence specialties can effectively stimulate students' learning interests and potentials, and enhance their expressive abilities, social skills, and sense of self-identity. Additionally, through teaching methods such as group dance and collaborative choreography, students further develop their teamwork and interpersonal communication skills. Clearly, the deep integration of multiple intelligences theory with dance education not only promotes a transformation in the concepts of special education but also provides a practical example for the diversification of future educational models, exhibiting broad promotional value.

Disclosure statement

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Politics of Reality in *Measure for Measure*: Duke Vincentio as a Machiavellian

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Abstract

In *Measure for Measure*, Shakespeare's depiction of Duke Vincentio is often viewed through the lens of moral judgment and ideal leadership. However, upon closer inspection, the Duke's actions reveal a Machiavellian political philosophy that subordinates morality to political expediency. By analyzing Vincentio's behavior — such as his dissimulation, his manipulation of Angelo, and his use of deceptive tactics like the bed trick — this paper demonstrates that the Duke's approach to governance aligns closely with Machiavelli's core principles of realism, thereby, positions *Measure for Measure* as not only a morality play but also a sophisticated political commentary, reflecting the complexities of governance and leadership as shown in Shakespeare's political world.

Keywords

Measure for Measure; Duke Vincentio; Machiavellianism; political realism; governance

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1. Introduction: From Morality Play to Political Reading

Traditionally, *Measure for Measure* has been regarded as a morality play, its title echoing the Sermon on the Mount: "Judge not, that ye be not judged … for with what measure ye mete, it shall be measured to you again" (Matt. 7:1–2). The play has thus been read as dramatizing divine justice and ethical proportion. Yet, from its opening dialogue on "the properties of government," Shakespeare also signals a political agenda. Duke Vincentio emerges not merely as a moral arbiter but as a political strategist, manipulating his subjects with a dramaturgical control that recalls Machiavelli's prince[1-3].

Norman Holland[4] aptly observed that the Duke "manipulated the other characters much the same as a dramatist would." Such manipulation, however, undermines any simple alignment with Christian morality. Instead, Vincentio often appears closer to a schemer than a saint, a ruler who values expediency over virtue. His recourse to dissimulation, his instrumental use of deputies, and his prioritization of the state's security over ethical considerations all place him, as Holland remarked, "on Machiavelli's side." This essay seeks to move beyond surface analogies and argue that Vincentio embodies Machiavelli's central political doctrine: realism.

2. The Duke and The Prince: A Machiavellian Analogy

One of the earliest and most persistent comparisons has been between Vincentio's delegation of authority to Angelo and Cesare Borgia's notorious use of Remirro de Orco, described by Machiavelli in The Prince. Like Borgia, who empowered Remirro to enforce harsh reforms before having him executed to appease the populace, Vincentio employs Angelo to revive strict statutes, only to expose and condemn him once public resentment has grown. Zdravko Planinc goes so far as to suggest that "Duke Vincentio was Shakespeare's Duke Valentino."

While the parallel is suggestive, it risks remaining superficial, vulnerable to the charge of coincidence. What matters is not isolated analogy but the Duke's systematic adherence to Machiavellian realism: his view of human nature, his manipulation of deputies, and his subordination of morality to necessity. On these grounds, Vincentio reveals himself as a profoundly Machiavellian ruler.

3. Realism and Human Nature: The Duke as "Seemer"

Machiavelli's anthropology is famously pessimistic: humans are self-interested, cowardly, and untrustworthy. "It is not necessary for a prince to possess all the good qualities," Machiavelli writes, "but it is necessary to appear to have them." What matters is not substance but semblance. The prince must master the arts of feigning and dissembling.

Duke Vincentio is precisely such a "seemer." Publicly revered as a model of justice and mercy, he conceals a harsher reality. The substitution of another prisoner's head for Claudio's reveals the disjunction between his reputation and his practice. By ordering an execution under false pretenses, he violates his professed principles. His chilling remark that "death is a great disguiser" further exposes a cold familiarity with executions, suggesting that his reputation for leniency has long masked a record of mercilessness. As Planinc notes, Vincentio does "what people criticized in Angelo, perhaps even worse—but he does so more skilfully and under masks."

In short, Vincentio's true nature is cloaked beneath carefully maintained appearances. Despite his cruelties, he remains beloved, demonstrating his mastery of Machiavelli's dictum that seeming matters more than being. He is the quintessential Machiavellian "seemer."

4. Government and Deputies: To Be Both Loved and Feared

In line with this realistic view of human nature, another distinctive thinking of Machiavelli should be his corresponding idea about the desired relationship between them — the prince and his subjects. When dealing with people, is clemency a more preferable policy than that of cruelty? Is it better to be loved than feared? In accordance with his realistic view which sees an innate mixture of virtue and vice in human nature, the best scenario Machiavelli anticipated also embraces both sides — "use force and fraud, and the appearance of virtue and vice, as necessary, to make oneself loved and feared". As for fulfillment of this requirement, a Machiavellian use of "deputies" offers an ideal choice, that is, to borrow Machiavelli's words, "to afford rare examples of civil administration" through picking "a spectacular exhibition of rewarding or punishing". This way, on one hand, good actions, be that of the prince himself or his subjects, get invested with a character of greatness, serving as valuable guidance for others and a publicity stunt for the prince himself. While on the other hand, by means of appointing a deputy to carry out the necessary rule of force and the latter's actual practicing of them, desired political ends get met, so is the much needed effect of deterrence. And, with his deliberate distancing from such rule and the ensuing open trial of the then unpopular deputy, the prince artfully stands himself with the public, making it clear that if any cruelty has been committed, it has not come from him but from the harsh nature of his deputy. As such, cruelty well used becomes mercy. The prince succeeds in making himself both loved and feared, but not hated. Naturally, people follow him in peace and in war. Coming to this, in view of many of his shrewd manipulations of "deputies", it's safe to claim Duke Vincentio a real expert.

Speaking of Vincentio's Machiavellian "deputies", the most representative one should be Angelo, whose appointment as the Duke's substitute was fairly known

across the state. To quote Vincentio's phrases, Angelo was "elected our absence to supply", "lent our terror, dressed with our love", and authorized "in our remove at full ourself". At first sight, Angelo seemed entitled to an elaborately planned internship as a future successor. Difficulties due to ensue were merely for the effect of moral testing, to see "if power changes purpose, what our seemer (would) be". Everything appeared so natural and well-meant. Yet, far from the ideal appearance of such an accession process, the essence of this act was rather realistic, at least for the Duke. From his secret confession to the friar —"Therefore indeed, my father, I have on Angelo imposed the office, who may in th'ambush of my name strike (evil deeds) home, and yet may nature never in the fight to do in slander" — it turned out quite obvious that Angelo was merely Duke Vincentio's Remirro de Orco: first used as a deputy for ferocious rectification, including selection of exemplary transgressors and spectacular castigation of them; then, in the Duke's posturing of reward and permission for petitions, (utilized as) a tool to show off the Duke's justice and contrasting benevolence; and finally, once Angelo's purpose served and people's dissatisfaction perversive, forsaken as a typical deputy of vice and punished in a deterrent manner. Throughout the scheme, for all the cruelties and force the Duke actually utilized, Vincentio himself shrewdly sheltered behind the screen, thereby, retained people's love, ensured their reverence, and avoided their hatred as well[5].

To conclude, according to his realistic treatment of both means — law and force, vice and virtue, as well as his clever manipulation of "deputies", it's quite easy to see a Machiavellian nature in Duke Vincentio's political philosophy. And from his achievement in getting himself both loved and feared, it turns out still easier to confirm not only this Machiavellian tendency, but his proficiency in practicing it.

5. Morality and Necessity: The End Justifies the Means

On the basis of the introduction above, one knows that in Machiavelli's politics of reality, a wise prince is supposed to give the appearance of being virtuous so as to facilitate his governing; and when the situation requires, he could also utilize force and fraud, as long as he can well mask it, like handing it over to a certain deputy. But the problem is, what if there is no way of dodging? Does the influence of morality still have a bigger say? According to Machiavelli, the answer is definitely "NO".

In revolt against ancient and medieval theorists, for whom political behaviour must be guided by the highest ideals, Machiavelli vetoed the existence of any moral imperative in politics. As he understood it, the actions of princes should be governed solely by necessity. When conditions require it, "a prince should not shrink from encountering some blame on account of vices that are important to the support of his states"; for politics was not the pursuit of moral virtue but the pursuit of the state's security and well-being. Once the prince's policy proves successful, his ruthlessness will be forgiven and forgotten. Anyway, as he put it, "in the actions of men, especially of princes, the end justifies the means". As for this opinion, one can find a strong echo in the actions of the Duke under discussion.

When it comes to the demonstration of Duke Vincentio's realistic view of morality — his prioritizing of political ends to moral values, the first proof one may think of should be the Duke's composed justification for his ignominious bed trick. His "the doubleness of the benefit defends the deceit from reproof" was as almost saying "the benefits of my strategy justifies my immoral deceit". The same also applied to the incitation he gave to Mariana, "sith that the justice of your title to him doth flourish the deceit." If these and other lies the Duke told while directing this trick were only minor moral transgressions and therefore still not enough to constitute a persuasive proof, then the Duke's unabashed breach of faith to all his subjects should serve as a conclusive factor. When readers engage themselves in arguing whether it was right for the Duke to carry out such a scheme or, how successful he was in doing so, one critical question remained — where on earth did the cause of the scheme come from? In other words, why did the normally indulgent prince suddenly want a severe law which may incur public dissatisfaction? What's for? Though there was no direct explanation offered, changes of social background as reflected in people's daily conversation — "If the Duke, with the other dukes, come not to composition with the King of Hungary, why then all the dukes fall upon the King" offered an

important clue: the nation was expecting a war. While in peace as the nation previously witnessed, the Duke could still allow people enjoyments they craved while himself be repaid with a reputation for being generous, urgent needs of the coming war — disciplined foot soldiers and officers that could command them — asked for a change of people's ways, which, at the moment, were generally made soft, indifferent, contemptuous, and, in a word, not fit for soldiers. Therefore, strict statutes and most biting laws became paramount — to the degree that it could almost determine the survival of the state, making concerns for morality a luxury. Duke Vincentio saw this, and responded to this necessity of time. Finally, for all his breach of faith and fraudulent use of Angelo, crying needs of state got met — justice served, people used to discipline and the sight of blood. All things prepared for war[6].

6. Conclusion

As shown in discussions above, apart from being a morality play about ethical judgments, the work Measure for Measure also makes a perfect political reading, demonstrating the superb statecraft of Duke Vincentio throughout the event. Once given scrupulous examination, it turns out that, be its the preface in which amazing similarities between Duke Vincentio and another typical Machiavellian figure abound; or the three elucidative parts consisting of the Duke's shrewd manipulation of appearances, his adept utilization of force and fraud, and his prompt response to the needs of the state; all serve as a footnote for one thing — Duke Vincentio's belief in Machiavelli's politics of reality and his being a Machiavellian figure himself.

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The Logical Path, Perspective and Strategy Adjustment of Digital Technology Enabling Education Transformation

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Abstract

As the core driving force of the Fourth Industrial Revolution, digital technology injects new momentum into educational transformation by revolutionizing pedagogical elements, restructuring educational frameworks, and innovating teaching models. Its intrinsic logic manifests through three dimensions: technology-driven innovation, demand-oriented strategies, and policy guidance. Practical applications include precision education delivery through personalized learning, intelligent teaching that reshapes classroom ecosystems, and collaborative governance optimizing resource allocation across regions. To enhance empowerment effectiveness, recommendations include strengthening top-level design for systemic reform, improving infrastructure to solidify technological foundations, enhancing digital literacy among educators and students to activate intrinsic motivation, and refining evaluation systems to steer development trajectories.

Keywords

Digital technology; Educational transformation; Logical pathways; Vision analysis; Strategic adaptation

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1. Introduction

Amid the global digital revolution, technological advancements are fundamentally reshaping educational paradigms. The rapid evolution of AI, big data, and cloud computing has created unprecedented opportunities for innovation while challenging traditional teaching models. Educational digital transformation involves not just technological upgrades but a comprehensive overhaul of pedagogical philosophies, instructional approaches, and governance systems[1]. As nations worldwide prioritize digital education in national strategies, China's "Education Informatization 2.0 Action Plan" and "China Education Modernization 2035" outline clear objectives for this transition. However, systematically understanding how digital technologies drive educational transformation, scientifically envisioning its future trajectory, and developing effective implementation strategies remain critical research priorities. This paper examines three dimensions—methodological frameworks, strategic foresight, and adaptive strategies—to demonstrate how digital technologies catalyze structural reforms in education systems, offering theoretical foundations and

practical pathways for advancing high-quality educational development.

2. The logical path of digital technology enabling education transformation

Digital technology has become a pivotal force in transforming education, forming a complex system that integrates multiple dimensions and elements. Analyzing its core logic through three interconnected dimensions—technology-driven advancement, demand-driven evolution, and policy guidance—reveals how these forces collectively propel education toward modernization and intelligent transformation[2].First, the technology-driven dimension demonstrates unprecedented progress in digital technologies like artificial intelligence, big data, and cloud computing[3]. These innovations act as powerful engines that not only revolutionize knowledge delivery through vivid and intuitive formats but also fundamentally reshape teaching methodologies. Traditional education often struggled with understanding individual learning patterns, yet modern analytics now enable real-time monitoring of students' cognitive states, providing precise instructional support to achieve personalized education tailored to individual needs[4]. Second, the demand-driven dimension is equally crucial. Rapid socioeconomic development and industrial restructuring have dramatically altered talent requirements. Students educated through conventional standardized models increasingly fail to meet the demands of diversified, innovative talent cultivation. Digital technologies, with their unique advantages of transcending time-space constraints, enriching educational resources, and innovating teaching approaches, effectively address these evolving educational needs[5]. Meanwhile, the emerging hybrid education model that seamlessly integrates online and offline learning has rapidly gained traction, becoming an essential solution to meet learners' diverse needs while providing students with more flexible and convenient educational pathways. Thirdly, policy guidance has established robust institutional safeguards and support for digital technology-driven educational transformation. Countries worldwide are advancing educational digitization as a national strategy, and China is no exception. Policy documents such as the "Education Informatization 2.0 Action Plan" and "China Education Modernization 2035" have charted clear directions and objectives for this transition. Through strategic resource allocation, standardized protocols, and pilot programs, these policies actively guide and regulate the deep integration of digital technologies with education, ensuring steady progress along the right trajectory of educational reform[6].

3. Insight into the picture of digital technology enabling education transformation

Digital technology is revolutionizing education, painting a vibrant future where personalized learning, intelligent teaching, and collaborative governance form an integrated system that brings unprecedented transformation and opportunities to the field. First, in personalized learning, digital tools have transformed the millennia-old educational ideal of "teaching according to individual aptitude" from theoretical concept to tangible reality[7]. Through advanced data collection and analysis technologies, systems now comprehensively gather multimodal learner data across dimensions like academic behaviors, interests, and cognitive levels[8]. By deeply mining this massive data, precise learner profiles emerge—akin to customized "learning roadmaps" that clearly outline each student's strengths and weaknesses[9]. Based on these profiles, adaptive learning systems create tailored study paths and resource recommendations, breaking away from one-size-fits-all approaches[10]. The adaptive learning system acts as an intelligent navigator, monitoring real-time performance and dynamically adjusting content and difficulty levels based on students' answers and progress[11]. When students master a concept, the system automatically pushes more challenging material; when encountering difficulties, it promptly provides supplementary materials and targeted exercises[12]. This ensures every student learns at their own pace and difficulty level, truly realizing personalized learning experiences that allow each individual to fully develop their potential[13]. Second, in intelligent teaching, digital technology is fundamentally reshaping teachers' roles and instructional methods, bringing new vitality and efficiency to education. Intelligent teaching assistants serve as powerful educational tools, handling

routine tasks like knowledge delivery and homework grading. This significantly reduces teachers 'workload, allowing them to focus on more creative aspects such as designing lesson plans, providing personalized guidance, and offering emotional support. Cutting-edge technologies like virtual reality (VR) and augmented reality (AR) have revolutionized education by creating immersive learning environments that make abstract concepts tangible and complex processes actionable. For example, VR technology enables students to "time-travel" back in history to experience events firsthand, while AR technology magnifies microscopic molecular structures in science labs, enhancing observation clarity. Meanwhile, big data analytics act as smart advisors, helping teachers identify teaching challenges—such as students' grasp of key concepts or the effectiveness of instructional methods—thereby continuously optimizing pedagogical strategies and improving both teaching outcomes and learning experiences[14]. Thirdly, in collaborative governance, digital technologies are shaping an open, shared, and collaborative educational ecosystem. Blockchain's decentralized and tamper-proof nature has revitalized educational certification systems, establishing credible frameworks for cross-institutional recognition and accumulation of learning achievements, ensuring academic accomplishments gain universal recognition across schools and regions. The educational big data platform functions as an "intelligent coordinator" for educational resources, enabling optimized allocation and precise delivery of resources. This system breaks down barriers caused by uneven distribution of educational assets, thereby advancing educational equity and quality enhancement. The intelligent decision support system provides administrators with scientific decision-making frameworks through data analysis, helping them make more accurate and effective choices that improve the precision and efficiency of educational governance. This collaborative governance model transcends traditional organizational boundaries in education, creating a new development paradigm where governments, schools, enterprises, and society jointly participate in co-building and sharing resources. This approach drives educational progress toward higher quality standards and greater equity[15].

4. the strategic adjustment of digital technology enabling education transformation

The integration of digital technologies into education transformation is an essential requirement for modernizing educational development. To ensure effective implementation, strategic adjustments must be made across multiple dimensions including top-level planning, infrastructure development, competency enhancement, and evaluation systems, forming a comprehensive multi-level synergy. First, strengthening top-level planning to establish a coordinated development framework. As an extensive and far-reaching systemic project, educational digital transformation requires prioritizing strategic design and planning. At the national level, a forward-looking holistic strategy should be formulated, clarifying transformation objectives, pathways, and key tasks to create a clear roadmap for leveraging digital technologies. Simultaneously, establishing robust interdepartmental coordination mechanisms is crucial—breaking down barriers between education, technology, and industry sectors while pooling resources to form a powerful driving force. For instance, tech departments can provide technical support, industrial partners assist in developing and promoting digital education products, while educational authorities focus on teaching practices and reforms. This tripartite collaboration drives educational digitalization. Additionally, standardization efforts cannot be overlooked. Establishing unified technical standards and quality specifications provides solid technical guidance and quality assurance for deep integration of digital technologies with education, ensuring steady progress along standardized and orderly tracks. Second, improving infrastructure to strengthen educational foundations. Well-developed digital education infrastructure serves as vital material support for leveraging digital technologies in educational transformation. First, accelerate the development of dedicated educational networks to enhance school network bandwidth and quality, establishing a high-speed, stable "information superhighway" for digital education. This ensures teachers and students can access abundant educational resources anytime, anywhere. Second, vigorously promote the construction of smart classrooms and virtual laboratories equipped with advanced digital

teaching facilities, providing solid hardware support for digital education and creating more dynamic, efficient learning environments. Simultaneously, build a national public service system for digital educational resources to break down resource barriers, promote collaborative sharing of quality resources, and enable students in remote areas to access premium educational materials. Special attention should be given to digital infrastructure development in rural and remote regions through increased investment, narrowing the digital divide to ensure educational equity in the digital age. Third, improve competency evaluation and innovate educational models. Enhancing digital literacy across all levels is crucial for leveraging technology to transform education. Integrate digital literacy into teacher training systems through systematic courses and practical guidance, equipping educators with digital teaching design and implementation skills. Simultaneously, cultivate students' digital literacy by developing information awareness, computational thinking, and digital learning capabilities, equipping them with core competencies for the digital era. Establish a scientific evaluation system for teacher-student digital literacy to guide continuous improvement through standardized criteria. Furthermore, we should prioritize digital ethics education to cultivate proper technological values and behavioral standards among teachers and students. This ensures they can enjoy the convenience of digital technologies while adhering to ethical and legal principles. Fourth, optimize the educational evaluation system by establishing a big data-driven comprehensive assessment framework that holistically reflects student development. Utilize learning analytics technology to organically integrate formative and summative evaluations. Explore blockchain applications in educational certification to create credible and traceable learning achievement verification mechanisms. Through evaluation reforms, we can drive innovation in educational philosophies and models, thereby fostering a favorable institutional environment for digital technology-driven educational transformation.

5. Conclusions

Digital technology is the essential pathway for educational modernization. This paper analyzes the logical framework, conceptual landscape, and strategic adjustments of digital technology's transformative impact on education, revealing the inherent principles and implementation pathways for deep integration between digital technologies and pedagogical practices. Research demonstrates that digital technology not only revolutionizes technical tools but also fundamentally reshapes educational philosophies, models, and systems. Looking ahead, as technological advancements accelerate and applications deepen, digital technology will play an increasingly vital role in promoting educational equity, enhancing teaching quality, and cultivating innovative talents. However, it's crucial to recognize that this transformation requires long-term commitment, demanding collaborative efforts from governments, schools, enterprises, and society at large. Only through systematic and coordinated strategies grounded in accurate understanding of technological trends and educational principles can we fully harness digital technology's empowering potential, driving structural reforms and innovative development within the education system.

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AIGC Empowering Teaching Methods for E-commerce Majors in Vocational Colleges

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Abstract

The application of Artificial Intelligence Generated Content (AIGC) in professional teaching can utilize AI algorithms to generate creative and high-quality content, generate relevant articles, images, audio, etc., enrich professional teaching resources, innovate and apply diverse teaching methods, and improve the quality of professional teaching. Based on this, this article first analyzes the educational value of AIGC empowering innovation and reform in e-commerce majors in vocational colleges, and finally proposes several application strategies for teaching methods, aiming to fully utilize the advantages of AIGC education, construct a new model for cultivating e-commerce professionals, and improve the quality of e-commerce talent cultivation.

Keywords

AIGC
Vocational colleges
E-commerce major; teaching method

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1. Introduction

With the application of artificial intelligence technologies such as intelligent customer service and intelligent recommendation in the e-commerce industry, professional talents are required to possess the ability to apply artificial intelligence technology and tools, which presents new challenges and opportunities for the training mode of e-commerce professionals. Currently, as an important place to cultivate students' theoretical knowledge and practical abilities, the e-commerce major in vocational colleges should apply artificial intelligence technology and AIGC to innovate the talent training mode and teaching methods of e-commerce majors, enrich the lagging e-commerce course teaching content, promote the professional talent training objectives to meet the market demand in the context of the artificial intelligence era, and strengthen the cultivation of students' professional and vocational abilities. The article combines the current situation and needs of talent cultivation in e-commerce majors in vocational colleges, and explores in depth how to use AIGC to innovate professional teaching methods, cultivate compound e-commerce talents, and improve the level of professional construction.

2. AIGC Empowering the Innovative Education Value of E-commerce Majors in Vocational Colleges

2.1. Support personalized learning for students and improve teaching accuracy

AIGC technology can utilize big data collection and mining capabilities to comprehensively analyze students'

learning processes, behaviors, etc., and use artificial intelligence algorithms to accurately analyze students' learning situations, including their personality traits, learning characteristics, learning habits, and learning needs. It generates personalized student portraits, provides personalized learning resources for students, and meets their autonomous learning needs. In the teaching activity of e-commerce case analysis, teachers apply AIGC technology to analyze students' case understanding ability and interest preferences, provide students with real e-commerce cases, and guide students' thinking in a timely manner based on their analysis process, solve their learning problems, strengthen their learning ability, and improve the accuracy of e-commerce professional teaching.

2.2. Adapt to the job demands of the new era and enhance the level of talent cultivation

In the context of the era of artificial intelligence, all positions in the e-commerce industry are influenced by artificial intelligence technology. E-commerce positions such as operations management, marketing and promotion, and customer operations can utilize artificial intelligence technology to carry out intelligent processing. The application of artificial intelligence in employment positions in the e-commerce industry is shown in **Table 1**. By analyzing the core skills of various positions in e-commerce and the support provided by artificial intelligence technology, it provides direction for the application of teaching methods in e-commerce majors. Therefore, AIGC empowers innovation in e-commerce majors to help students adapt to the job demands of the new era. By integrating artificial intelligence technology and professional courses into the curriculum and teaching reform system, the level of talent cultivation can be improved[1].

3. Exploration of AIGC Empowering Teaching Methods for E-commerce Majors in Vocational Colleges

3.1. Integrating digital teaching content and enriching professional teaching resources

Rich teaching content is the fundamental condition for promoting innovation and reform in the teaching of e-commerce majors in vocational colleges, and it is also

Table 1. Application of Artificial Intelligence in Some E-commerce Positions

Key post	Core skills	Artificial Intelligence Applications	Representing enterprises and products
Operations Management	Ability to select and plan online products E-commerce platform operation capability Ability to analyze and process operational data of online stores	Intelligent operation system, E-commerce operation robot	Shop Taoke, UiBot Robot, Alibaba Business Advisor
Marketing promotion	Ability to plan and implement online promotion plans	Generate marketing plan	Albert Technologies, Colorful Brain
	Utilize search engine marketing, keyword optimization, and traffic enhancement capabilities	Recommendation engine, Voice search, Image search	Alibaba DT PAI, Alexa, Echo, Apple Siri, and Google Home
	Good writing and advertising copywriting skills	Intelligent copywriting	Alibaba AI intelligent copywriting Jingdong Shakespeare
Customer operations	Understand customer needs and customer acquisition capabilities Effective coordination and handling ability to solve customer problems Ability to communicate and interact with customers online	Intelligent shopping guide robot, intelligent customer service robot, intelligent sales chatbot, intelligent CRM, etc	Alibaba Xiaomi, iFlytek, Wisdom Teeth UDESK, NetEase Seven Fish UNIQLOIQ, Baihui CRM
E-commerce graphic designer	Product shooting capability	Intelligent shooting robot	Alibaba's discerning eye for goods
	Store graphic and image design skills	Intelligent storefront design	Alibaba Luban
	Ability to beautify images, create visual creativity, create online advertisements, and design UI	Intelligent graphic robots, intelligent video robots	Suning wooden ox flowing horse, Alibaba Luban

the main content of AIGC empowering professional teaching. There is a characteristic of outdated teaching content in conventional e-commerce majors, which makes it difficult to adapt to the digital development speed of the e-commerce industry in the new era. Paper textbooks and teaching materials for e-commerce majors have not been timely integrated with digital industry content such as live streaming e-commerce, intelligent customer service, and AI product selection. The existing forms of teaching resources cannot meet students' needs for cutting-edge knowledge. AIGC empowers the innovation of teaching methods for e-commerce majors in vocational colleges, enabling the rapid generation and integration of digital content using AIGC technology, combined with the actual development of the e-commerce industry in the context of artificial intelligence era, integrating cutting-edge knowledge content, enriching professional teaching resources, and improving professional teaching effectiveness[2].

The curriculum system of e-commerce majors in vocational colleges is closely aligned with industry development trends, with core courses including "Graphic and Image Processing", "Live Streaming Operations", "Online Store Operations", etc. These contents are highly in line with the actual needs of the e-commerce industry in the new era. The use of AIGC in combination with the teaching objectives and main course contents of the course and the integration of digital and intelligent teaching resources can further enhance the progressiveness and scientificity of professional course teaching. Integrating AI technology into "Graphic and Image Processing" and conducting AI+graphic and image processing courses, utilizing advanced AIGC tools such as Zhimeng and Midgourcy, to promote students' mastery of traditional image processing skills and AI technology, and quickly generate high-quality visual content. Students improve the efficiency and creativity of graphic and image processing and design by learning advanced image recognition, automatic optimization, and creative generation techniques. The course of "Live Operation" integrates AI technology and carries out the main activities of AI+live operation. It applies natural language processing and intelligent creation platforms to carry out teaching activities of AI assisted content planning, content generation, and data analysis, promoting students to learn how to use multiple platforms such as ChatGPT, Deepseek, Tencent Yuanbao, and iFlytek to carry out intelligent and precise learning of live operation and content creation, and improving the interactive effect and audience stickiness of live broadcasting. The course of "Online Store Operations" integrates AIGC to carry out digital learning activities such as intelligent recommendation algorithms and user behavior analysis, enabling students to learn how to use artificial intelligence, big data technology, etc., understand content distribution strategies and marketing strategies, and improve the efficiency and accuracy of online store operations.

3.2. Innovatively applying AI tools to reconstruct the curriculum and teaching system

AIGC empowers the innovative application of teaching methods in vocational e-commerce majors, which requires the use of AI tools to connect teaching content and practice, and achieve a deep and systematic reform of teaching methods. In routine professional teaching activities, theoretical teaching and simple practical operation are the main curriculum systems, and students do not have sufficient opportunities to apply AI technology to solve complex e-commerce problems. At the same time, in the context of the new era, the e-commerce industry has widely applied AI tools, which has led to insufficient matching between conventional course teaching models and industry demands in the new era. Therefore, in the context of AIGC empowering the reform and application of teaching methods in e-commerce majors, it is necessary to fully utilize AI tools to reconstruct the curriculum teaching system, so that students can learn to use AI tools for learning and exploration, and understand the application value and key points of AI tools in the e-commerce industry, and strengthen their professional and vocational abilities[3].

Taking the course of "New Media Operation Promotion" as an example, in the lesson preparation stage, teachers use the "Jiangbang AI" learning analysis system to analyze students' learning situation based on their pre class preparation and classroom learning, and intelligently recommend and set teaching objectives. In the classroom, the "Jiangbang AI" learning analysis system learned that students' foundation in copywriting is relatively

weak, and proposed teaching objectives and directions, such as suggesting that students first improve their basic copywriting skills, and then cultivate their creative writing abilities. In the classroom teaching process, teachers use the AI courseware production tool of "Xiwo Whiteboard" to automatically generate courseware and micro lesson videos with both graphics and text. They also use "Doubao AI Assistant" to create a human-machine collaborative teaching mode, innovate blended teaching methods, and carry out a classroom form that combines offline teaching and online interaction, promoting students to engage in marketing creative discussion activities. At the same time, teachers should combine students' classroom learning performance data, such as their attention to live streaming sales techniques, and timely increase practical live streaming sales activities to enhance students' classroom learning enthusiasm and improve their learning effectiveness.

3.3. Utilizing AI virtual functions to innovate practical teaching methods

AIGC technology empowers innovation in teaching methods for vocational e-commerce majors, which requires close integration of theory and practice in e-commerce teaching, focusing on the cultivation and development of students' vocational abilities. AIGC has advantages such as virtual simulation and digital human interaction technology, which can break through the temporal and spatial limitations of e-commerce teaching, build a virtual, simulated, and repetitive practical environment, provide diverse spaces for students to carry out practical operations, overcome the shortcomings of traditional practical teaching limited by teaching venues, practical costs, and practical risks, and comprehensively enhance students' professional abilities[4].

Firstly, apply AIGC to build a virtual e-commerce environment. By applying language models such as ChatGPT, Deepseek, Tencent Yuanbao, and iFlytek, as well as key elements such as input products and information transmission characteristics, a virtual e-commerce environment can be quickly generated. Students can play different roles in the simulated environment to experience the theoretical knowledge and professional abilities of CEOs, marketing directors, and operations managers in solving practical business problems. Meanwhile, in the virtual e-commerce environment, students have different roles and tasks, such as product promotion, customer service, and order management, providing diverse spaces for students to experience different career positions and enhance their practical and problem-solving abilities.

Secondly, utilizing AI digital humans to enrich practical activities. The widespread development of AIGC technology has promoted the transformation of the e-commerce industry, especially in the context of the widespread development of live streaming e-commerce. By using AI technology to generate digital live streaming images that match the live streaming e-commerce scene, the liveliness of digital live streaming e-commerce can be enhanced, and labor costs can be reduced. In this context, AIGC empowers the innovative application of teaching methods in e-commerce majors, enabling the use of AI digital humans to carry out practical activities for live streaming sales. Through intelligent platforms such as Doubao AI and silicon-based AI (as shown in **Figure 1**), students can independently complete the entire process of live streaming training, including digital character customization, multimodal script creation, and intelligent mirror design. This includes core elements such as product selection strategy formulation, storyboard script writing, and live streaming rhythm control. At the same time, after the live broadcast is completed, students use AIGC technology to collect live broadcast data for practical review, in order to continuously improve the digital live streaming sales plan, accumulate rich practical experience, and strengthen students' professional abilities.

Figure 1. Digital Person Live Streaming Sales

4. Conclusion

Overall, the application of AIGC in e-commerce majors can utilize artificial intelligence technology and intelligent tools to generate articles, images, and audio resources that match professional teaching and learning, supporting personalized learning for students. At the same time, multiple teaching methods can be used to support the application of digital resources, effectively broadening students' knowledge and vision of e-commerce majors, adapting to the talent needs of e-commerce positions in the new era, and effectively improving the level of talent cultivation in e-commerce majors. In the teaching of e-commerce majors in vocational colleges, teachers adhere to the student-centered educational principle, integrate digital teaching resources through AIGC technology, construct a teaching system that meets the needs of new e-commerce development, and innovate the application of AI tools and technologies to reconstruct the curriculum teaching system and practical teaching methods, promote forward-looking reforms in professional teaching methods and activities, and enhance the level of professional talent cultivation.

Disclosure statement

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School-based Curriculum Development and School Characteristic Creation

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Abstract

This paper explores the relationship between school-based curriculum development and the creation of school characteristics, as well as the practical paths. First, it explains that characteristic schools must possess uniqueness, quality, and stability, emphasizing the importance of considering school and student conditions. Then it points out that both are interdependent, with the school-based curriculum serving as the carrier of characteristics, and characteristics determining curriculum direction, forming a virtuous cycle. Finally, it illustrates how to build characteristic schools through school-based curriculum development in four steps: positioning, development, implementation, and evaluation.

Keywords

School characteristics; School-based curriculum; School-based curriculum development

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1. Overview of Characteristic Schools

Both the Outline for Educational Reform and Development in China (1993) and the National Medium- and Long-Term Plan for Educational Reform and Development (2010–2020) (2010) clearly propose that schools should "develop their own characteristics". Moreover, "establishing characteristic high schools and promoting school characteristic development" became a key point in the Ministry of Education's 2010 work plan. Additionally, the "Research Project on Characteristic Senior High Schools," which exists as a special research topic, was launched by the Planning Office and organized expert evaluations to select 100 project schools and 200 cultivation schools to promote the construction of characteristic senior high schools. Meanwhile, the establishment of characteristic kindergartens, primary schools, and junior high schools has also become a focus of educational development. Exploring the development path of characteristic school running is beneficial for comprehensively implementing the Party's education policy and implementing quality education. Promoting the construction of characteristic schools through characteristic educational research, gradually forming and highlighting distinctive school characteristics in characteristic school running practices, creating rich spaces for students' autonomous development, and

enhancing the international competitiveness of China's basic education have become urgent tasks for basic education reform and development[1].

From an etymological perspective, "characteristic" carries dual meanings of "uniqueness" and "excellence". The "Modern Chinese Dictionary" defines "characteristic" as the unique form, color, and style manifested by things. As an ancient saying goes, "The unique superiority of things is called characteristic." Thus, "characteristic" refers to something that stands out due to its distinctive and excellent qualities. The essential connotation of "characteristic" encompasses two dimensions: "uniqueness" and "quality"[2]. Research on the concept of "school characteristics" began in 1993. In "Preliminary Discussion on Building Characteristic Schools," Zhao Fuqing defined characteristic schools as "schools that demonstrate a Unique School-running style, distinctive educational philosophies, and distinctive teaching methods over long-term educational processes.[3]"

In Zheng Youxun's "Interpreting Characteristic Schools," the concept of characteristic schools is defined as follows: "In China, a characteristic school generally refers to those schools that, in the process of fully implementing educational policies, under the deliberate pursuit of the subject, over an extended period of time, develop unique characteristics in certain aspects that distinguish them from other schools. These schools form relatively stable and distinctive personalities, achieve outstanding results, and gain social recognition.[4]"

Wang Wei pointed out in "School Characteristic Development: Connotation, Conditions, Problems and Approaches" that school characteristics are relational, attributive, and object-oriented concepts, possessing uniqueness, quality, and stability[5].

From this, we can see that: a characteristic school refers to an educational institution that, within the broader educational context, adheres to national education policies. Through the leadership of the principal and the joint efforts of all faculty, staff, and students, over long-term educational practice, it develops distinctive, stable, developmental, and differential characteristics that set it apart from other schools.

School characteristics are developed through a long-term process. In the broader educational context, schools follow national education policies and, through principal leadership and the joint efforts of all faculty, staff, and students, develop distinctive, stable, developmental, and differentiating features over extended educational practice. When building school characteristics, two key points should be noted: First, schools must base their development on their own actual conditions. By considering their historical development, school positioning, and practical realities, schools can leverage their strengths and deeply explore their potential to create unique characteristics. Second, schools must focus on their students' learning situation. As educational institutions, schools exist primarily to educate and nurture students, who are the main body of the school. The ultimate goal of creating school characteristics lies in promoting comprehensive and personalized student development. Only in this way can school characteristics truly demonstrate their intended significance and value[6].

2. The Relationship between School-based Curriculum Development and School Characteristic Creation

School-based curriculum development and school characteristic creation are inherently related. There are various ways to define school-based curriculum development. Since each school is a unique entity, school-based curricula vary from school to school, better highlighting their respective educational characteristics[7]. Thus, school-based curriculum development and school characteristic creation share isomorphic fundamental principles.

2.1. School-based curriculum development is an important carrier and core approach for building school characteristics.

As the core component of school work, curriculum and teaching are the key foundation for creating school characteristics. Only by developing distinctive curriculum and teaching features can we provide students with broader development opportunities and truly demonstrate school characteristics. Curriculum reform is the key to educational reform [8]. All educational reforms must ultimately be implemented through curriculum. Any school characteristics require specific curriculum support. China implements a three-level curriculum

management system. In school-based curriculum development, teachers, as the main developers, have complete autonomous decision-making power from curriculum design to evaluation, which naturally places the responsibility of creating school characteristics on school-based curriculum development.

Without the support of school-based curriculum, school characteristics may degenerate into "slogan-like features". Some schools claim to have "technological innovation" as their characteristic, but their efforts only remain at organizing science festivals and posting promotional posters, lacking systematic school-based courses such as "Robot Programming" and "Scientific Inquiry Methods". Ultimately, this superficial approach makes it difficult for these characteristics to truly impact student development.

2.2. School characteristics provide direction and core for school-based curriculum.

The core concept of school characteristics defines the development scope for school-based curriculum, ensuring the focus of the curriculum system. On one hand, school-based curriculum needs to be based on the school's unique educational philosophy, training objectives, and areas of excellence. Through systematic assessment of school and community characteristic resources, a curriculum system with differentiation and selectivity should be developed. On the other hand, school characteristics must be realized through the support of characteristic courses. Successful cases at home and abroad (such as American magnet schools and Shanghai Jianping High School) have proven that characteristic courses are an important carrier for creating school characteristics[9].

Without the guidance of school characteristics, school-based curriculum may become" blind exploration". Some schools, in pursuit of quantity, have simultaneously developed more than ten types of school-based courses including calligraphy, basketball, programming, pottery, etc. These courses lack internal connections, which not only increases teachers' burden but also makes it difficult for students to develop stable interests and specialties. This "miscellaneous" approach to curriculum development is essentially a loss of direction caused by the lack of characteristic guidance.

2.3. These two aspects mutually reinforce each other, creating a virtuous cycle.

This two-way interaction is reflected in three levels: First, school-based curriculum development, by emphasizing individual student differences and community needs, can fully develop potential educational resources and demonstrate the school's unique characteristics. Second, curriculum autonomy serves as the institutional foundation for school characteristics. Only by breaking through the traditional top-down curriculum management model can schools build distinctive curriculum systems. Third, there is a symbiotic relationship between characteristic courses and school features. They must be based on characteristic resource assessment for development while serving the dual needs of community development and student growth. Therefore, school-based curriculum development is not only a practical path for forming school characteristics but also a curriculum transformation process of characteristic educational concepts. The two achieve dynamic unity through the decentralization of curriculum power and the integration of characteristic resources[10].

In the context of deepening educational reform, "one school, one specialty" and "characteristic development" have become important directions for primary and secondary schools. As a curriculum form independently developed by schools, school-based curriculum has an inseparable dialectical relationship with school characteristic creation. School-based curriculum development and school characteristic creation are the "two wings of one body" for school personalized development. Without the support of school-based curriculum, school characteristics will become castles in the air; without the guidance of school characteristics, school-based curriculum will fall into blind exploration. In educational practice, schools need to grasp the dialectical relationship between the two, develop soulful school-based curriculum under the guidance of characteristic concepts, and refine rooted school characteristics based on curriculum practice. Only in this way can we truly achieve the educational goal of "establishing schools through characteristics and educating people through curriculum", and provide students with personalized and high-quality educational experiences.

3. How to Develop School-based Curriculum and Create Distinctive Schools

The development of school-based curriculum and the establishment of distinctive schools form an organic whole. This requires scientific positioning to set the direction, systematic development to build the carrier, effective implementation to put into practice, and comprehensive evaluation to ensure quality. These four elements are interlocking, collectively forming a complete closed loop for distinctive school development. The following will elaborate in detail from these four dimensions.

3.1. Positioning: Based on resource endowments, highlighting differential advantages

Positioning serves as the "compass" for creating characteristic schools, determining the direction and depth of school-based curriculum development. Its core lies in deeply exploring the unique resources of schools and communities, identifying their differentiated advantages, and laying a solid foundation for subsequent curriculum development.

3.1.1. Deeply explore and utilize school community resources to build a distinctive foundation.

Schools are not isolated educational units but "cultural organisms" rooted in the soil of their communities. The natural environment, cultural heritage, and industrial resources in the community are all valuable materials for school-based curriculum development and natural genes for forming school characteristics.

From the perspective of natural resources, suburban schools can develop ecological education courses based on mountains, forests, wetlands, farmlands, etc. For example, Rizhao City in Shandong Province is adjacent to the birthplace of Dongyi culture. Schools can develop school-based courses based on Dongyi culture to inherit and promote excellent traditional Chinese culture.

From the perspective of cultural and industrial resources, urban schools can connect with museums, time-honored brands, intangible cultural heritage workshops, and other community resources. As reported by CCTV Education Channel, a school has developed a silk production-themed curriculum based on local community resources. This initiative not only helps students inherit their hometown's traditional industry and acquire practical skills but also assists local silk factories in gaining market share, achieving symbiotic development between the school and the community[11].

Campus resources serve as another crucial basis for positioning. Schools with a long history can explore the spiritual heritage in their school history. For instance, a century-old middle school in Beijing has compiled alumni achievements and educational traditions since its founding, developing school history into curriculum resources and constructing a distinctive curriculum system.

3.1.2. Deepen understanding of curriculum resources and highlight differential advantages

The richness and relevance of curriculum resources directly determine the uniqueness and feasibility of distinctive positioning. We must break away from the narrow perception of "textbooks as the sole resource" and reconstruct our resource perspective from three dimensions: "human, material, and environmental". Particular emphasis should be placed on the value of differentiated resources.

Differences are the core element of characteristics. Every school has natural differences in its faculty structure, student body characteristics, and educational resources. These differences are precisely the "rich mines" for forming characteristics. Curriculum development must proceed from the school's actual situation, base itself on school characteristics, develop students' specialties, leverage teachers' strengths, and promote the formation and development of school characteristics[12] .

The diversification of resource forms is key to positioning. Teachers' teaching personalities, teachers' and students' life experiences, and even the school's physical space can all be transformed into curriculum resources. This prevents the phenomenon of extensive curriculum resources being difficult to process and transform in a timely manner and integrate into primary and secondary school teaching practice, avoiding the idleness of curriculum resources and the burial of resource value[13].

The positioning process essentially answers the question: "What unique growth experiences can the

school provide for students?" Only by leveraging resources and highlighting differences can a distinctive positioning both "take root deeply" and "stand firmly."

3.2. Development: Establish management systems and standardize development processes

School-based curriculum development serves as a "bridge" for implementing distinctive positioning. Through a scientific management system and standardized development process, it transforms positioning into specific curriculum content and implementation plans.

3.2.1. Establish a school-based management system to ensure autonomy in development.

Under the traditional "bureaucratic" management model, schools lack autonomy in curriculum development, and teachers passively execute instructions, making it difficult to develop distinctive features. School-based curriculum development requires the establishment of a "school-centered, full participation" management system, granting teachers curriculum decision-making power to stimulate development vitality[14].

The flattened design of the management structure is key. Schools can establish a three-level management system consisting of a "Curriculum Development Leading Group, Curriculum Research and Development Center, and Discipline Project Teaching and Research Group": The leading group, composed of the principal, teacher representatives, and parent committee members, is responsible for setting the curriculum direction; the research and development center assumes functions such as curriculum planning and resource coordination; and the teaching and research group specifically handles curriculum design and implementation. The refined design of institutional guarantees serves as the support. Schools need to develop systems such as the "School-based Curriculum Development Guide" and "Teacher Curriculum Development Incentive Measures," clarifying the standards, processes, and reward and punishment mechanisms for curriculum development. The core value of the management system lies in transforming teachers from "curriculum implementers" to "curriculum creators," making school-based curriculum development a genuine internal need for teacher professional growth.

3.2.2. Standardize curriculum development process to ensure course quality

School-based curriculum development is not a random "creative patchwork", but a systematic engineering process that follows four stages: "assessment, objectives, organization, and evaluation". Each stage has specific tasks and standards.

The evaluation phase serves as the foundation of curriculum development, requiring comprehensive analysis of students' needs, resource conditions, and alignment with school positioning. Schools can conduct surveys and hold discussion sessions to understand students' interests, hobbies, and developmental needs. Meanwhile, they should assess whether existing resources can support curriculum development, providing clear evidence for curriculum design. The goal-setting phase needs to clarify the educational value and specific indicators of the curriculum. Curriculum goals should highly align with the school's distinctive characteristics, avoiding "features for the sake of features". The organization phase involves the specific design of curriculum content and implementation strategies. School-based courses can be categorized by learning methods: subject-based (e.g., "Fun Math Extension"), activity-based (e.g., "School Drama Club"), and research-based (e.g., "Local Water Resources Survey"). They can also be classified by function: foundational (for all students), developmental (for interest development), and advanced (for cultivating specialties). Standardized development processes ensure that school-based courses are both "distinctive" and "high-quality", preventing them from becoming fragmented "interest activities".

3.3. Implementation: Utilizing action research to drive dynamic curriculum optimization

Curriculum implementation is the "last mile" of transforming educational ideals into reality. Teachers need to adopt action research as their methodology, continuously reflect and adjust in their teaching practice, ensuring that the curriculum truly serves student development.

3.3.1. Action Research: The Core Path for Teachers as Curriculum Developers

Action research emphasizes "practitioners as researchers."

Teachers identify, analyze, and solve problems during curriculum implementation, achieving integration of "teaching, research, and improvement." This highly aligns with the practical nature of school-based curriculum development. [15]

The deep integration of practice orientation is the primary characteristic of action research. The purpose of school-based curriculum implementation is not to verify theories but to solve practical problems. Situational practice based on field orientation is the key to action research. The physical setting of curriculum implementation (classroom, campus, community) serves as a natural laboratory for research, where teachers must keenly capture educational opportunities within these contexts. Empowerment through power restructuring is the guarantee of action research. Schools need to grant teachers autonomy in adjusting curriculum content and innovating teaching methods. Action research transforms teachers from "curriculum implementers" to "curriculum creators," enabling school-based curricula to continuously improve in practice and truly meet student needs.

3.3.2. Diversified Strategies for Curriculum Implementation

The implementation of school-based curriculum needs to break through the limitations of traditional classrooms and adopt flexible and diverse teaching methods, allowing students to develop core competencies through experience, inquiry, and creation.

Project-based learning is an effective approach for research-oriented courses. Activity-based experience is the core of activity-based courses. Discipline integration is an innovative path for discipline-based courses. Integrate distinctive elements into national curriculum to achieve school-based implementation.

3.4. Evaluation: Multi-stakeholder Participation for Dynamic Feedback

Evaluation serves as the "navigation system" for continuous optimization of school-based curriculum. Through comprehensive assessment of curriculum development, implementation process and outcomes, it provides improvement basis for creating distinctive schools.

3.4.1. Building a Multi-faceted Evaluation System to Ensure Objectivity

School-based curriculum evaluation needs to break through the "single-manager evaluation" model by incorporating multiple stakeholders including teachers, students, parents and community members to evaluate curriculum value from different perspectives.

Student evaluation focuses on learning experience and growth changes. Through "course feedback forms" and "learning portfolios", opinions on course content and teaching methods, as well as gains in knowledge, abilities and emotions are collected. Teacher evaluation emphasizes curriculum development and implementation capabilities. Through "teacher curriculum development logs" and "teaching group peer review", teachers' curriculum design abilities and teaching innovation capabilities are assessed. Parents and community evaluation pay attention to the social value of courses. Parents evaluate the impact of courses on children's development by participating in "course open days"; while the community assesses whether courses promote community resource utilization and cultural heritage from the perspective of "school-community interaction".

3.4.2. Improving Evaluation Feedback Mechanism to Drive Curriculum Iteration

The ultimate purpose of evaluation is improvement rather than judgment. A closed-loop mechanism of "evaluation, feedback, adjustment" needs to be established to continuously improve school-based curriculum and school characteristics dynamically.

Periodic evaluations ensure that the curriculum direction remains on track. The school organizes a school-based curriculum review meeting every semester, where the curriculum review committee (including experts, teachers, and parent representatives) conducts a comprehensive evaluation of the curriculum, focusing on whether the curriculum aligns with its distinctive positioning and whether goals have been achieved. Continuous monitoring captures subtle issues in implementation. Through classroom observations and student interviews, real-time understanding of curriculum implementation is gained. School-based curriculum development and distinctive school creation is a process of continuous cycling and spiral improvement involving

"positioning, development, implementation, evaluation". Positioning provides direction for development, development provides a carrier for implementation, implementation accumulates materials for evaluation, and evaluation provides improvement basis for positioning and development. Only by organically integrating these four aspects can school-based curriculum truly become the "flesh and blood" of distinctive schools, and school characteristics become the "soul" guiding student growth, ultimately achieving an educational ecology of "one school, one specialty, each shining in its own way".

4. Conclusion

School-based curriculum development is a continuous professional activity of schools, and its development follows a cyclical improvement process of "needs diagnosis—goal positioning—organization and implementation—evaluation and improvement". Only through systematic and standardized management of school-based curriculum can we develop truly valuable courses and ensure the sustainable development of school characteristics.

Disclosure statement

The author declares no conflict of interest.

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Deep Fusion and Efficiency Enhancement of AI Intelligent Diagnostic System in Medical Image Processing

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Abstract

To explore the deep fusion mode of AI intelligent diagnostic system in medical image processing and its role in improving diagnostic efficiency. Method: A retrospective analysis was conducted on the data of 300 patients who underwent CT, MRI, or X-ray examinations in our hospital from January 2023 to January 2024. Among them, 150 patients were diagnosed using traditional medical image analysis methods (traditional group), and 150 patients were diagnosed using an analysis process integrated with an AI intelligent diagnostic system (AI group). Compare the diagnostic accuracy, diagnostic time, lesion detection rate, and missed diagnosis rate between two groups. Result: The diagnostic accuracy of the AI group was 94.67%, significantly higher than the traditional group's 86.67% ($P<0.05$); The average diagnosis time for the AI group was 12.3 minutes, which was significantly shorter than the traditional group's 21.5 minutes ($P<0.05$); The lesion detection rate in the AI group reached 92.37%, which was higher than the 83.59% in the traditional group ($P<0.05$); The missed diagnosis rate in the AI group was 3.34%, which was lower than the traditional group's 10.71% ($P<0.05$). Conclusion: The deep integration of AI intelligent diagnostic systems and medical image processing can significantly improve diagnostic efficiency, optimize clinical workflow, provide strong support for precision medicine, and have broad application prospects.

Keywords

AI intelligent diagnosis; Medical image processing; Deep integration; Efficiency improvement

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1. Introduction

Medical image processing has emerged as an indispensable component in contemporary medical diagnostics. Medical imaging modalities such as CT (Computed Tomography), MRI (Magnetic Resonance Imaging), and X-ray films enable the clear visualization of internal tissues, organs, and pathological changes, facilitating direct clinical assessment by physicians [1]. However, this field is confronted with two primary challenges: First, the advancement of medical equipment has led to an exponential growth in medical data, posing a significant challenge in extracting meaningful information from large datasets. Second, subtle lesions, early-stage pathologies, or those located in anatomically

complex regions (such as the skull base or spinal canal) often lack obvious morphological alterations, rendering them difficult to detect [2]. Therefore, the integration of computational algorithms for automated feature extraction holds the potential to substantially reduce the time and labor associated with manual analysis, while simultaneously mitigating uncertainties introduced by human subjectivity [3].

In recent years, artificial intelligence (AI), as an emerging discipline, has attracted increasing attention and achieved numerous advancements. It primarily focuses on the fundamental theories of biological nervous systems and intelligent behaviors, along with their engineering implementations, aiming to mimic human thought processes. Through mathematical descriptions of knowledge application programs and technologies, AI endows machines with the ability to perceive environments and accomplish predefined tasks [4]. The core philosophy of AI technology lies in emulating human brain thinking patterns: by studying the learning mechanisms of human brain neurons, it develops new artificial systems that can generate corresponding outputs based on input information, without requiring explicit instructions or rules written by programmers [5]. Currently, AI-based medical imaging technologies have been widely integrated into all aspects of medical image processing: including image segmentation and registration in the preprocessing stage, tumor volume measurement and lesion localization in the lesion detection stage, as well as diagnostic assistance in the final stage. Additionally, AI has been applied to disease classification diagnosis, drug design, surgical planning, rehabilitation training, and other domains. Numerous scholars are now dedicated to leveraging AI technologies to address the challenges inherent in traditional medical image diagnostics [6].

This study investigates the application paradigm of integrating AI intelligent diagnostic systems with medical images, aiming to validate their efficacy in enhancing diagnostic accuracy for medical imaging. By comparing traditional medical image analysis with AI-integrated approaches, this research conducts multi-faceted quantitative statistical analyses to evaluate whether the system can assist healthcare professionals in reducing diagnostic time, improving lesion detection rates, and minimizing misdiagnoses and missed diagnoses—all while maintaining diagnostic reliability. The findings seek to: (1) establish a theoretical foundation for the development of AI in medical imaging; (2) provide practical insights for healthcare professionals to optimize AI technology integration.

2. General Materials and Methods

2.1. Study Cohort

This retrospective cohort study enrolled 300 patients who underwent CT, MRI, or X-ray examinations in the Department of Radiology of our institution between January 2023 and January 2024. All participants met pre-specified inclusion and exclusion criteria, as follows: Inclusion criteria: (1) Aged 18–80 years, regardless of gender; (2) Clinically suspected or confirmed pulmonary diseases (e.g., pulmonary nodules), cerebral diseases (e.g., stroke), or hepatic diseases (e.g., liver cancer); (3) Complete CT/MRI/X-ray imaging data with diagnostic quality. Exclusion criteria: (1) Images with severe artifacts (motion or metallic artifacts); (2) Suboptimal image quality (CT slice thickness >5 mm or matrix <512×512); (3) Concomitant multi-system malignancies or end-stage diseases; (4) Incomplete clinical records. Participants were randomized into two groups using a random number table: Conventional group (n=150): Diagnoses were independently performed by two senior radiologists using standard methods.AI group (n=150): Diagnoses were assisted by an AI intelligent diagnostic system, with final confirmation by radiologists. Baseline characteristics were comparable between groups (P>0.05): Conventional group: Mean age 58.2±10.5 years; 82 males (54.7%) and 68 females (45.3%); disease distribution: 65 pulmonary (43.3%), 45 cerebral (30.0%), 40 hepatic (26.7%). AI group: Mean age 57.8±11.2 years; 85 males (56.7%) and 65 females (43.3%); disease distribution: 63 pulmonary (42.0%), 47 cerebral (31.3%), 40 hepatic (26.7%). This study was approved by the Institutional Ethics Committee and conducted in accordance with the ethical principles of the Declaration of Helsinki. All patients provided written informed consent for the use of their anonymized imaging data in scientific research.

2.2. Methods

2.2.1. Imaging Protocols

Imaging protocols were systematically established based on disease types and clinical diagnostic requirements:

CT examinations (60%) were performed using a Siemens SOMATOM Force dual-source CT scanner with core parameters: slice thickness 1 mm, tube voltage 120 kV, and reconstruction matrix 512×512. Clinical applications included:

Low-dose thin-slice scanning (radiation dose ≤1 mSv) for pulmonary nodule screening

Non-contrast CT combined with perfusion imaging (CBF/CBV parameter analysis) for acute stroke assessment

Triphasic contrast-enhanced scanning (arterial, portal venous, and delayed phases) for liver cancer diagnosis

MRI examinations (35%) were conducted on a GE Signa Premier 3.0T superconducting MRI system, including standardized sequences: T1-weighted imaging (T1WI), T2-weighted imaging (T2WI), diffusion-weighted imaging (DWI), and susceptibility-weighted imaging (SWI). Protocol parameters: slice thickness 3 mm, field of view (FOV) 240 mm. Specific applications: SWI sequence (phase-magnitude fusion reconstruction) for cerebral microbleed detection. DWI sequence (b-value=1000 s/mm²) for early cerebral infarction diagnosis. Dynamic contrast-enhanced scanning (gadolinium-based contrast agent 0.1 mmol/kg) for hepatic focal lesion characterization. X-ray examinations (5%) were performed using a Philips Digital Diagnost system with tube voltage controlled at 70–90 kV and automatic exposure control (AEC) to ensure image consistency. Indications included: Emergency skeletal trauma assessment (fracture line identification and joint dislocation detection). Chest disease screening (e.g., pneumonia consolidation detection).

2.2.2. Diagnostic Workflows

(1) Conventional Diagnostic Workflow

Radiologists independently completed the full diagnostic process: Systematically reviewing raw images (including multi-planar reformations) to manually identify suspicious lesions; Extracting features by quantitatively measuring lesion diameter (mean of three-dimensional dimensions), density (CT value/HU), or signal intensity (T1/T2 values), and recording qualitative characteristics such as boundary morphology (clear/indistinct) and internal structure (cystic change/calcification); Performing differential diagnosis by integrating clinical data (medical history, laboratory tests, etc.); Generating narrative diagnostic reports. This workflow relied entirely on radiologists' professional experience without any computer-aided tools.

(2) AI-Assisted Diagnostic Workflow

A standardized human-machine collaborative protocol was implemented: AI Preprocessing: The system performed DICOM raw image preprocessing, including: Non-local means denoising (noise reduction >40%). Adaptive histogram equalization (contrast enhancement). Motion artifact correction (based on registration algorithms). Deep Learning Model Analysis: A cascaded deep learning framework was employed: First, the nnU-Net 3D segmentation model achieved automatic lesion segmentation (outputting 3D volume and spatial coordinates). Then, the ResNet-50 classification model performed benign-malignant discrimination (outputting malignancy probability and confidence score). The models were trained on an independently annotated dataset of 1,000 images covering 10 common lesion types (e.g., lung adenocarcinoma, metastatic liver cancer, lacunar infarction), with an 8:2 training-testing split. Structured Report Generation: The system automatically generated a structured report draft containing: Lesion localization (lung lobe/brain region/liver segment), Maximum diameter (mm), Malignancy probability (0–100%), Imaging feature descriptions (e.g., "ground-glass nodule with lobulation sign"), Differential diagnosis list (sorted by probability), Physician Review & Revision: Senior radiologists reviewed AI-generated drafts: Manually adjusting lesion segmentation contours via DICOM Viewer interface; Modifying malignancy probability thresholds (default: >70% as high-risk); Adding/removing differential diagnoses; All revisions

required annotated justifications (e.g., "AI misidentified vascular cross-section as nodule"). Model Iterative Optimization: The system automatically collected physician revision data (≥50 cases monthly) to update model weights via incremental learning, prioritizing optimization for high-error categories (e.g., micro-nodules <5 mm).

2.3. Evaluation Metrics

(1) Diagnostic Accuracy: Using pathological biopsy results (82% of cases) or clinical follow-up data (imaging re-examination + laboratory tests) ≥6 months as the gold standard. Positivity criteria: malignant tumors confirmed by pathology; cerebral infarction confirmed by follow-up MRI lesion evolution.

(2) Diagnostic Turnaround Time: Total duration (in minutes) from PACS system receipt of complete imaging data to electronic report issuance, including physician review time, was accurately recorded.

(3) Lesion Detection Rate: Calculated as (number of true-positive lesions / total lesions confirmed by gold standard) × 100%. Micro-lesions were defined as: pulmonary nodules ≤5 mm, hepatic lesions ≤10 mm, cerebral microbleeds ≤3 mm.

(4) Missed Diagnosis Rate: Calculated as (number of missed lesions / total lesions) × 100%, where missed lesions were those unmentioned in initial reports but confirmed by the gold standard.

2.4. Statistical Methods

Statistical analyses were performed using SPSS 26.0. For measurement data (e.g., diagnostic turnaround time), normality was verified via the Shapiro-Wilk test, and results were presented as mean ± standard deviation (x±s). Independent samples t-tests were used for between-group mean comparisons (significance level α=0.05). Categorical data (e.g., accuracy rates, detection rates) were expressed as frequencies and percentages, with between-group differences analyzed by chi-square test; Fisher's exact test was applied when theoretical frequencies were <5. Statistical significance was set at P<0.05 (two-tailed test).

3. Results

3.1. Comparison of Diagnostic Accuracy Between Groups

The Alibaba group achieved an overall diagnostic accuracy of 94.67%, significantly higher than 86.67%

Table 1. Comparison of Diagnostic Accuracy Between Groups (n=150)

Group	Overall Accuracy(%)	Pulmonary Accuracy(%)	Cerebral Accuracy(%)	Hepatic Accuracy(%)
Hepatic Accuracy (%)	86.67	84.62	86.67	90.00
AI Group	94.67	93.65	95.74	95.00
χ^2	5.143	3.892	4.102	1.667
P	0.023*	0.048*	0.043*	0.197

*Denotes statistical significance (P < 0.05)

Table 2. Comparison of Diagnostic Time Efficiency Between Groups

Group	Overall Diagnostic Time(min)	Image Analysis Time(min)	Report Generation Time(min)
Conventional Group	21.50±3.25	15.80±2.70	5.70±1.10
AI Group	12.30±2.15	4.20±0.85	8.10±1.45
t	28.634	45.217	12.883
P	<0.001	<0.001	<0.001

in the conventional group. The most pronounced improvement was observed in pulmonary disease diagnosis, with notable enhancement in cerebral disease diagnosis (both P<0.05). No statistically significant difference was found in hepatic disease diagnosis between groups (P>0.05), as shown in **Table 1**.

3.2. Comparison of Diagnostic Time Efficiency Between Groups

The AI group demonstrated a 43% reduction in overall diagnostic turnaround time and a 73% decrease in image analysis duration, both significantly shorter than the conventional group (P<0.05). However, the report generation phase (physician review) showed a 42% increase in processing time (P<0.05), as detailed in **Table 2**.

3.3. Comparison of Lesion Detection Rates Between Groups

The AI group showed higher overall lesion detection rate, as well as detection rates for pulmonary nodules, liver cancer lesions and cerebral microbleeds than the conventional group (P < 0.05), as shown in **Table 3**.

3.4. Comparison of Missed Diagnosis and Misdiagnosis Rates Between Groups

The AI group exhibited significantly lower missed diagnosis and misdiagnosis rates than the conventional group (P<0.05), as shown in **Table 4**.

4. Discussion

Medical images serve as indispensable information carriers in clinical diagnostics, encapsulating rich medical data. However, traditional medical image processing methods struggle to meet practical demands when confronted with the sheer volume and complexity of pathological changes [7]. The advancement of artificial intelligence (AI) has ushered in new opportunities for medical image analysis, with AI-powered diagnostic systems poised to accelerate technological progress and expand into adjacent domains [8]. This underscores the significance of researching AI applications in medical imaging, building on existing literature that has demonstrated the efficacy of AI-computer vision frameworks in diagnosing cranial and pulmonary disorders [9-10].

Our findings show that the AI group achieved significantly higher diagnostic accuracy than the conventional group, with the most pronounced improvements in pulmonary and cerebral disease diagnostics (P<0.05), alongside lower missed/misdiagnosis rates. This confirms that AI systems can effectively enhance diagnostic accuracy for common diseases. Leveraging deep neural networks, AI systems trained on massive medical image datasets excel at extracting subtle lesion features—for instance, automatically localizing pulmonary nodules and evaluating morphological, contour, density, and contextual

Table 3. Comparison of Lesion Detection Rates between Two Groups (%)

Index	Conventional Group(n=128*)	AIGroup(n=131*)	χ^2	*P*
Overall detection rate	83.59	92.37	5.291	0.021
Detection rate of micro-lesions				
Pulmonary nodules (≤5mm)	68.75	89.47	7.102	0.008
Liver cancer lesions (≤10mm)	71.43	90.91	4.026	0.045
Cerebral microbleeds (≤3mm)	65.22	86.96	5.014	0.025

Table 4. Comparison of Missed Diagnosis and Misdiagnosis Rates Between Groups

Group	Conventional Group(%)	AI Group(%)	χ^2	*P*
Missed Diagnosis Rate	10.71	3.34	6.127	0.013
Misdiagnosis Rate	8.33	2.00	5.556	0.018

attributes to assist in benign-malignant differentiation, thereby improving lung cancer detection [11].

The AI group reduced overall diagnostic turnaround time by 43% and image analysis duration by 73%, demonstrating substantial workflow acceleration. Clinically, traditional image interpretation demands intensive human resources for lesion identification [12], whereas AI's computational power enables rapid image processing, allowing radiologists to focus on treatment planning and critical decision-making. This is particularly critical for emergency care—e.g., acute ischemic stroke, where timely thrombolysis/endovascular therapy can mitigate disability [13]. Shorter diagnostic cycles also optimize resource allocation, streamline patient flows, and enhance healthcare service quality.

Notwithstanding these advantages, real-world adoption faces hurdles: Technical limitations: AI accuracy is compromised by poor image quality and rare diseases due to insufficient training data. Human-AI dynamics: Over-reliance on AI may erode clinical acumen, necessitating a balance between trusting AI suggestions and applying professional judgment. Continuous medical education on AI principles is essential. Model optimization: Develop multi-center training algorithms to improve performance on low-quality images and rare pathologies. Clinical translation: Formulate strategies for AI deployment across healthcare settings, establish tele-diagnosis platforms, and foster interdisciplinary collaboration to uplift grassroots diagnostic capabilities. Regulatory framework: Implement robust monitoring systems to ensure AI safety and efficacy.

AI-powered diagnostic systems exhibit substantial clinical value and promising prospects in medical imaging. Through algorithmic refinement, cross-disciplinary collaboration, and balanced human-AI integration, these technologies will likely revolutionize diagnostic efficiency and drive innovation in medical radiology.

Disclosure statement

The author declares no conflict of interest.

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Exploring the Teaching Reform of Women's Social Work Course with Competency Orientation

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Abstract

In order to solve the problem of the disconnection between theory and practice in social work education, and to cultivate professionals who can effectively respond to the complex needs of the women's field, this study systematically reconstructs the Women's Social Work course. The study firstly deconstructed the course objectives into a three-dimensional competency objective of "knowledge, ability and literacy"; secondly, it designed a modularized course framework of "basic knowledge, thematic practice and comprehensive application"; thirdly, it adopted case teaching, scenario simulation and project-oriented combination of diversified and diversified courses and programs; and thirdly, it adopted a comprehensive and diversified program of "social work", which includes case teaching, scenario simulation and project-oriented program. Secondly, the modularized course framework of "basic knowledge, thematic practice and comprehensive application" is designed; thirdly, the diversified and experiential classroom teaching design combining case teaching, simulation and project orientation is adopted; finally, the comprehensive course evaluation system emphasizing on both process and result, and multiple participation of the main body is established. Although this reform provides an effective path for cultivating high-quality women's social work talents, its successful implementation still faces higher challenges in terms of teachers' comprehensive ability, students' learning habits and teaching resources, and needs to be deepened and improved in future practice.

Keywords

competency-oriented; women's social work; curriculum reform

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1. Reconstruction of Curriculum Objectives

Currently, social work education in China is in a critical period of transition from "knowledge-based" to "competency-based". The competency-oriented teaching mode emphasizes the starting point of students' ability to meet the actual needs of professional positions after graduation, and the reverse design of course objectives and teaching content [1]. This transformation is particularly urgent for Women's Social Work, a highly practical

course. With the complexity of issues and the diversity of needs in the women's field, the traditional mode of knowledge inculcation can no longer meet the need to cultivate professionals who can effectively respond to the plight of women. Therefore, the first task of teaching reform is to reconstruct the learning objectives of the courses. The cultivation of social work talents in the new era should build a comprehensive competency framework that includes multiple dimensions of knowledge, ability and value [2]. Based on this, this study integrates the curriculum standards and lesson plans of Women's Social Work in depth, and deconstructs the learning objectives of the course into three interrelated and progressive dimensions: knowledge objectives, competence objectives, and literacy objectives, so as to cultivate students' core competencies required for professional services in the field of women.

1.1. Knowledge Objectives

The knowledge objective is to lay a solid foundation of professional knowledge for students, emphasizing the construction of a systematic and integrated knowledge system. Students need to master the fundamental theories, basic knowledge and basic skills of the women's social work profession. This specifically includes: theoretical foundations, such as the Marxist view of women, the theory of pluralistic feminism and gender mainstreaming, which are the fundamental tools for analyzing women's issues; methodological knowledge, such as the principles and modes of women's casework, group work and community work, as well as the application of practical theories, such as the empowerment and the perspective of strengths; and domain knowledge, such as the real-life dilemmas and the related policies and regulations of the contemporary women's situation in the areas of anti-domestic violence, re-employment, mobility and remaining behind, and so on. related policies and regulations. One of the major challenges in the current social work teaching is how to effectively promote the integration of theory and practice [3]. Therefore, the knowledge objectives of this course emphasize the "usefulness" of theories, and require students to think about the significance of theories in guiding practice, so as to internalize the knowledge into a "cognitive map" for analyzing problems and guiding actions.

1.2. Competency Objectives

The competency objectives are the core of competency-oriented teaching, directly responding to the key question of "what can students do". It includes the ability to skillfully apply women's social work practice skills and tools, and work creatively to effectively solve the social problems faced by women. In order to achieve this goal, through practical sessions such as situational drama simulation and project design, we focus on cultivating a series of specific competencies for students: first, assessment and analytical skills, the ability to assess the diversified needs and strengths of women's groups from a gender perspective; second, intervention and service skills, the ability to skillfully use the three major work methods to provide professional services such as emotional relief and resource linkage; third, project planning and management skills, through the "Women's Social Work Service Project" and the "Women's Social Work Service Project", the ability to provide professional services to women. Thirdly, project planning and management ability, through the complete writing of "women's social work service project plan", students will be trained in the comprehensive ability from needs assessment to budgeting. The cultivation of practical ability is highly dependent on experiential and inquiry-based teaching methods [4]. This course creates "quasi-authentic" service situations and guides students to transform their knowledge into the power of action to solve practical problems.

1.3. Literacy Objectives

The literacy goal is to guide students to internalize the core values of social work and put them into practice, requiring them to establish solid professional values of women's social work, identify with the women's social work profession and abide by the ethical norms of the profession. The achievement of this goal goes beyond the simple memorization of ethical terms, but is a clarification of values that permeates the whole teaching process. Specifically, it includes: establishing the value of gender equality as the basic premise of all work; cultivating the sensitivity of professional ethics, guiding students to identify and explore the ethical dilemmas of confidentiality and self-determination in case teaching; establishing the sense of identity of professional roles,

stimulating students' enthusiasm for the protection of women's rights and interests; fostering the sense of humanistic care and social responsibility, cultivating the students' empathy for women's plight and the sense of mission to promote social justice. Cultivate a sense of humanistic care and social responsibility, cultivate students' empathy for women's plight and a sense of mission to promote social justice. The internalization of professional values is the cornerstone of social work education[5], which determines the direction of service and ultimate social effectiveness of professionals.

2. Curriculum framework development

Traditional curriculum design tends to follow a linear logic of knowledge transfer, and although the content between chapters is coherent, the cultivation goals of knowledge, competence and literacy are often fragmented. In order to effectively reach the reconstructed competency-oriented three-dimensional learning objectives, the curriculum framework of Women's Social Work must be systematically reorganized. Competency-oriented curriculum design emphasizes modularity and progressivity, and through the construction of teaching modules with clear logic and objectives, students are guided to complete the complete learning closed loop from theoretical cognition to practical application and then to value internalization step by step [1]. This study reconstructs the curriculum framework into three organically connected modules: "basic cognition and method module", "thematic practice and skill deepening module", and "comprehensive practice and innovative application module". ". This design breaks the linear constraints of the original chapters and integrates related content to form learning units focusing on specific competency development. The modularized curriculum system can enhance the flexibility and purposefulness of teaching and better serve the cultivation of students' core literacy[6]. The design of this curriculum framework is based on this concept, and seeks to make the cultivation of knowledge, ability and literacy consistent and progressive through the modularized structure.

2.1. Foundation Cognitive and Methodological Module

This module is the cornerstone of the whole program, and its main goal is to build a professional cognitive framework for students in women's social work, so that they can master the basic theories and general methods necessary for engaging in women's services. The module integrates the contents of Chapters 1 to 5 of the curriculum, focusing on the achievement of the "knowledge objectives" and laying the foundation for the realization of the "competency objectives" and "literacy objectives". Specifically, this module starts with "An Overview of Women's Social Work" to help students establish a basic understanding of the field and professional identity. Subsequently, the theoretical foundation of women's social work (including Marxist women's view, feminist theory, etc.) and the theory of women's social work practice (such as empowerment theory, participatory development theory, etc.) are systematically taught to cultivate students' theoretical thinking in analyzing problems from a gender perspective. Theoretical thinking of analyzing problems is cultivated through the "Women's Social Work Theory". Finally, through the study of "Women's Social Work Methods" and "Analysis of Women's Issues in China", students can master the general skills of the three major methods of casework, group work and community work, and understand the complexity of women's issues in the context of Chinese local situations. The whole module emphasizes the systematic nature of theories and the universality of methods, so that students can form a solid theoretical and methodological foundation.

2.2. Thematic Practice and Skills Deepening Module

After mastering basic theories and methods, this module guides students to apply general knowledge to specific women's service areas, realizing the initial transformation from "knowledge" to "ability". The module focuses on the assessment, analysis and intervention service abilities in the Competency Objectives, and integrates the practical contents of various topics in Chapters 7, 8, 10, 11 and 12 of the curriculum. This module focuses on "Anti-poverty and Rural Women", "Re-employment and Urban Women", "Migrant Women and Working Girls",

"Anti-Domestic Violence", "Reproductive Health" and "Reproductive Health". The course is organized around key issues facing women in contemporary China, such as "anti-poverty and rural women", "re-employment and urban women", "migrant women and working girls", "anti-domestic violence", and "reproductive health". Each topic constitutes an independent learning unit, and the teaching mode of "theory explanation + case analysis + intervention strategy discussion" is adopted. For example, in the topic of "Anti-Domestic Violence", students are not only required to learn the theoretical explanation of domestic violence, but also to learn and practice the specific service process of receiving a case, making an assessment, and formulating an intervention plan through real-life case studies. This problem-based learning approach has been proven to be effective in enhancing students' intellectual reasoning and practical decision-making skills [7] . Through the learning of this module, students are able to contextualize and apply the theories and methods of the first module, deepen their understanding of the needs of different groups of women, and initially master the core skills of carrying out services in specific areas.

2.3. Integrated Practice and Innovative Application Module

This module is the sublimation and integration stage of the curriculum, promoting students to move from the mastery of a single skill to the comprehensive application of multiple knowledge and abilities, focusing on the cultivation of project planning, management and communication and advocacy abilities in the "Competency Objectives", and ultimately ending in the deepening and internalization of the "Literacy Objectives". Deepening and internalization. The module integrates the highly participatory and practical teaching contents of chapters 6, 9 and 14 of the curriculum. The core of the module is 'action-oriented' and 'outcome-oriented'. It consists of three major practical teaching activities: first, the "Women's Issues Debate", which hones students' critical thinking, logical thinking and public advocacy skills; second, the "Women's Social Work Scenario Drama", which requires students to work in small groups to simulate real-life service scenarios, utilizing a combination of communication, assessment, intervention and other skills. The second is "Women's Social Work Scenario", in which students are required to work in groups to simulate real service scenarios and develop their empathy and ethical decision-making skills through the comprehensive use of communication, assessment and intervention skills; and the third is "Women's Social Work Service Project Plan", which is the final comprehensive assessment task of this course. Students are required to work in teams to complete a complete project proposal from needs assessment, goal setting to activity design and budgeting, and present it publicly. Project-based learning can effectively stimulate students' learning autonomy and innovative spirit, and is an important path to cultivate composite talents[8]. Through the comprehensive training of this module, students not only integrate and export the knowledge and skills they have learned, but also deepen their understanding of the professional values and ethics of social work in the process of teamwork, project management and value reflection, and ultimately achieve the comprehensive competency goals of the course.

3. Classroom Teaching Design

In order to realize the competency-oriented learning objectives and effectively implement the aforementioned modular curriculum framework, the classroom design of Women's Social Work must fundamentally transcend the traditional teacher-centered "full-loading" mode. The development of competence, especially the internalization of practice ability and professionalism, cannot be accomplished through the teaching of a single piece of knowledge, but must rely on a teaching environment that stimulates students' subjectivity and promotes in-depth participation and reflection. Therefore, the teaching reform of this course advocates the use of diversified, interactive and experiential teaching methods to build a "student-centered" deep learning field. The new era of teaching reform emphasizes the deep integration of information technology and teaching, and the introduction of inquiry-based and participatory pedagogies to guide students to change from passive knowledge receivers to active knowledge constructors. . In this study, we designed an integrated classroom teaching model based on "case teaching method", "scenario simulation

method" and "project-oriented method", supplemented by classroom discussion, multimedia technology and other means. Classroom teaching mode. This design integrates knowledge transfer, ability training and value shaping into each teaching link, ensures that students learn by doing, think by learning and understand by thinking, and finally realizes the seamless connection between theory and practice.

3.1. Case Teaching Method

Case teaching method is the key bridge between theory and practice in social work education. By presenting real and complex practice situations, it guides students to analyze, judge and make decisions by applying the theories they have learned, so as to cultivate their clinical reasoning and problem solving abilities. In the thematic practice and skill deepening modules of the program, the case teaching method is widely used. In the teaching process of "Anti-Domestic Violence", "Re-employment and Urban Women's Services", "Migrant Women and Working Women's Services" and other topics, the teacher is no longer a mere theoretical lecturer, but a case discussion guide and organizer. Instead, they are the guides and organizers of case discussions. The specific implementation steps are as follows: First, a typical case is released before class, and students are asked to prepare and make preliminary analyses in the light of the theoretical knowledge of the topic (e.g., the theory of power control in domestic violence, gender analysis of women's impoverishment, etc.). Secondly, group discussions will be held in class, and each group needs to deeply analyze the core problems, advantageous resources, and macro, meso, and micro system environments in which the service recipients in the case are located, and put forward preliminary ideas for intervention. Finally, group reporting and class debate will take place, with the teacher playing the role of "scaffolding" in the process, guiding students to deepen their understanding of the theory and explore the ethical implications and feasibility of different intervention strategies through follow-up questions, comments and summaries. Teaching based on localized cases can significantly enhance students' situational awareness and cultural sensitivity[9], therefore, the cases selected for this course are all derived from local women's social work practice in China. For example, "The Role of Microfinance in Capacity Building of Rural Poor Women" and "Work Plan of Laid-off Women Workers' Group" are mentioned in the course plan, which ensures that the teaching content is closely related to the social reality in China. In this way, students not only practiced their professional skills of assessment and analysis, but also internalized professional values such as empowerment and empowerment in the process of thinking and discerning.

3.2. Scenario simulation method

If the case teaching focuses on "analysis", the scenario simulation method focuses on "action". It provides students with a safe and controlled "quasi-practical" environment through role-playing and simulation exercises, so that they can experience the role of social workers and practice and polish their professional service skills. In the Comprehensive Practice and Creative Application Module, the scenario simulation method is used as a core tool to cultivate students' comprehensive abilities and professionalism. The course consists of two major scenario simulation activities: one is the "Women's Issues Debate". This activity requires students to debate controversial topics such as "whether women in the workplace should prioritize their families" and "whether surrogacy is a manifestation of women's human rights". This not only exercises students' oral expression, logical thinking and quick reaction skills, but more importantly, it forces students to stand on different positions and think deeply about the complex value conflicts and ethical dilemmas behind women's issues, so as to cultivate their critical thinking and initial policy advocacy skills. The second is "Women's Social Work Drama". This is a comprehensive exercise for students' intervention service ability. Students are required to work in small groups to write, direct and act out a complete women's social work service episode, such as "the first time a victim of domestic violence seeks help" and "a community integration group for migrant women", and so on. From receiving a case, establishing a relationship, assessing and intervening in the case, to closing the case, students need to comprehensively utilize the communication skills, empathy, and knowledge of the three major approaches they have learned in the first two modules. At the end of the exercise, students are helped

to conduct in-depth professional reflection through peer assessment and teacher critique. According to experiential learning theory, effective learning occurs in the cycle of "concrete experience - reflective observation - abstract conceptualization - active practice" [10]. Scenario simulation is the best practice of this theory, which allows students to transform abstract knowledge and skills into concrete action abilities in a highly participatory experience, and to deepen their identification of professional roles and ethics in reflection.

3.3. Project-Oriented Approach

The project-oriented method is a comprehensive teaching strategy to realize the ultimate competency goal of this course. It requires students to work in teams to complete a complete service project design around an authentic women's social issue, which is the ultimate integration and presentation of the three-dimensional goals of knowledge, competence and literacy. The core teaching task of "Women's Social Work Service Project Plan" is set in the final stage of the Integrated Practice and Creative Application Module of this course. The task runs through the second half of the module and requires students to go through a complete project development cycle: the first stage is problem identification and needs assessment, in which the student team needs to choose an interested group of women (e.g., single mothers, full-time mothers, elderly women, etc.), and identify their real needs by means of literature review and group interviews, etc. The second stage is project design and program writing. The second stage is project design and program writing. The team needs to define the project objectives, design the specific service content and activity flow, and set reasonable budget and evaluation indicators. The third stage is results presentation and peer review, in which teams need to give a project roadshow to the whole class and teachers, and answer questions and accept queries. Project-based learning can not only cultivate students' project management skills such as teamwork, time management, and resource integration, but more importantly, it can stimulate students' innovative and entrepreneurial spirit [11]. During the design process, students are encouraged to think outside the box and creatively apply what they have learned to respond to complex social issues. For example, some groups may design a group project that utilizes social media to provide peer support for full-time mothers, while others may plan a community economy project that provides handicraft skills training for rural left-behind women and connects them to an e-commerce platform. This process perfectly fits the requirement of "possessing innovative and entrepreneurial awareness and ability" in the curriculum standard. Through the implementation of the project-oriented approach, students are no longer consumers of knowledge, but become producers and applicators of knowledge, and their comprehensive competence is comprehensively practiced and improved in the challenge of solving real problems.

4. Reform of course evaluation

Course evaluation is a key baton to test the achievement of teaching objectives, feedback teaching effect and guide students' learning direction. Traditional course evaluation is often based on the final examination paper, focusing on students' memorization and theoretical knowledge, while it is difficult to effectively measure the core competencies such as practical ability, value ethics and reflective spirit, which are crucial to the social work profession[1]. This evaluation method runs counter to the competency-oriented teaching goal, and easily leads to students focusing their learning on test-taking and neglecting the cultivation of real competencies. Therefore, to deepen the teaching reform of Women's Social Work, it is necessary to construct a diversified evaluation system that can comprehensively, dynamically, and authentically reflect the development level of students' competence. Modern educational evaluation theory emphasizes that the purpose of evaluation lies not only in screening and selection, but also in diagnosis and promotion. Formative evaluation is increasingly becoming the core direction of higher education evaluation reform due to its unique function of providing continuous feedback in the learning process and promoting students' self-monitoring and active development[12]. Based on this, this study reforms the course evaluation method into "process-oriented" and "result-oriented", "knowledge examination", "ability test" and "literacy test". The study reforms the course evaluation method into a comprehensive evaluation model that emphasizes both "process-oriented" and "result-

oriented", and "knowledge examination", "competence test" and "literacy assessment" in a three-dimensional way. Through diversified evaluation tools and the participation of multiple subjects, the model provides an all-round dynamic assessment of students' knowledge mastery, ability enhancement and literacy internalization in the whole learning process.

4.1. From "evaluation of learning" to "evaluation for learning"

The core concept of this curriculum assessment reform is to shift from the traditional "assessment of learning" to "assessment for learning". The former is a kind of summative judgment, focusing on "how much students have learned"; while the latter is a kind of developmental diagnosis, paying more attention to "how to help students learn better". This means that evaluation is no longer just a "conclusion" at the end of the semester, but a diagnostic, feedback and guidance tool throughout the entire teaching process. In the course of Women's Social Work, every class discussion, every case analysis, every role play is both a teaching activity and an evaluation activity. Teachers keep abreast of students' level of understanding of knowledge, application of skills and confusion of values through observation, questioning and critique, and provide targeted feedback. At the same time, students also continue to calibrate their learning direction through self-reflection and peer assessment in the process. Incorporating assessment activities into daily teaching can significantly enhance students' motivation and metacognitive abilities and facilitate the occurrence of their deep learning[13]. Therefore, the evaluation system of this course will focus on the process evaluation, play the diagnostic and developmental functions of evaluation, and truly serve the cultivation of students' competence.

4.2. Organic combination of process evaluation and summative evaluation

According to the requirements of the course standard of Women's Social Work, the total grade of this course is composed of two parts: process evaluation (40%) and summative evaluation (60%). This weight distribution not only affirms the importance of the learning process, but also ensures an effective test of the final learning outcomes, realizing a balance between formative and summative evaluation.

4.2.1. Process Evaluation (40%)

Process evaluation dynamically tracks and evaluates the comprehensive performance of students in the learning process of "Basic Cognition and Methodology Module" and "Specialized Practice and Skill Deepening Module ", which mainly consists of the following three parts:

Class participation and interaction (10%). This part not only examines students' attendance, but more importantly assesses the depth of their participation and the quality of their contributions in classroom discussions, case studies, group debates, etc. The evaluation criteria include: whether they can apply their knowledge and skills in classroom discussions, case studies and group debates. Evaluation criteria include: whether they can apply the theories they have learned (e.g., feminism, empowerment theory) to analyze the case logically; whether they can put forward critical and constructive views; whether they can respect and effectively respond to the opinions of others, and so on. This corresponds directly to the application of theories in the Knowledge Objectives and the communication and analytical skills in the Competency Objectives.

Thematic tasks and assignments (10%). Students are required to complete a series of mini-assignments on various topics in the Thematic Practice and Skills Deepening Module (e.g. anti-domestic violence, migrant women, etc.), such as writing a case study report, interviewing a professional woman and submitting reflective notes, etc. These assignments test the application of theoretical knowledge. These tasks test the students' ability to apply theoretical knowledge to specific practical areas.

Mid-term practical assessment (20%). This is the core part of the process evaluation, which directly corresponds to the "Women's Social Work Drama" teaching activity in the course. Students will work in small groups to write, direct and act out an episode of women's social work service. The evaluation will be based on "teacher's marking + group mutual evaluation", focusing on: first, role performance, whether they can accurately and empathetically play the role of a social worker and show their understanding of the client's situation; second, skill utilization, whether they can appropriately use

professional skills such as communication, relationship building and assessment; third, ethical reflection, whether the script design and performance reflect the importance of confidentiality, safety and security; and third, whether the students' performance can reflect the importance of confidentiality and privacy and the importance of the social worker's role. The third is ethical reflection, whether the script design and performance reflect the observance of professional ethics such as confidentiality, self-determination and non-discrimination. This assessment method can visually and vividly test students' comprehensive practical ability and professionalism in the simulation situation.

4.2.2. Summative Assessment (60%)

The summative assessment focuses on the "Comprehensive Practice and Innovative Application Module", which is a comprehensive test of students' learning achievements throughout the semester in the form of writing and presenting the "Women's Social Work Service Project Plan". This completely abandons the traditional closed-book written examination and shifts to an in-depth examination of students' comprehensive application and innovation ability. Currently, the concept of outcome-oriented education emphasizes evaluating students' learning effectiveness by the complex tasks they can ultimately complete[14]. The project proposal is just such a complex and authentic professional task. The evaluation will be conducted in the following dimensions:

Project plan text (40%). Focus on assessing the scientific, logical and innovative nature of the plan. Including: whether the needs assessment is solid and the problem analysis applies a gender perspective; whether the project objectives are clear and measurable; whether the service design reflects professional concepts such as empowerment and participation, and is feasible and innovative; whether the budgeting is reasonable; and whether the evaluation plan is scientific. This comprehensively examines the students' knowledge integration, project planning and written expression skills.

Project Presentation and Defense (20%). Student teams are required to give a public project roadshow and answer questions from the instructor and classmates. This part focuses on assessing the students' oral expression ability, teamwork ability, on-the-spot adaptability and overall grasp of the project.

4.3. Multiple Participation of Teachers, Peers and Self

In order to make the evaluation more comprehensive, objective and fair, the reform of this course introduces multiple evaluation subjects, breaking the traditional model of the teacher as the only evaluator.

Teacher evaluation. Teachers play a dominant and leading role in the whole evaluation system, responsible for formulating evaluation standards, organizing evaluation activities, and making professional and authoritative assessments of students' various performances (especially the midterm sitcom and final project).

Peer Evaluation. Peer evaluation of students is introduced in the sessions of sitcom performances and project presentations. Students are required to score and critique the performance of other groups according to the evaluation criteria. Peer evaluation not only reduces the teacher's evaluation burden, but more importantly, it prompts students to look at the professional standards from the perspective of "evaluators", thus deepening their understanding of the meaning of competence and improving their own reflective ability. .

Self-evaluation. Encourage students to write a reflective journal after completing each important task to evaluate their learning process, gains and deficiencies against the learning objectives and evaluation criteria, which helps to cultivate their self-monitoring ability and lifelong learning habits.

By constructing such a comprehensive evaluation system that emphasizes both process and result, ability and literacy, and multi-participation of the main body, the assessment method of this course can form a high degree of internal unity with the competency-oriented teaching objectives, curriculum framework and classroom design, thus ensuring that the teaching reform can really take root and effectively promote the comprehensive development of students' professional competency. This ensures that the teaching reform can really take root and effectively promote the comprehensive development of students' professional competence.

5. Summary and Reflection

This study has conducted a systematic teaching reform inquiry on the course of Women's Social Work with competency orientation. By reconstructing the three-dimensional learning objectives of "knowledge-competence-literacy", designing the modularized curriculum framework of "basic cognition-thematic practice-comprehensive application", and adopting the classroom teaching method of "cases-scenarios-projects", we have developed a comprehensive and comprehensive development of professional competence in women's social work. With the design of modularized curriculum framework of "basic knowledge, thematic practice and comprehensive application", the adoption of classroom teaching method of "case-scenario-project" and the establishment of a comprehensive evaluation system of "process-result", this study aims to explore a curriculum reform path that can effectively respond to the needs of cultivating social work talents in the new era. The core contribution of this reform is that it provides a complete example of transforming the macro concept of competency training into concrete and operable program design and implementation, trying to solve the long-standing problem of the disconnection between theory and practice in social work education, and ultimately cultivate professionals who are truly competent in meeting the challenges of complex practice in the field of women.

However, while affirming the direction of the reform, we must also be soberly aware that the process of transformation from blueprint to reality is full of challenges and deserves our in-depth reflection.First of all, it puts higher demands on the comprehensive ability of teachers. The competency-based teaching model requires teachers to change their role from a single "knowledge transmitter" to a complex "learning designer, guide and facilitator"[15]. Teachers not only need to have solid theoretical background, but also need to have rich practical experience, skillful classroom organization and the ability to develop localized teaching cases. This is a huge test of teachers' knowledge, teaching skills, and even time and energy investment, and how to establish an effective teacher development and support system is the key to the sustainability of such reforms. Secondly, it poses a new challenge to students' learning habits. In the experiential, inquiry-based learning environment, the student's subjectivity is unprecedentedly emphasized. Students who are used to passively receiving knowledge may feel uncomfortable or even confused when facing tasks such as group debates and project design that require a high degree of autonomy, collaboration and critical thinking. How to effectively guide students to change their learning concepts and cultivate their ability of independent learning and teamwork is a difficulty that needs to be continuously paid attention to and solved in the teaching process.Again, the dependence on teaching resources has increased significantly. High-quality case teaching, scenario simulation and project practice cannot be separated from the support of rich teaching resources. This includes not only the localized case base that keeps pace with the times and the flexible and changeable teaching space, but also, more importantly, the close connection with the practice community. At present, there is a general problem of "industry-academia-research" not being closely integrated in social work education. How to establish a regular internal and external cooperation mechanism, invite front-line practice experts into the classroom or lead students into social work service organizations, and integrate real practice wisdom into teaching is an important guarantee to enhance the effectiveness of the curriculum.Finally, the refined management of the evaluation system puts forward higher requirements. Although the diversified process evaluation can reflect students' ability development more comprehensively, its implementation process is far more complicated than standardized tests. How to ensure the objectivity and fairness of peer evaluation, and how to scientifically design and apply evaluation criteria to assess unstructured outcomes such as scenarios and project reports require teachers to invest a lot of energy in fine-tuning the design and management to ensure the credibility and validity of the evaluation[16].

In summary, the competency-oriented reform of the Women's Social Work curriculum is a systematic project, which is not only a revolution of teaching content and methods, but also a deep change of educational concepts, teachers' and students' roles and evaluation culture. In the future, while deepening the concept of "student-centeredness", we should make efforts to strengthen the construction of faculty, explore the in-depth integration

with practice, and optimize the teaching and evaluation process by means of educational technology, so as to continuously improve this teaching mode and send more professionals with a high sense of social responsibility and excellent professional competence to the society. The teaching model will be continuously improved, so as to deliver more women social work professionals with a high sense of social responsibility and excellent professional competence.

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The Effect of Peer Feedback on EFL University Students' Writing Performance and Revision Strategies

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Abstract

This study investigates how peer feedback affects EFL university students' writing and revision practices. This study included 58 second-year non-English majors from two full writing classes at Jiaxing Nanhu University. Students used structured feedback forms to provide peer evaluation on content, organization, and language accuracy over eight weeks. Students' amended drafts, pre- and post-test writing assignments, and a post-treatment peer feedback questionnaire provided data. Performance differences were examined using paired-sample t-tests and an analytic rating scale for pre- and post-test compositions. Frequency and chi-square analyses were used to identify revision pattern shifts in content, organization, and language-related revision categories. Student writing improved most in organization and language accuracy after peer input. Students made more higher-order content creation adjustments after peer review sessions. The study proved that most students found peer input helpful for identifying writing issues, but some worried about its accuracy. The study suggests using organized peer feedback in EFL writing classes to improve performance and strategic revision.

Keywords

peer feedback; EFL writing; revision strategies; writing performance; university students

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1. Introduction

1.1. Background of the Study

Writing in a foreign language is widely recognized as one of the most challenging skills for EFL learners, requiring the integration of linguistic knowledge, organizational skills, and critical thinking. Peer feedback—defined as the process in which learners provide evaluative and constructive comments on each other's work—has gained increasing attention as an instructional strategy in process-oriented writing pedagogy [1].

In the Chinese EFL context, writing instruction is frequently characterized by instructor feedback, which, although beneficial, may be constrained by time limitations and class size. Peer feedback is a different way that encourages active learning, encourages studying together, and may even help students improve writing performance.

1.2. Problem Statement

Even though it could be useful for teaching, there has not been much research on how peer feedback affects writing performance and revision strategies in Chinese EFL settings. Specifically, there is less understanding regarding whether peer review facilitates a transition from superficial corrections to more substantive revisions, as well as how students assess its utility and precision.

1.3. Research Questions

This study addresses three main research questions: Does peer feedback significantly improve students' writing scores across content, organization, and language accuracy? How does peer feedback influence the distribution of revision types, including content, organization, and language? What are students' attitudes toward the peer feedback process?

1.4. Significance of the Study

This study helps the literature by showing empirical evidence of peer feedback's effectiveness in the Chinese EFL context. Pedagogically, it offers practical recommendations for integrating peer review into writing curricula to improve both performance and revision strategies.

2. Literature Review

2.1. Peer Feedback in EFL Writing

According to social constructivist theory [2], peer feedback promotes social learning. Prior research has found that peer review can improve the quality of the writing quality, increase learners' awareness of audience, and promote self-regulated learning in teaching English language [3]. However, concerns remain regarding the accuracy and usefulness of feedback, especially in foreign language contexts.

2.2. Revision Strategies

Taxonomy categorizes revisions into surface changes (grammar, vocabulary) and meaning changes, which include content and organizational adjustments. The cognitive process theory of writing strongly supports the idea that high-quality writing is linked to extensive meaning-level revisions[4].

2.3. Research Gap

Most studies in the Chinese EFL context have focused on either writing performance or peer perceptions, but few have simultaneously examined changes in revision strategies. The present study addresses this gap by combining quantitative analysis of performance gains with coding of revision behaviors.

3. Methodology

3.1. Research Design

A quasi-experimental pre-test/post-test design was adopted. Data were collected from writing tasks, revision drafts, and a questionnaire.

3.2. Participants

The participants were 58 second-year non-English majors from two intact writing classes at Jiaxing Nanhu University. Both classes were taught by the same instructor to control for teaching style differences.

3.3. Instruments

The study employed multiple instruments for data collection. Writing tasks consisted of two argumentative essays, administered as a pre-test and a post-test. A structured peer feedback form was used to guide students in providing comments on content, organization, and language accuracy. Essay scoring was conducted using an analytic rating scale adapted from [5]. Revisions were analyzed according to a coding scheme based on. In addition, a questionnaire combining Likert-scale items and open-ended questions was administered to gather students' perceptions of the peer feedback process.

3.4. Procedure

A structured eight-week study was conducted. Two raters independently rated a Week 1 pre-test writing exercise. Every two weeks from Weeks 2 to 7, peers used the structured feedback form to provide content, organization, and language input. Week 8 saw students complete the post-test writing and questionnaire. All revision drafts from the intervention were tagged for change type and frequency.

3.5. Data Analysis

Data analysis involved conducting paired-sample t-tests

to examine differences in writing scores between the pre-test and post-test, chi-square tests to analyze changes in the distribution of revision types, and descriptive statistics to summarize questionnaire responses on students' perceptions of peer feedback.

4. Results

This section presents the findings of the study in response to the three research questions: whether peer feedback improves EFL students' writing performance; how it affects students' revision strategies; and students' attitudes toward peer feedback.

4.1. Effect of Peer Feedback on Writing Performance

A paired-sample t-test was conducted to compare students' writing scores before and after the peer feedback intervention. As shown in **Table 1**, there were statistically significant improvements across all three dimensions—content, organization, and language accuracy—as well as in the total writing score. The largest mean gain was observed in organization (M increase = 1.70, $p < .001$), followed by language accuracy (M increase = 1.60, $p < .001$) and content (M increase = 1.50, $p < .001$). These results indicate that structured peer feedback had a positive and significant impact on students' overall writing performance.

4.2. Changes in Revision Strategies

To examine how students' revision behaviors changed after receiving peer feedback, the frequency distribution of revision types (content-related, organization-related, and language-related) was analyzed using a chi-square test. As presented in **Table 2**, there was a significant increase in the proportion of content-related revisions from 22.5% in the pre-test to 35.0% in the post-test ($\chi^2 = 12.45$, $p < .001$). Organization-related revisions also increased modestly from 25.0% to 30.5% ($\chi^2 = 4.32$, $p = .038$). Conversely, language-related revisions decreased from 52.5% to 34.5% ($\chi^2 = 15.20$, $p < .001$). This shift suggests that students became more focused on higher-order concerns—such as content development and text organization—after participating in peer review activities.

4.3. Students' Attitudes toward Peer Feedback

Descriptive statistics from the post-treatment questionnaire revealed generally positive attitudes toward peer feedback (**Table 3**). The highest-rated item was "Peer feedback helped me identify problems" (M=4.35, SD=0.60), followed closely by "Peer review improved my awareness of good writing practices" (M=4.25, SD=0.62). Students also reported that peer feedback improved their writing organization (M=4.10, SD=0.72) and motivated them to revise more (M=4.20, SD=0.65). However, the lowest-rated item was "I trust the accuracy of peer feedback" (M=3.80, SD=0.85), indicating that

Table 1. Paired-sample t-test results for writing performance

Dimension	Pre-test M(SD)	Post-test M(SD)	*t*	*p*
Content	12.35 (1.82)	13.85 (1.75)	5.12	0.000
Organization	11.20 (1.60)	12.90 (1.55)	6.45	0.000
Language	10.80 (1.50)	12.40 (1.40)	6.02	0.000
Total Score	34.35 (3.20)	39.15 (2.95)	8.25	0.000

Table 2. Chi-square test results for revision type distribution

Revision Type	Pre(%)	Post(%)	χ^2	*p*
Content	22.5	35.0	12.45	0.000
Organization	25.0	30.5	4.32	0.038
Language	52.5	34.5	15.20	0.000

while students valued the process, concerns about peers' language proficiency and feedback quality remained.

Table 3. Descriptive statistics for questionnaire items

Item	Mean	SD
Peer feedback helped me identify problems.	4.35	0.60
Peer feedback improved my writing organization.	4.10	0.72
I trust the accuracy of peer feedback.	3.80	0.85
Peer feedback motivated me to revise more.	4.20	0.65
Peer review improved my awareness of good writing practices.	4.25	0.62

4.4. Summary of Findings

Overall, the results suggest that structured peer feedback is effective in improving EFL students' writing performance, particularly in organization and language accuracy. It also encourages a shift from surface-level to higher-order revisions. While students generally hold positive perceptions of peer feedback, teacher guidance and peer training remain important to address concerns about feedback accuracy.

5. Discussion

This study set out to investigate the effects of peer feedback on EFL university students' writing performance, their revision strategies, and their perceptions of the peer review process. The findings provide empirical evidence that structured peer feedback can yield significant improvements in writing quality while promoting more substantive revision practices.

5.1. Improvement in Writing Performance

Students' content, organization, and linguistic accuracy improved significantly after peer feedback, according to the paired-sample t-test. The biggest gain was in organization, suggesting peer review helped students focus on text structure and coherence. Previous research [6] showed peer input particularly useful in improving student writing's logical flow and paragraph development. The gain in language accuracy supports earlier study that implies peer feedback helps learners spot and correct grammatical and lexical problems they might miss. Content gains were statistically significant, but they were smaller than structure and language, suggesting that ideation may require more scaffolding beyond peer input [7] .

5.2. Shift toward Higher-Order Revision Strategies

The chi-square analysis of revision types revealed a shift from predominantly surface-level (language-related) changes to higher-order revisions involving content and organization. This pattern supports[8] assertion that substantive revisions are more likely to occur when writers receive feedback that challenges them to rethink their ideas and structure rather than merely correct surface errors. Similar findings have been reported by [9], who emphasized that peer comments often stimulate writers to make more global changes. In the current study, the provision of a structured feedback form may have helped guide students toward addressing higher-order concerns, thereby enhancing the depth and quality of their revisions.

5.3. Positive Perceptions with Caution on Accuracy

The questionnaire showed that students usually liked peer feedback, especially for recognizing writing issues and promoting strong writing. These views agree with Hyland and [10] that peer review promotes audience and collaborative learning. However, the lower trust score in feedback accuracy implies that students still worry about their peers' language and evaluative skills. It also[11] found that EFL learners doubt peer-provided linguistic adjustments. Training in constructive, factual criticism and teacher moderation to validate peer comments may help solve this problem.

5.4. Pedagogical Implications

Based on these data, EFL writing teaching can be improved in several ways. Using a consistent feedback form for organized peer evaluation regularly can help students focus on content, organization, and language to provide a fair review. Second, short workshops or practice sessions on peer evaluations can enable students to give constructive and accurate feedback, which will increase their trust in the process. Third, combining peer and teacher feedback, with teachers monitoring peer

comments, improves accuracy and revision practices. Finally, reminding students why they made particular adjustments based on criticism may help them understand writing metacognitively.

5.5. Limitations and Suggestions for Future Research

This study contains flaws. First, the sample size was small and from one university, limiting generalizability. Second, the intervention only lasted eight weeks; longitudinal studies may reveal longer-term effects of peer feedback on writing. Third, the study largely used statistics to measure writing quality and revision. Qualitative data like student interviews or think-aloud techniques may help us understand brain reconfiguration. To evaluate if digital mediation improves peer review in EFL situations, future research may use Google Docs or AI-driven feedback systems.

6. Conclusion

Structured peer feedback significantly improved EFL students' writing performance and fostered a shift toward higher-order revisions. While students valued the process, training and teacher involvement remain critical for ensuring feedback quality. Future research should explore technology-mediated peer feedback and long-term impacts.

Disclosure statement

The author declares no conflict of interest.

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Study on the Relationship between Family Intimacy, Psychological Resilience, Coping Strategies, and Non-Suicidal Self-Injury among Middle School Students in Sanming City

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Abstract

Purpose: To explore the underlying interactive constraints and mechanisms among family intimacy, non-suicidal self-injury behavior, psychological resilience, and coping strategies among middle school students in Sanming City. This study aims to provide a systematic and scientifically sound theoretical basis for the prevention and intervention mechanisms of non-suicidal self-injury behavior among junior high ccccschool students.*Method:* Using convenience sampling, 388 students from the first year of high school at a school in Ninghua County, Sanming City, Fujian Province, were selected. Assessment tools such as the Adolescent Self-Harm Behavior Questionnaire, the Connor-Davidson Resilience Scale (CD-RISC), the Family Intimacy Scale, and a simplified coping methods questionnaire were employed for data collection.*Results:* 1) The overall reporting rate of non-suicidal self-injury behavior among the surveyed students is 31.7%. There is a significant difference in the reporting rate of non-suicidal self-injury behavior based on family economic status ($p < 0.01$). 2) ccStudents with and without left-behind experiences show a significant difference in strength scores ($t = 2.19$, $p < 0.05$). 3) Students with and without non-suicidal self-injury behavior exhibit significant differences in family intimacy ($t = 5.58$, $p < 0.01$), psychological resilience ($t = 4.16$, $p < 0.01$), resilience ($t = 3.50$, $p < 0.01$), strength ($t = 4.02$, $p < 0.01$), optimism ($t = 4.03$, $p < 0.01$), and negative coping strategies ($t = -1.97$, $p < 0.05$). 4) Correlation analysis results show that non-suicidal self-injury behavior is positively correlated with negative coping strategies ($r = 0.17$, $p < 0.01$) and with total psychological resilience ($r = 0.20$, $p < 0.01$), resilience ($r = 0.19$, $p < 0.01$), strength ($r = 0.21$, $p < 0.01$), optimism ($r = 0.20$, $p < 0.01$), family intimacy ($r = 0.21$, $p < 0.01$), and positive coping strategies ($r = 0.10$, $p < 0.05$). Family intimacy is positively correlated with total psychological resilience ($r = 0.41$, $p < 0.01$), resilience ($r = 0.38$, $p < 0.01$), strength ($r = 0.37$, $p < 0.01$), optimism ($r = 0.32$, $p < 0.01$), and positive coping strategies ($r = 0.36$, $p < 0.01$). Positive coping strategies are positively correlated with total psychological resilience ($r = 0.47$, $p < 0.01$), resilience ($r = 0.44$, $p < 0.01$), strength ($r = 0.45$, $p < 0.01$), and optimism ($r = 0.36$, $p < 0.01$). 5) The mediating effect of coping strategies between family intimacy and non-suicidal self-injury behavior is not significant. 6) Psychological resilience has a mediating effect on the relationship between family intimacy and non-suicidal self-injury behavior, with a mediating effect of -0.08. This accounts for 30.18% of the total effect of family intimacy (-0.26).*Conclusion:* These results indicate a relatively high detection rate of non-suicidal self-injury behavior and a significant mediating effect of psychological resilience. This suggests that school interventions may benefit from focusing on providing additional support at the family level to enhance individual levels of psychological resilience, ultimately reducing the occurrence of non-suicidal self-injury behavior among middle school students.

Keywords

family intimacy; non-suicidal self-injury; positive coping strategies; psychological resilience; mediating effect

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1. Introduction

The high school stage is an important turning point for students' future development directions. The huge talent competition in today's society and the high-intensity learning tasks often multiply the pressure on students at this stage. When students face challenges from their academic and personal lives without having the correct scientific coping mechanisms and timely help from their surroundings, the accumulation of pressure can often lead to serious consequences. This article will start from the relatively serious issue of non-suicidal self-injury behavior, explore the level of this indicator and related factors among first-year high school students in Ninghua County, Sanming City, Fujian Province, and provide corresponding intervention and prevention measures.

Non-suicidal self-injury behavior refers to various behaviors that individuals adopt due to a lack of appropriate coping mechanisms, which are not accepted and recognized by today's social culture. However, these behaviors occur without clear behavioral motives. These behaviors, due to repeated and intentionally targeted at body tissues, can cause mild to moderate damage[1]. The detection rate of non-suicidal self-injury behavior depends on the definition of related concepts, specific measurement methods, sample representativeness, etc. In Lang Junjie's meta-analysis of non-suicidal self-injury behavior in China, the overall prevalence rate among middle school students was 22.37%, with 20.6% for males and 21.9% for females[2]. Similarly, in Zheng Ziwei's study, 29.75% of middle school students had engaged in non-suicidal self-injury behavior, with females (32.03%) higher than males (27.89%) (p=0.032), and junior high school students (33.05%) higher than high school students (26.99%)[3]. Regarding the different results shown by non-suicidal self-injury behavior in terms of the demographic variable of gender, Fang Xiaojia summarized from previous research progress on risk factors for non-suicidal self-injury behavior that most studies indicate that females show a slightly higher number of non-suicidal self-injury behaviors in terms of gender, which may be related to females experiencing more negative events in life than males. Furthermore, Fang Xiaojia discussed the impact of biological factors and individual factors on non-suicidal self-injury behavior from a medical perspective. Firstly, the author discussed the influence of three biological factors, genetics, neuroendocrinology, and neuroimaging, on non-suicidal self-injury behavior, and then explained individual factors such as age, gender, etc., which also have varying degrees of influence[4].

Of course, we cannot ignore the individual's family environmental factors, which are also very important risk factors. As Li Yun's study showed, the more intimate the emotional relationship between family members, the stronger the family's ability to cope with changes, but the poorer the parent-child relationship, the greater the probability of dangerous behaviors such as self-harm. In addition, research also suggests that adolescents growing up in incomplete family structures such as divorced families are more likely to engage in non-suicidal self-injury behaviors[5]. Foreign studies also indicate that the quality of social support and emotional connection from other family members in the family environment is closely related to non-suicidal self-injury. Another study showed that family intimacy is an important protective factor for non-suicidal self-injury behavior[6]. By implementing appropriate psychological intervention measures and assistance, effectively addressing issues such as family rules and family adaptive development can make family members closer to each other, thus reducing the recurrence of self-harm behaviors[7]. Psychological resilience refers to an individual's ability to withstand setbacks or adversity and successfully cope with adversity and trauma. When individuals take spontaneous behavioral actions in response to stressful events from their life environment, these behaviors are called coping mechanisms[8]. These mechanisms often demonstrate the social adaptability developed by individuals and judge whether an individual's social skill development meets societal standards[9]. Both are psychological abilities reflected by individuals in adverse situations. Previous literature has indicated a significant correlation between family intimacy and coping mechanisms, which can significantly positively predict coping mechanisms[10]. Research also suggests that coping mechanisms may impact an individual's non-suicidal self-injury behavior, as some self-harm behaviors exhibited by adolescents can be seen as resulting from a lack of positive and correct coping mechanisms[11-12]. Intimate family relationships and a good environment can protect children, enabling them to exhibit higher levels of psychological resilience[13].

Additionally, the research results of Ma Yuqiao's article indicate that students with different types of self-harming behaviors show significant differences in their levels of psychological resilience[14]. Therefore, this article proposes the following hypotheses:

Hypothesis 1: Coping mechanisms play a mediating role between family intimacy and non-suicidal self-injury behavior. Hypothesis 2: Psychological resilience plays a mediating role between family intimacy and non-suicidal self-injury behavior.In conclusion, this study will examine the relationship between family intimacy, psychological resilience, coping mechanisms, and non-suicidal self-injury behavior. Theoretically, it aims to further clarify the underlying psychological mechanisms and hopes to apply the results to practical teaching activities, promote attention to students' psychological health status at the societal, school, and family levels, and provide timely prevention and intervention strategies.

2. Materials and Methods

2.1. Participants

A questionnaire survey was conducted on first-year high school students at a certain high school in Ninghua County, Sanming City, Fujian Province, using convenience sampling. A total of 441 questionnaires were distributed, and 388 valid questionnaires were collected based on the lie detection questions and answer conditions set, with an effective questionnaire recovery rate of 87.89%. The distribution of various demographic statistical indicators is shown in Table 1.

2.2. Questionnaire

Adolescent Self-Harm Behavior Questionnaire

This scale is divided into self-harm frequency and severity. Self-harm frequency is categorized into 4 levels, scored from 1 to 4; severity ranges from "none" to "extreme" scored from 1 to 5. Self-harm behavior is calculated as the product of self-harm frequency and severity, with higher scores indicating more severe behavior. In this study, the Cronbach's alpha coefficient for this scale was 0.90.

Connor-Davidson Resilience Scale (CD-RISC)

This scale includes the dimensions of resilience, strength, and optimism. It uses a five-level rating, with higher scores indicating higher levels of psychological resilience. In this study, the Cronbach's alpha coefficients for the full scale and the three sub-scales were 0.92, 0.88, 0.80, and 0.60, respectively.

Family Intimacy Scale The study utilized the family intimacy sub-scale from the Chinese version of the Family Intimacy and Adaptability Scale to assess the actual level of family intimacy among research subjects. It employs a five-level scoring system, with higher scores indicating higher levels of family intimacy. The Cronbach's alpha coefficient for this scale in the study was 0.86.

Simple Coping Style Questionnaire

This scale is divided into two dimensions: positive coping

Table 1. Population distribution of each demographic statistical index

Gender		Whether serving as a class cadre		Family location		Whether an only child		Family economic situation				
Male	Female	Yes	No	Rural	Urbanor town	Yes	No	Very poor	Lower-middle	Medium	Upper-middle	Very good
193	195	159	229	134	254	66	322	17	64	270	33	4
Parents'work situation				whether there is a left-behind experience.								
Both parents work locally	Both work outside	Only mother works outside	Only father works outside	Yes	No							
213	58	18	99	175	213							

style and negative coping style. It uses a 0-3 ("never used" to "frequently used") 4-level rating system. In this study, the Cronbach's alpha coefficients for the full scale and the positive and negative coping style sub-scales were 0.80, 0.82, and 0.74, respectively.

2.3. Data analysis

Data analysis was conducted using SPSS 25.0 software, including descriptive statistical analysis, correlation analysis, independent sample t-tests, stepwise multiple regression, and other analytical methods.

3. Results

3.1. Common Method Bias Test

Psychological characteristics of the participants were measured using self-report scales in this study. To test for the presence of common method bias, a Harman single-factor test was conducted[15]. The results showed that there were 31 factor eigenvalues greater than 1 in the unrotated factor solution, and the first common factor explained variance was 14.666% (<40%), indicating that the common method bias effect was not severe in this study.

3.1.1. Reporting Rates of Non-Suicidal Self-Injury Behavior Across Different Student Categories

In this study, the reporting rate of non-suicidal self-injury behavior was 31.7%. There was a significant difference in the reporting rates of non-suicidal self-injury behavior based on the demographic variable of family economic situation, with $p < 0.01$, as shown in **Table 2**.

3.1.2. Students' Non-Suicidal Self-Injury Behavior, Psychological Resilience, Family Intimacy, and Coping Strategies Scores Comparison Based on Left-Behind Experience

There were no significant differences ($p > 0.05$) in non-suicidal self-injury behavior, coping strategies, psychological resilience, resilience, and optimism scores between students with and without left-behind experiences. However, there was a significant difference ($p < 0.05$) in strength scores. Refer to **Table 3** for details.

3.2. Students with and without Non-Suicidal Self-Injury Behavior: Comparison of Psychological Resilience, Family Intimacy, and Coping Strategies Scores

The research results indicate that significant differences ($p < 0.01$) exist in the scores of psychological resilience and its three sub-dimensions, as well as family intimacy, between students with and without non-suicidal self-injury behavior. There is also a significant difference ($p < 0.05$) in scores related to negative coping strategies. However, there is no significant difference ($p > 0.05$) in scores related to positive coping strategies. Refer to **Table 4** for details.

3.3. The Relationship between Non-Suicidal Self-Injury Behavior and Family Intimacy, Psychological Resilience, Coping Strategies

Pearson correlation analysis results indicate that non-suicidal self-injury behavior is positively correlated with negative coping strategies ($r = 0.17$, $p < 0.01$), as well as with total psychological resilience score ($r = 0.20$, $p < 0.01$), resilience ($r = 0.19$, $p < 0.01$), strength ($r = 0.21$, $p < 0.01$), optimism ($r = 0.20$, $p < 0.01$), family intimacy ($r = 0.21$, $p < 0.01$), and positive coping strategies ($r = 0.10$, $p < 0.05$); family intimacy is positively correlated with total psychological resilience score ($r = 0.41$, $p < 0.01$), resilience ($r = 0.38$, $p < 0.01$), strength ($r = 0.37$, $p < 0.01$), optimism ($r = 0.32$, $p < 0.01$), and positive coping strategies ($r = 0.36$, $p < 0.01$); positive coping strategies are positively correlated with total psychological resilience score ($r = 0.47$, $p < 0.01$), resilience ($r = 0.44$, $p < 0.01$), strength ($r = 0.45$, $p < 0.01$), and optimism ($r = 0.36$, $p < 0.01$). Refer to **Table 5** for details.

3.4. The Mediating Effect of Coping Strategies between Family Intimacy and Non-Suicidal Self-Injury Behavior

The correlation analysis results between coping strategies and family intimacy indicate that there is no correlation between negative coping strategies and family intimacy, whereas positive coping strategies show a significant correlation with family intimacy ($r = 0.36$, $p < 0.01$). Based on this result, the subsequent discussion specifically focuses on the mediating role of positive

Table 2. Comparison of Reporting Rates of Non-Suicidal Self-Injury Behavior Among Students Based on Different Demographic Characteristics

Demographic index		Number	Non-Suicidal Self-Injury Behavior		χ^2 values	*p* values
Gender	Male	193	55	28.50%	1.82	>0.05
	Female	195	68	34.87%		
Whether serving as a class cadre	Yes	159	54	33.96%	0.64	>0.05
	No	229	69	30.13%		
Family location	Rural	134	44	32.84%	0.12	>0.05
	Urban or town	254	79	31.10%		
Whether an only child	Yes	66	20	30.30%	0.07	
	No	322	103	31.99%		
Family economic situation	Very poor	17	5	29.41%	22.58	<0.01
	Lower-middle	64	35	54.69%		
	Medium	270	70	25.93%		
	Upper-middle	33	13	39.40%		
	Very good	4	0	0.00%		
whether there is a left-behind experience	Yes	213	63	29.58%	0.98	>0.05
	No	175	60	34.29%		

Table 3. Comparison of Non-Suicidal Self-Injury Behavior, Psychological Resilience and its Factors, Family Intimacy, and Coping Strategies Scores among Students with and without Left-Behind Experience (x ± s)

Whether there is a left-behind experience	No	Yes	T values	P values
Non-Suicidal Self-Injury Behavior	22.92±11.28	23.66±13.00	-0.61	0.55
Psychological Resilience	3.19±0.61	3.08±0.58	1.75	0.08
Toughness	3.10±0.67	3.03±0.65	1.13	0.26
Strength	3.30±0.67	3.15±0.64	2.19	0.03*
Optimism	3.26±0.70	3.13±0.66	1.85	0.07
Family Intimacy	66.28±10.26	64.87±9.73	1.38	0.17
Positive Coping Strategies	77.46±14.02	75.42±12.34	1.51	0.13
Negative Coping Strategies	18.09±4.95	18.46±4.81	-0.74	0.46

Note：* $p<0.05$, ** $p<0.01$

Table 4. Comparison of Psychological Resilience, Family Intimacy, and Coping Strategies Scores among Students with and without Non-Suicidal Self-Injury Behavior (x ± s)

Non-SuicidalSelf-InjuryBehavior	Number	Psychological Resilience	Toughness	Strength	Optimism	Family Intimacy	Positive Coping Strategies	Negative Coping Strategies
No	265	3.23±0.6	3.15±0.66	3.32±0.64	3.29±0.68	67.51±9.55	35.22±7.44	17.92±4.81
Yes	123	2.96±0.57	2.9±0.62	3.04±0.66	3.00±0.65	61.63±9.92	34.34±6.66	18.97±4.97
t values		4.16	3.5	4.02	4.03	5.58	1.12	-1.97
p values		<0.01	<0.01	<0.01	<0.01	<0.01	>0.05	<0.05

Table 5. Correlation Coefficients between Non-Suicidal Self-Injury Behavior and Psychological Resilience, Coping Strategies, Family Intimacy (N=388)

	Non-SuicidalSelf-InjuryBehavior	Psychological Resilience	Toughness	Strength	Optimism	Family Intimacy
Psychological Resilience	-0.22**	1				
Toughness	-0.19**	0.95**	1			
Strength	-0.21**	0.91**	0.77**	1		
Optimism	-0.20**	0.75**	0.60**	0.66**	1	
Family Intimacy	-0.21**	0.41**	0.38**	0.37**	0.32**	1
Positive Coping Strategies	-0.10*	0.47**	0.44**	0.45**	0.36**	0.36**
Negative Coping Strategies	0.17**	-0.05	-0.05	-0.1	0.02	-0.01

Note：**$p < 0.01$（two-tailed）; *$p < 0.05$（two-tailed）

coping strategies. As shown in **Table 3**, there is a close relationship between positive coping strategies and non-suicidal self-injury behavior. Hence, it can be inferred that positive coping strategies may act as a mediating variable in the relationship between family intimacy and non-suicidal self-injury behavior.

The process of testing the mediating effect is as follows: First, family intimacy total score is set as the independent variable, non-suicidal self-injury behavior as the dependent variable for regression analysis. Second, family intimacy total score is set as the independent variable, and positive coping strategies as the dependent variable for regression analysis. Third, using positive coping strategies and family intimacy total score as independent variables, and non-suicidal self-injury behavior as the dependent variable, conduct a stepwise multiple regression analysis. The mediating effect test can be conducted using the Bootstrap method with bias correction, with a sample size of 5000. If the confidence interval of the bias-corrected probability is above 95%, and the result does not include zero, the mediating effect is established.

The results indicate that under the conditions of a bias-corrected confidence interval probability of over 95%, the mediating effect result contains zero (LLCI=-0.199, ULCI=0.002). This suggests that there is no mediating effect of positive coping strategies in the relationship between family intimacy and non-suicidal self-injury behavior, as shown in **Table 6**.

3.5. The Mediating Effect of Psychological Resilience between Family Intimacy and Non-Suicidal Self-Injury Behavior

The correlation analysis results show that the total score and dimensions of psychological resilience are significantly correlated with family intimacy. Based on this result, the subsequent discussion focuses on the mediating role of psychological resilience. As shown in **Table 3**, psychological resilience is also significantly correlated with non-suicidal self-injury behavior. Therefore, it can be inferred that psychological resilience may act as a mediating variable in the relationship between family intimacy and non-suicidal self-injury behavior.

The process of testing the mediating effect is similar to the steps outlined in section 2.6, with positive coping strategies replaced by psychological resilience. Using the Bootstrap method with bias correction and a sample size of 5000, under the condition of a bias-corrected probability of over 95% for the confidence interval, the mediating effect result does not contain zero (LLCI=-0.120, ULCI=-0.010). This indicates that psychological resilience has a mediating effect in the relationship between family intimacy and non-suicidal self-injury behavior. Furthermore, according to Figure 6, the effect size is -0.08, accounting for 30.18% of the total effect of family intimacy on self-injury behavior (-0.26). Refer to **Table 7** for details.

Table 6. Testing the Mediating Effect of Positive Coping Strategies between Family Intimacy and Non-Suicidal Self-Injury Behavior (N=388)

Step	DependentVariable	IndependentVariable	R^2values	Fvalues	Bvalues	StandardError	tvalues
First	Non-Suicidal Self-Injury Behavior	Family Intimacy	0.05	18.40**	-0.26	0.06	-4.29**
Second	Positive Coping Strategies	Family Intimacy	0.59	512.25**	1	0.04	22.63**
Third	Non-Suicidal Self-Injury Behavior	Family Intimacy	0.05	10.78**	-0.14	0.09	-0.11**
		Positive Coping Strategies			-0.12	0.07	-0.13

Table 7. Testing the Mediating Effect of Psychological Resilience between Family Intimacy and Non-Suicidal Self-Injury Behavior (N=388)

Step	DependentVariable	IndependentVariable	R^2values	Fvalues	Bvalues	StandardError	tvalues
First	Non-Suicidal Self-Injury Behavior	Family Intimacy	0.05	18.40**	-0.26	0.06	-4.29**
Second	Psychological Resilience	Family Intimacy	0.17	76.19**	0.02	0.01	8.73**
Third	Non-Suicidal Self-Injury Behavior	Family Intimacy	0.06	13.72**	-0.18	0.07	-2.76**
					-3.19	1.09	-2.94**

4. Discussion

4.1. Reporting Rates of Non-Suicidal Self-Injury Behavior among Students of Different Categories

The overall reporting rate of non-suicidal self-injury behavior among the survey participants is 31.7%, which is higher than the detection rates reported by Zheng Ziwei et al. (29.75%)[3] among 2040 middle school students, Wang Xiaoyan et al. (9.5%)[16], Chen Yunli et al. (21.9%)[17], and lower than the rate reported by Lin Lihua et al. (40.34%). Furthermore, demographic indicators such as gender, class cadre status, family location, being an only child, and experiencing left-behind situations did not show significant differences in the presence of non-suicidal self-injury behavior. However, non-only children (31.99%) reported higher rates than only children (30.30%), and rural areas (32.84%) reported higher rates than urban areas (31.10%). This aligns with the results of Lang Junjie et al.'s meta-analysis, where non-only children and rural students in mainland China had higher reporting rates than their counterparts. Interestingly, students with left-behind experiences showed a lower detection rate of self-injury behavior (29.58%) compared to those without such experiences (34.29%), contrary to previous studies[17]. This discrepancy could be attributed to the boarding school setting of the surveyed students, where the provision of a supportive environment and strict dormitory management may reduce the occurrence of non-suicidal self-injury behavior. However, students with left-behind experiences scored slightly higher on the item of self-injury behavior compared to students without such experiences, albeit with a lower detection rate[20]. This suggests that this group may exhibit more extreme self-injurious behaviors. Notably, the consideration of boarding school life dimensions in the criteria reveals that whether female students board at school has been identified as a factor influencing their non-suicidal self-injury behavior.

Regarding family economic status as a demographic indicator, students from different economic backgrounds showed significant differences in reporting rates of non-suicidal self-injury behavior. Research has indicated that family environment plays a dominant role in human development, with familial support being a

crucial protective factor against individual self-injurious behaviors. Additionally, studies have shown that left-behind children in middle school tend to exhibit more emotional and behavioral problems within the lower to middle economic range[21].

Overall, the study demonstrates a relatively high reporting rate of non-suicidal self-injury behavior. Several reasons may account for this finding: the survey was conducted in Ninghua, a poverty-stricken county in Fujian province experiencing a significant outflow of migrant workers, resulting in a higher prevalence of left-behind students. Moreover, the unpredictable and uncontrollable nature of the COVID-19 pandemic has impacted individuals' mental health, particularly adolescents who may lack coping strategies compared to other age groups, making them more vulnerable to severe mental health issues[22]. Additionally, first-year high school students are in the adolescence period[23], which is a high-risk group for non-suicidal self-injury behavior. The survey was conducted around January 20, 2022, a time when students were preparing for year-end exams, potentially heightening academic stress and leading to negative emotions such as anxiety and depression, which could trigger self-harming behaviors.

4.2. Comparison of Non-Suicidal Self-Injury Behavior, Psychological Resilience, Family Intimacy, and Coping Strategies between Students with and without Left-Behind Experiences

From **Table 3**, it is evident that students with left-behind experiences scored slightly lower than students without such experiences in total psychological resilience, resilience, strength, optimism, family intimacy, and positive coping strategies. However, they showed the opposite results in negative coping strategies. Notably, there was a significant difference in scores between the two groups in the strength dimension.

In terms of psychological resilience, the study results align with those of Jin Yinghua et al[24]. However, differences in research tools and sample sizes may yield varying results among scholars[25].

Regarding family intimacy, students with left-behind experiences scored slightly lower than those without such experiences, consistent with previous research indicating that left-behind students, due to parents' long absences for work and limited time spent with parents, may experience a sense of detachment and a decrease in family intimacy due to the lack of effective communication and support caused by distance[26].

When it comes to coping strategies, students with left-behind experiences scored slightly lower in positive coping strategies compared to those without such experiences, while displaying opposite results in negative coping strategies. Previous studies, such as Zhu Yan's research, have shown insignificant differences in coping strategies between the two groups of students[27].

4.3. Comparison of Psychological Resilience, Family Intimacy, and Coping Strategies between Students with and without Non-Suicidal Self-Injury Behavior

Table 4 indicates significant differences in scores of psychological resilience and its three sub-dimensions, family intimacy, and negative coping strategies between students with and without non-suicidal self-injury behavior, with the latter group scoring higher. Studies have suggested that students engaging in different types of self-injurious behaviors demonstrate varying levels of psychological resilience. Furthermore, as the frequency of self-injury behaviors increases, individuals may exhibit lower levels of psychological resilience. Family intimacy serves as an indicator of close family relationships and atmosphere, which can decrease the likelihood of engaging in maladaptive behaviors[28]. Guerreiro et al. mentioned in their review that adolescents engaging in self-injurious behaviors tend to adopt relatively passive coping strategies[29].

4.4. Relationship between Non-Suicidal Self-Injury Behavior, Family Intimacy, Psychological Resilience, and Coping Strategies

The results reveal a negative correlation between non-suicidal self-injury behavior and family intimacy, psychological resilience, its sub-dimensions, and positive coping strategies. In contrast, positive correlations are observed between psychological resilience, family intimacy, positive coping strategies, indicating that these factors are important influencing factors for non-suicidal self-injury behavior. Jiang Guangrong et al.

mention in their self-harm behavior study that traumatic childhood experiences hinder individuals' development of motivation, attitudes, tools, emotions, and interpersonal abilities required for positive adaptation, leading them to adopt harmful coping mechanisms when lacking necessary resources and adaptive skills[30].

4.5. Mediating Effect of Coping Strategies between Family Intimacy and Non-Suicidal Self-Injury Behavior

Research suggests that adolescents who have experienced adverse events during childhood may exhibit a direct relationship between their coping strategies for handling sudden major life events and current self-injurious behaviors[31]. Surprisingly, the present study did not find a mediating effect of coping strategies between family intimacy and non-suicidal self-injury behavior, which contradicts previous research. By comparing this study with the research of Ma Shuangshuang and Ren Y, we can explore why there is no mediating effect of positive coping strategies in the present study.

Ma Shuangshuang et al. similarly used a questionnaire on adolescent self-harm behavior and a trait coping style questionnaire with the same dimensional division as this study. The consistency in the process of testing for mediating effects was evident. However, a detailed comparison between Ma Shuangshuang et al.'s research and the present study reveals some inconsistencies. Firstly, Ma Shuangshuang et al. employed a stratified cluster sampling method, which allowed for the investigation of different levels of objects. In contrast, this study focused solely on first-year high school students, showcasing strong homogeneity and weak representativeness due to this single-level survey. Additionally, in terms of sample size, Ma Shuangshuang et al. studied 9704 urban and rural middle and high school students in Zhengzhou and Guiyang, demonstrating a significant difference in sample size compared to the present study[32].

Ren Y, using Nock's comprehensive theoretical model, conducted a representative sampling of 1989 Taiwanese high school students (stratified sampling based on school type and class) and employed the Brief Family Functioning Scale (BFF), Stress Coping Scale (SCC), and Deliberate Self-Harm Inventory (DSHI) to collect data on family functioning, coping strategies, and non-suicidal self-injury behavior. The study explored the predictive roles of distal risk factors (i.e., family functioning) and general susceptibility factors (i.e., coping strategies) in non-suicidal self-injury behavior, as well as the mediating effect of coping strategies in the relationship between family functioning and non-suicidal self-injury behavior[13]. The results indicated that avoidance/emotion-focused coping strategies mediated the relationship between family functioning and non-suicidal self-injury behavior. By comparing this study with Ren Y et al.'s research, several reasons for discrepancies can be considered: the disagreement in research subjects, consistent with Ma Shuangshuang et al., and in terms of research tools, this study utilized a simplified coping strategy questionnaire that categorized coping strategies into positive and negative aspects. Ren Y's study included more detailed coping strategies, such as avoidance and seeking social support, which might explain the lack of significant mediating effects of positive coping strategies in this study.

4.6. The Mediating Effect of Psychological Resilience between Family Intimacy and Non-Suicidal Self-Injury Behavior

In the previous studies mentioned, such as Ma Shuangshuang et al., it was noted that emotional symptoms and maladaptive psychological symptoms during childhood abuse have a partial mediating effect on non-suicidal self-injury. The trait of psychological resilience in this study is closely related to these emotional and maladaptive symptoms, indicating that psychological resilience could also play a mediating role in the relationship between family intimacy and non-suicidal self-injury behavior.

Looking back at previous research, we understand that when children receive timely warmth and care from family members during their growth, as well as having their needs for care and attention met, their development of psychological resilience improves. Conversely, hindered development of psychological resilience may lead to psychological or behavioral risks, such as self-harm or suicide, especially when family intimacy is weak among family members[33]. This insight provides valuable lessons for the psychological development of adolescents:

on one hand, schools and families should actively create platforms to showcase students' abilities, helping them enhance positive psychological qualities such as self-esteem and optimism. On the other hand, efforts should be made to facilitate students in improving their personal qualities while learning how to utilize external resources effectively. This can be achieved through regular mental health workshops conducted by the school or through close and supportive relationships with peers. Combining these approaches can promote the development of psychological resilience, thereby enhancing the mental health levels of individuals.

5. Conclusion

The overall reporting rate of non-suicidal self-injury behavior among the surveyed students is relatively high at 31.7%, with variations in reporting rates based on different family economic situations.

Students with left-behind experiences scored lower in strength compared to students without such experiences.

Students engaging in non-suicidal self-injury behavior demonstrated lower scores in family intimacy, psychological resilience, and its three sub-dimensions, while showing opposite results in negative coping strategies.

Non-suicidal self-injury behavior showed a negative correlation with the total score and three sub-dimensions of psychological resilience, family intimacy, and positive coping strategies, and a positive correlation with negative coping strategies. Family intimacy exhibited a positive correlation with the total score and three sub-dimensions of psychological resilience and positive coping strategies. The total score and three sub-dimensions of psychological resilience were positively correlated with positive coping strategies.

Coping strategies did not exhibit a mediating effect in the relationship between family intimacy and non-suicidal self-injury behavior.

Psychological resilience was found to have a mediating effect in the relationship between family intimacy and non-suicidal self-injury behavior.

Disclosure statement

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Formation Mechanism and Governance Path of "Light Social Interaction" among College Students from the Perspective of Social Exclusion

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Abstract

The phenomenon of "light social interaction" among college students, characterized by low investment and shallow interaction, is replacing traditional deep connections. This study uses a three-dimensional framework based on social exclusion theory—institutional, technological, and relational exclusion—to analyze the mechanisms behind this trend and explore solutions. Findings show that light interaction is an adaptive response to exclusion: institutional pressures foster utilitarianism, technology weakens real-world social skills, and relational gaps in both online and offline networks reinforce this behavior. While it may temporarily ease exclusion, it risks a cycle leading to deeper exclusion. Addressing this issue requires multi-stakeholder collaboration: reforming education to reduce institutional exclusion, regulating technology to minimize alienation, and enhancing students' real-world interaction through training and peer support. This study offers a theoretical lens for understanding youth sociocultural shifts in the digital age and provides practical strategies for building a healthier social environment.

Keywords

College Students
Social Exclusion
Light Social Interaction
Digital Technology
Educational Involution

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1. Introduction

Affected by various factors, especially advances in digital technology, today's youth are experiencing significant changes in their social interaction patterns. "Light social interaction" has drawn increasing attention[1]. A joint survey by the Social Survey Center of China Youth Daily found that 77.4% of young respondents agree that this superficial, emotionally detached form of interaction is becoming dominant [2]. This trend is especially evident among college students [3]. It is not merely a shift in preference but a response to structural pressures, including institutional exclusion in education, digital alienation, and social exclusion in both online and offline environments.

Existing research mainly examines college students' "light social interaction" from social demand. However, few studies explore its mechanisms and governance strategies from social exclusion. Drawing on social exclusion theory, this paper proposes a three-dimensional framework—institutional, technological, and relational exclusion—to explain how these exclusion mechanisms influence students' social behaviors. It also investigates strategies to dismantle such structures and foster a healthier social environment.

2. Phenomenon Review: Light Social Interaction and Social Exclusion Theory

Light social interaction is a new way for youth to connect, offering relaxed experiences, simple relationships, and pure intentions [4]. Currently, scholars are focusing on the causes of changing youth interaction patterns and their behavioral effects. Sun S et al. [4] suggest that light social interaction shows how Generation Z adapts to the digital era, influenced by changes in social structures and individual needs. Xiang J [5] argues that changes in youth social behavior result from declining social competence and an increasing preference for leisure-based interactions, which may lead to a shallow relationship society characterized by weak social ties [6].

The theory of social exclusion originated from poverty research in the 1980s and later extended into the social domain, connecting it to social dilemmas. This offers a framework for understanding alienation in social interactions. Xu L et al. [7] found that social exclusion reduces social self-efficacy and increases social anxiety, showing its impact on behavior through psychological factors. Jia Y et al. [8] showed that social exclusion worsens social anxiety, with interpersonal trust acting as a moderating factor—those with low trust are more likely to fear negative judgment.

3. Formation Mechanism: The Superposition Effect of Multiple Exclusions and the Adaptive Choice of Light Social Interaction

3.1. Multiple Exclusions: The Structural Pressure Field of College Students' Social Interaction

3.1.1. Institutional Exclusion: Resource Squeeze Under Educational Involution

The evaluation system in colleges and universities perpetuates social exclusion. Students often prioritize beneficial relationships and avoid those seen as non-utilitarian, deepening this divide. Unequal resource distribution worsens the issue, as high-quality academic and social resources concentrate among top students. Those in weaker positions may engage in low-pressure interactions to relieve stress. For example, average students may avoid comparing themselves with top performers to reduce anxiety, but this also limits non-utilitarian social connections.

3.1.2. Technological Exclusion: Implicit Control of Algorithms and Platforms

Digital technology reinforces social circles through information cocoons, leading to superficial interactions. It limits exposure to diverse perspectives and discourages deep connections. Virtual communication often relies on emojis or short texts, which can misrepresent emotions. Social media feeds users homogeneous content based on their profiles, trapping college students in similar interest groups and limiting cross-circle interactions. Features like likes and comments offer instant rewards, reinforcing shallow engagement. Over time, students may mistake "likes for companionship," weakening their ability to engage in meaningful emotional exchanges.

3.1.3. Relational Exclusion: Identity Marginalization in Virtual and Real Networks

Relational exclusion leads college students to prefer superficial social interactions. Because of the gap between their online and real selves, they fear rejection and hide true emotions. Exclusive language and social norms create barriers, pushing outsiders to avoid deep connections. Emotional detachment and the rise of utilitarian relationships encourage pseudo-intimacy,

which masks real emotional needs. For example, unspoken silence among roommates may seem peaceful but avoids emotional closeness, reducing anxiety but limiting meaningful bonds.

3.2. Survival Strategy: Adaptive Choice of Light Social Interaction

The above exclusions together create strong social pressure that leads to light social interaction through "exclusion perception–psychological defense–behavioral adjustment." Essentially, this is a passive response to exclusion pressure, which in turn worsens social exclusion.

Three types of exclusions create systematic pressure. Institutional exclusion leads students to see relationships as resource exchanges, shaping their choice of social partners. Combined with algorithm-driven homogeneity, it solidifies social circles and reinforces technological exclusion. Technological exclusion weakens real-world emotional bonds, increasing identity fragmentation and fear of emotional failure. It also raises sensitivity to resource competition in institutions. These experiences trigger psychological defenses, making individuals favor instant feedback and avoid deeper interactions.

Psychological defense leads to superficial social interactions, where college students exchange resources based on needs to reduce costs and maintain personal boundaries. They rely on symbolic expressions to manage low expectations and avoid risks, and use aloofness to escape social pressure. As light interactions become common, deep social skills atrophy, limiting meaningful connections and widening social gaps. This also heightens sensitivity to exclusion, reinforcing psychological defenses. Ultimately, stronger defenses increase reliance on light interaction, creating a cycle of "exclusion–light interaction–deeper exclusion."

4. Governance Path: Multi-Subject Collaboration to Break the Exclusion Cycle

4.1. Institutional Optimization: Shifting Educational Assessment and Distribution of Social Resources

Colleges and universities should reform their evaluation systems and create social spaces to reduce the negative effects of resource competition on relationships and encourage meaningful interactions. First, institutions should shift evaluation from focusing solely on GPA to including non-utilitarian indicators. Second, they should build environments that promote emotional connections. For example, regular activities in interest-based clubs and public welfare projects can move beyond task-driven interactions, restoring the warmth of face-to-face communication and helping students build genuine relationships based on shared interests.

4.2. Technological Regulation: Regulating Algorithmic Alienation and Improving Network Supervision Mechanisms

Social platforms should tackle technological exclusion among college students and create a healthier digital environment. First, improve algorithms by reducing reliance on similar content and distributing resources more evenly to ensure fair participation and prevent monopolization, especially for users with fewer connections. Second, increase transparency by clearly explaining how content and traffic are prioritized, helping students recognize algorithmic influence, identify hidden biases, and become more aware. Third, partner with universities to promote media literacy by offering practical courses that teach students to distinguish symbolic interaction from real emotional connection, encouraging mindful use of digital tools and greater control over technology.

4.3. Subject Empowerment: Scenario-Based Social Training and Peer Support Network Building

Colleges and universities, along with students themselves, can enhance student development through scenario-based training and peer support. Institutions can offer practical courses like mock interviews and team projects, helping students build listening, communication, and conflict resolution skills. They can also establish peer networks through club activities and online support platforms, encouraging experience sharing, expanding social connections, and improving interpersonal abilities. On an personal level, students should balance light social interaction and in-depth communication. Participating

in small group discussions and regular meetups can strengthen deep connections and improve real-world social resilience.

5. Conclusion

Light social interaction among college students is not only a result of the digital age and evolving education models but also a reaction to structural pressures. This trend stems from overlapping forms of exclusion: academic competition and unequal resource access push students toward practical interactions; information bubbles and algorithms weaken real-world social skills; and weak emotional bonds and identity confusion reduce meaningful connections. Together, these factors create a cycle of social exclusion. While light interaction may ease stress temporarily, it can deepen isolation, trapping students in a pattern of "exclusion–light interaction–deeper exclusion." Breaking this cycle requires collective action. Schools should foster inclusive environments and fair resource distribution; tech platforms must improve algorithm transparency; and students need social skills training and peer support. Only through joint efforts can this cycle be disrupted.

Disclosure statement

The author declares no conflict of interest.

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Self-Presentation and Identity Negotiation among Disabled Social Media Influencers: A Review

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Abstract

Disabled social media influencers are redefining disability in the digital age by challenging stereotypes and fostering vibrant communities. By leveraging platforms like Instagram and TikTok, these influencers move beyond the traditional, often pity-driven portrayals of disability in mainstream media. Instead, they craft authentic self-presentations and negotiate their identities, employing strategies such as curated transparency and visual rhetoric. This review explores how they navigate online harassment, commercialization, and public perception, ultimately pushing for a more inclusive societal understanding of disability.

Keywords

disabled influencers
self-presentation
identity negotiation
social media
disability studies

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1. Introduction

Disabled social media influencers are reshaping how disability is perceived in society[1]. In traditional media, disabled individuals were often portrayed as either objects of pity or sources of inspiration. However, the digital realm, with its vast reach and creative freedom, provides a platform for these individuals to control their own narratives[2]. On platforms like Instagram and TikTok, they have unprecedented agency to curate their self-images, directly engage with their audiences, and craft an online identity that challenges conventional stereotypes. This review explores how these influencers strategically manage perceptions of their disability while addressing online harassment, commercialization, and public attitudes toward disability.

2. Theoretical Foundations

Understanding the intricate dynamics of self-presentation and identity negotiation among disabled social media influencers necessitates a grounding in established theoretical frameworks. This section delves into the foundational theories that illuminate how individuals construct and manage their identities in social interactions, particularly within the mediated environments of social media.

2.1. Self-Presentation Theories in Online Environments

Self-presentation, the conscious way individuals manage how others see them, is key in social interaction, especially online. Erving Goffman's dramaturgical theory

helps understand this, viewing social interaction as a performance. Online, influencers act as "performers," carefully choosing photos, words, and interaction styles to present a desired public image or "front"[3]. The digital world allows for editing, leading to a more polished "front stage" display, while private moments or "back stage" remain hidden or selectively shared[4]. This careful selection of what to show helps disabled influencers manage how authentic and relatable their digital self appears to their audience. Furthermore, Social Identity Theory (SIT) states that people get part of their self-concept from the groups they belong to[5]. For disabled influencers, social media is a vital place to confirm and show their disability identity within a community of others with disabilities and allies. By publicly connecting with the disabled community, influencers not only feel better about themselves but also help change negative ideas society has about disability[6]. This often means highlighting positive aspects of their community[7]. The online community then becomes a crucial source of support, shared experiences, and combined efforts for change, which strengthens a positive and empowered disability identity.

2.2. Identity Negotiation: Concepts and Frameworks

Identity is not fixed; it constantly changes through interactions with others and the world[8]. Online identity is particularly flexible and performative. Unlike real-world interactions where identity might seem more set, the digital world allows for trying out and showing different parts of oneself. Disabled influencers are always negotiating their identity as they respond to comments, talk with people, and change their content based on audience feedback and their own evolving self-perceptions[9]. This active process means balancing the wish to be authentic with the need to manage their public image, especially when facing negative attitudes or unwanted advice, shaping both how they are seen and how they understand their own disability. How disability is understood deeply affects how disabled individuals see themselves and how society treats them. The medical model sees disability as an individual problem or illness that needs a cure, which can lead to feelings of shame. In contrast, the social model of disability suggests that disability mainly comes from societal barriers and attitudes, not from a person's impairment. Disabled influencers often use their platforms to promote the social model, reframing disability as a form of diversity and a source of strength. This shift in thinking empowers them to challenge self-stigma and external biases, pushing for changes in systems rather than just individual "fixes." Using and talking about different disability models is a key part of how they negotiate their identity online.

2.3. The Digital Landscape for Disabled Individuals

The digital environment is not equally available to everyone. While social media offers great possibilities, many disabled individuals face significant barriers to access. These can include websites that are not designed for accessibility, or content that lacks captions or audio descriptions. The digital divide, made worse by economic factors and access to special technologies, further limits participation. Influencers often find ways around these technical issues, sometimes by advocating for better accessibility or by creating their own solutions. Their ability to successfully present themselves and negotiate their identity is directly linked to how inclusive and well-designed the platforms they use are. Beyond just personal expression, social media acts as a powerful tool for advocacy and building communities within the disability rights movement. Disabled influencers often move from sharing personal stories to wider activism. They raise awareness about big problems affecting disabled people, challenge unfair rules, and gather their followers to support social change. These platforms help create online communities where disabled individuals and their allies can connect, share helpful information, support each other, and work together. This community aspect is very important for feeling a sense of belonging and collective power, which in turn strengthens each individual's identity negotiation process.

3. Strategies of Self-Presentation among Disabled Influencers

3.1. Curating Authenticity: Disclosure and Transparency

A primary strategy involves cultivating an image of

authenticity, which paradoxically often requires careful curation. Influencers decide what aspects of their disability and daily life to disclose, and to what extent. Some opt for radical transparency, sharing intimate details of their medical conditions, personal care routines, or emotional struggles, aiming to normalize disability and foster deeper connections[10]. Others may choose more selective disclosure, focusing on specific aspects that align with their advocacy goals or content niche. The balance between sharing enough to be relatable and maintaining personal boundaries is a constant negotiation, as audiences often demand a high degree of "realness" while influencers strive to protect their privacy and well-being. This strategic disclosure challenges the traditional veil of silence often imposed upon disability.

3.2. Visual Rhetoric and Image Management

Visual content forms the backbone of many social media platforms. Disabled influencers strategically utilize visual rhetoric to shape perceptions of their bodies and abilities[11]. This can involve showcasing adaptive equipment as tools of empowerment rather than symbols of limitation, or highlighting fashion choices that defy conventional beauty standards. Many influencers actively engage in "disability pride" aesthetics, presenting themselves in ways that celebrate their bodies and identities, often contrasting sharply with media's historically desexualized or medicalized portrayals[12]. They meticulously manage lighting, angles, and poses to convey confidence, strength, and joy, subverting the gaze that often reduces disabled bodies to objects of pity or medical scrutiny.

3.3. Narrative Construction: Storytelling and Lived Experience

Storytelling is a potent tool for human connection, and disabled influencers excel at constructing narratives that resonate with their audiences[13]. They share personal anecdotes, daily challenges, triumphs, and reflections, often framing their experiences in ways that demystify disability and emphasize shared humanity. These narratives are not merely informational; they are emotionally engaging, challenging ableist assumptions by presenting disability as a multifaceted and valuable part of human experience. Through carefully crafted captions, video scripts, and long-form blog posts, influencers transform individual experiences into relatable stories that educate, inspire, and foster empathy. They leverage the power of personal voice to counter dominant, often able-bodied, narratives about life with a disability.

3.4. Engaging Audiences: Interaction and Co-creation

Beyond broadcasting content, disabled influencers actively engage in dialogue with their audiences, fostering a sense of community and co-creating meaning. This involves responding to comments, participating in Q&A sessions, and inviting followers to share their own experiences. This interactive approach blurs the lines between content creator and consumer, transforming followers into active participants in the identity negotiation process. Through these interactions, influencers can directly address misconceptions, provide support, and build a loyal following that feels personally invested in their journey. This constant feedback loop also informs their future content strategies, ensuring relevance and responsiveness to community needs and interests.

4. Identity Negotiation Processes and Outcomes

4.1. Challenging Stereotypes and Stigma

A core outcome of disabled influencers' online presence is the active challenging of entrenched stereotypes and the reduction of stigma associated with disability. By showcasing diverse lives, capabilities, and aspirations, they directly counter media's historical tendency to portray disabled individuals as monolithic or tragic figures. Each post, each story, and each interaction serves as a micro-intervention against ableism, slowly dismantling preconceived notions[14]. They demonstrate that disability is not a singular experience but a spectrum, encompassing varied identities, joys, and struggles. This constant counter-narrative chips away at societal biases, fostering a more nuanced and accepting understanding of disability.

4.2. Fostering Positive Disability Identity

For many disabled influencers and their audiences, social media becomes a powerful site for fostering and

affirming a positive disability identity. In a society that often pathologizes or marginalizes disability, finding a space where one's identity is celebrated and understood is profoundly empowering[15]. Influencers articulate messages of disability pride, self-acceptance, and resilience, which can significantly impact the self-esteem and mental well-being of their followers. This digital environment provides validation, allowing individuals to move beyond internalizing negative societal views and instead embrace disability as a valuable and integral part of their identity. The shared experience of navigating a world not always designed for them transforms into a source of collective strength and cultural identity.

4.3. Managing Public Perceptions and Misunderstandings

The open nature of social media also means that influencers must constantly manage public perceptions, which often include misunderstandings, unsolicited advice, or even outright prejudice. Disabled influencers develop strategies to educate their audience, correct misinformation, and respond to ableist comments with grace or firm boundaries. This negotiation is delicate, as they seek to inform and advocate without alienating potential allies[16]. They often act as cultural translators, bridging the gap between able-bodied and disabled experiences. The ability to directly address these issues in real-time allows for a more dynamic and responsive form of advocacy than traditional media often permits, fostering a more informed public dialogue around disability.

4.4. The Role of Community and Support Networks

Online communities formed around disabled influencers play a crucial role in reinforcing identity negotiation. These networks provide a safe space for shared experiences, mutual support, and validation that may be lacking in offline environments. Followers often interact with each other, forming bonds based on shared identities and challenges. This communal aspect strengthens the individual's ability to navigate external pressures and internal doubts, offering a sense of solidarity and collective agency. Influencers often actively cultivate these communities, seeing them not just as an audience but as a vital support system for themselves and their followers, enabling a resilient and empowered collective disability identity.

5. Challenges and Ethical Considerations

5.1. Online Harassment and Discrimination (Ableism)

The very platforms that offer liberation also expose disabled influencers to heightened risks of online harassment, hate speech, and discrimination, often manifesting as ableism. This can range from offensive comments and unsolicited advice about their bodies or conditions to outright bullying and threats. Managing such negativity can be emotionally draining and requires robust coping mechanisms or community support. The public nature of their identity negotiation means they are constantly under scrutiny, making them vulnerable to both overt and subtle forms of prejudice. The persistent battle against online ableism underscores the ongoing need for platform moderation and user education.

5.2. Emotional Labor and Mental Health Impacts

The constant demand for self-presentation, emotional disclosure, and engagement with a large audience constitutes significant emotional labor. Influencers are often expected to be perpetually "on," accessible, and inspiring, which can lead to burnout, stress, and adverse mental health impacts. The pressure to always be a positive role model or "inspiration porn" can be particularly taxing, denying them the space for vulnerability or simply existing without a narrative. Managing personal well-being while maintaining a public persona that often involves sharing deeply personal experiences is a delicate balancing act that is not without its psychological costs.

5.3. Commercialization and Authenticity Dilemmas

As influencers gain popularity, opportunities for commercialization through sponsorships, brand partnerships, and advertising often arise. While this can provide financial independence, it also introduces ethical dilemmas concerning authenticity. The line

between genuine advocacy and commercial gain can become blurred, raising questions about the motivations behind content and the potential for perceived sell-out. Maintaining credibility and trust with an audience that values authenticity becomes a critical challenge when balancing personal values with commercial pressures. Influencers must navigate these tensions carefully to avoid undermining their message or alienating their community.

5.4. Privacy Concerns and Data Security

Sharing personal narratives and images inevitably raises privacy concerns. Disabled influencers, often sharing intimate details of their health, bodies, and daily lives, are particularly vulnerable to breaches of privacy or the misuse of their data. The public nature of their content means that personal information can be easily accessed, archived, and potentially weaponized. Ensuring data security and understanding the privacy policies of various platforms are critical, yet often complex, responsibilities. The perpetual negotiation of privacy boundaries – what to share, with whom, and under what conditions – remains a constant ethical challenge in their digital lives.

6. Conclusion and Future Research Directions

This review has systematically explored the multifaceted landscape of self-presentation and identity negotiation among disabled social media influencers. We have delved into the theoretical underpinnings, examined the diverse strategies employed, elucidated the profound outcomes, and highlighted the significant challenges inherent in their digital existence. The rise of these influencers represents a pivotal moment in disability representation, transitioning from passive reception of stereotypes to active, agentic construction of identity. Their engagement challenges ableist norms, fosters positive disability identity, and builds vital support networks, while simultaneously navigating the complexities of online harassment, emotional labor, and commercialization.

6.1. Key Insights and Contributions

The primary contribution of this review lies in synthesizing disparate research strands to offer a holistic understanding of disabled influencers' roles in contemporary digital culture. We underscore that their self-presentation is not merely superficial but a deeply strategic and theoretically informed process of identity work. Their actions contribute significantly to the social model of disability, transforming public discourse from deficit-based views to an appreciation of diversity and lived experience. The review also highlights the intricate interplay between individual agency, technological affordances, and societal structures in shaping online disability identity.

6.2. Methodological Approaches for Future Studies

Future research would benefit from employing a diverse range of methodological approaches to further deepen our understanding. Longitudinal studies could track the evolution of influencers' self-presentation strategies and identity negotiation over time, revealing how these processes adapt to platform changes and personal development. Mixed-methods research, combining quantitative analysis of content trends (e.g., sentiment analysis, network analysis) with in-depth qualitative interviews or ethnographic studies of influencers and their communities, would offer a richer, more nuanced picture. Experimental designs could also explore audience perception shifts in response to different types of disability representation.

6.3. Unexplored Sub-groups and Contexts

While this review provides a broad overview, there is a pressing need for research that focuses on specific, currently underexplored sub-groups within the disabled community. This includes examining influencers with intellectual disabilities, chronic illnesses, or those from diverse intersectional identities (e.g., disabled LGBTQ+ individuals, disabled people of color). Additionally, comparative studies across different cultural contexts and political systems are crucial to understand how varying societal norms, legal frameworks, and media landscapes impact self-presentation and identity negotiation. Further exploration of platform-specific affordances (e.g., TikTok's short-form video vs. Instagram's image focus) and their differential impact on disability representation would also yield valuable insights.

Disclosure statement

The author declares no conflict of interest.

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Rural Literature of Shaanxi and Its International Projection: Translation, Circulation, and Reception

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Abstract

Within the broader internationalization of Chinese culture, the rural literature of Shaanxi constitutes a distinctive corpus characterized by ethnographic density, the centrality of agrarian landscapes, and a stylistic profile shaped by local dialect and communal structures. Despite its literary and cultural value, its presence in global publishing circuits remains uneven: translation catalogues show incomplete language coverage, fragmented trajectories, and a dissemination pattern that combines state-led initiatives, academic endeavors, and—more recently—commercial platforms such as Amazon Crossing. This article offers a synoptic account along three axes—translation, circulation, and reception—across Anglophone, Francophone, and Japanophone contexts. Drawing on publication data and reader reviews from platforms such as Goodreads, Babelio, and Bookmeter, the analysis identifies a shift of regime from an initial "institutional outbound" model to a more recent "platformization" that increases visibility but does not, by itself, resolve language-coverage gaps or deficits in cultural mediation. It argues that consolidating the international projection of Shaanxi's rural literature requires strengthening co-translation teams, diversifying media formats, and designing reader-oriented contextualization strategies so that these works can function as robust intercultural bridges.

Keywords

Shaanxi
Chinese rural literature
literary translation
international circulation
comparative reception

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1. Introduction

In the context of cultural globalization and China's national "going-out" strategy, literature has assumed a central role in shaping national image and fostering intercultural understanding. Since the late twentieth century, a range of translation programs has sought to introduce to foreign audiences both established authors and regional writers whose work reflects the country's cultural diversity. Within this panorama, the rural literature of Shaanxi occupies a prominent place, articulating a narrative universe in which historical memory, social transformation, and the linguistic richness of China's northwest coexist [1].

Authors such as Chen Zhongshi, Lu Yao, and Jia Pingwa have produced novels that, while deeply rooted in local realities, interrogate processes of universal

scope: the disintegration of rural communities, tensions between countryside and city, and the struggle for upward mobility. Works such as *Bailuyuan* (*White Deer Plain*), *Ren sheng* (*Life*), and *Qinqiang* (*The Shaanxi Opera*) have become landmarks of the contemporary canon. Their international circulation, however, has been uneven: whereas *Ren sheng* has versions in English, Russian, French, and Japanese, *Bailuyuan* still lacks a complete English translation, a fact that has sparked debate among critics [2].

The case of *Qinqiang* is even more complex, as its dialectal and cultural elements pose a genuine challenge for translators and condition its reception abroad. Recent studies show that the absence of explanatory paratexts and mediation strategies has weakened the transfer of its cultural density[3]. A similar dynamic emerges with *Ren sheng*, whose international trajectory has been examined as exemplary of the dilemmas faced by Chinese rural novels when reaching new readerships, oscillating between cultural fidelity and readability for foreign audiences[4].

This article seeks to provide a comprehensive overview of the translation, circulation, and reception of Shaanxi's rural literature in international contexts. Unlike studies focused solely on the "challenges of cultural adaptation," the approach adopted here considers the full process of internationalization—from the production of translations to market diffusion and the ways in which foreign readers construct meaning from these texts. This perspective makes it possible to identify both achievements and persistent gaps, and to propose strategies that can strengthen the international projection of this literary tradition.

2. Translation and International Circulation

The internationalization of Shaanxi's rural literature has unfolded in successive phases shaped by political conjunctures, editorial decisions, and transformations in the global market. In its early stages—the 1980s and 1990s—translations were driven primarily by cultural-diplomacy projects: a few versions appeared in European and Asian languages, but with limited print runs and little continuity, which reduced their medium-term impact.

A second phase opened with niche editions in Japan and France. The Japanese translation of *Bailuyuan* (1996) is a key case: although it attracted attention in specialized circles, critics have underscored the loss of cultural imagery and the problematic handling of dialectal and ritual markers, which curtailed the work's resonance among the broader Japanese reading public [5].

Against this backdrop, a symbolic fact stands out: *Bailuyuan* still lacks a complete English translation [2]. This absence is explained not only by the work's cultural density and stylistic complexity but also by contractual constraints that blocked its release into other Western languages, as documented in recent Chinese criticism.

A third phase corresponds to the twenty-first century and is characterized by the emergence of global platforms and commercial imprints (e.g., Amazon Crossing). The publication of *Ren sheng* in English (2019) and *Qinqiang* (2023) marked a shift in model: print and digital distribution now coexist, and circuits of visibility and recommendation within reading communities are activated immediately. However, greater visibility does not automatically translate into a deep understanding of cultural referents: reception depends largely on how translators manage peasant lexicon and dialectal features and on whether editions incorporate paratextual mediation devices. In the case of *Ren sheng*, analyses grounded in translator-behavior criticism point to a tilt toward pragmatic domestication strategies, prioritizing clarity and fluency for the target reader (including evidence of solid performance on platforms such as Amazon) [6].

Beyond individual cases, comparative studies of internationalization routes for Chinese rural fiction—contrasting, for example, the trajectories of Mo Yan and Jia Pingwa—emphasize that outcomes hinge on an assemblage of factors: modes of working with translators, sponsorship, editorial alliances, media promotion, and audience definition. From this perspective, the difficulties of Shaanxi literature are not exceptional but rather part of a structural pattern: when mediation and sustained support are lacking, circulation fragments and insertion into the translated canon remains fragile [7].

In the realm of translation challenges, *Qinqiang* functions as a proving ground. Recent studies show that carrying over its dialectal register and references to the local opera into English requires fine-grained decisions

of "adaptation and selection" (notes, glossaries, prefaces) so as not to sacrifice cultural density for readability. The framework of eco-translatology describes this balance as a process in which the translator adapts to different ecological constraints (target language, editorial norms, reader expectations) while selecting strategies that retain local color without undermining intelligibility [3].

In sum, the trajectory of translation and circulation for Shaanxi's rural literature has moved from an institutional-diplomatic model to an academic-niche model, and finally to a globalized, digital model. In each phase, however, persistent limits remain: gaps in key languages, loss of cultural density in existing versions, dependence on a small number of commercial platforms, and scarcity of paratextual mediation. Overcoming these bottlenecks requires integrated mechanisms that balance cultural fidelity and accessibility, anchoring these works in international markets and reading communities in a sustainable way.

3. Reception in International Contexts

The reception of Shaanxi's rural literature abroad displays differentiated patterns depending on language communities and media ecosystems. In the Anglophone sphere, the recent entry of *Ren sheng* and *Qinqiang* produced a visibility boost via global-reach imprints/platforms; however, the critical conversation tends to cluster in online fora and reader communities, where readers value the social realism and the "window onto rural China," yet stumble over dialectal markers, ritual references, and densely ethnographic features. Analyses of large-scale online reviews indicate that, in the absence of robust paratextual mediation, reader debates oscillate between enthusiasm for cultural novelty and difficulty interpreting local signifiers; the result is a "sawtooth" reception more responsive to immediate readability than to cultural depth [8].

In the case of *Ren sheng*, the cartography of opinions across networks and platforms reveals relatively stable thematic cores: social mobility, the tradition–modernity clash, moral dilemmas, and individual agency. This constellation of themes facilitates identification by general readers, but it coexists with recurrent misunderstandings when the text alludes to communal practices, ritual kinship, or local speech. Qualitative tracking of discussion threads and quantitative ratings suggests that the acceptance curve improves when editions incorporate mediation devices (prefaces, notes, glossaries) and worsens when these are absent [9].

Reception of *Qinqiang* in English introduces a complementary problem: its dialectal register and the centrality of the local opera compel translators to negotiate between preserving local color and securing intelligibility. From the perspective of eco-thanatology, this tension is described as a process of "adaptation–selection" conditioned by the receiving environment (editorial norms, reader expectations, cultural horizon). Where editions prioritize fluency, readers show greater adhesion, but at the cost of blurring cultural thickness; when local features are preserved, the "strangeness index" rises and paratextual scaffolding becomes crucial to sustain reading [10].

Shifting the lens to Francophone and Japanophone spaces brings other nuances to the fore. The Japanese translation of *Bailuyuan* fostered academic discussion and found its way into university courses, yet the general readership remained more distant when versions softened or neutralized cultural images and certain localisms, thereby reducing the "imprint of reality" the text carries in Chinese. This asymmetry between academic legitimation and broader readership uptake reappears in European experiences, where Chinese rurality is often read as "documentary" rather than as a situated aesthetics—except when editions are accompanied by cultural maps and reading guides.

To explain why the *same* works elicit such divergent receptions across reading communities, the framework of the manipulation theory is useful: the hypothesis that receiving literary systems "rewrite" texts through norms, dominant poetics, and institutional values. Applied to *Ren sheng*, this perspective illuminates how translation and editorial decisions—especially in treating peasant speech and dialectal markers—configure a "more universal" image of the original, yielding greater accessibility but reduced local density. Evidence from theses and case studies confirms that small microtextural decisions (lexical neutralization, cultural substitutions, suppression of modal particles) *accumulate* and steer reading toward a model of socially oriented fiction that is "globally legible" [11].

Reception, however, does not depend solely on translation and its paratexts, but also on the architecture of mediation. From the perspective of 译介学 (translation–intermediation as a dual operation), the external circulation of Shaanxi literature requires meshing bridging agents: translators, editors, critics, festivals, book clubs, and educators who "build the bridge" between the text and new communities of meaning. Where the mediation chain is fragmented or overly personalized, reception disperses; where an articulated dispositif exists—press kits, teaching materials, university circuits, public conversations with translators—the work stabilizes and reading gains depth [12].

This framework even helps reinterpret early attempts to bring *Bailuyuan* into English [13]: the well-known "test translation" of two chapters revealed not only the difficulty of cultural lexis (e.g., *kang* kang-beds, ritual-kinship terms, proto-toponyms) but also the institutional fragility of mediation at the time; without a sustained editorial project or a network of cultural agents to accompany the work, the draft could not become a reference edition, and Anglophone reception remained on hold.

Finally, an empirical cartography of digital receptions around Jia Pingwa's novels suggests an operational diagnosis: (a) international readers are sensitive to the authority of recommenders (critics, translators, reading influencers); (b) curatorial paratext (prefaces, glossaries, timelines, kinship maps) measurably affects the persistence of conversation and ratings; (c) enriched editions (digital versions with hyperlinks, audio, and opera music samples) correlate with "longer reads" and lower abandonment. Such findings do not merely describe how Shaanxi is read outside China; they offer levers for intervention to refine future dissemination strategies.

In sum, the international reception of Shaanxi's rural literature combines sustained interest with challenges of intelligibility. Where mediation and curation fail, a reading of "proximate exoticism" predominates and the conversation quickly loses steam; where interventionist frameworks (译介学), situated translation designs (eco-translatology), and conscious management of rewritings (manipulation) are integrated, reception gains density, discussion is prolonged, and the works begin to secure a place of their own within receiving literary systems.

4. Challenges and Problems of Translation and Circulation

The internationalization of Shaanxi's rural literature does not depend solely on the existence of translations. The process faces a series of structural challenges that limit its impact and merit detailed analysis. These problems can be grouped into four principal dimensions: linguistic, cultural, editorial, and reception.

First, the linguistic plane constitutes an evident difficulty. Shaanxi's narrative is characterized by intensive use of dialects, popular sayings, folk songs, and rural expressions that do not always have clear equivalents in target languages. The temptation to neutralize these elements in order to guarantee readability in international markets often results in a loss of local color. Without dialectal thickness, characters appear homogenized and the work risks diluting the cultural specificity that gives it value. Conversely, an overly literal translation can produce estrangement or even incomprehension among foreign readers. The balance between fidelity and fluency remains an unresolved challenge [10].

Second, there are cultural barriers. Shaanxi's literature not only tells the stories of individuals; it also conveys a universe of collective practices—community rituals, kinship systems, religious celebrations, and rural honor codes. In many cases these referents lack immediate counterparts in the receiving culture. If explanatory notes, prefaces, or accompanying materials are absent, readers tend to interpret these elements through their own frameworks, generating misunderstandings or reductionist readings. Hence cultural mediation is not an accessory but a basic condition for enabling the work to engage with foreign publics.

A third set of challenges concerns editorial structures and channels of circulation. For years, the international dissemination of Chinese rural literature depended almost exclusively on institutional projects or individual initiatives. This produced a dispersion of efforts: single editions, limited print runs, and a lack of continuity. The recent entry of platforms such as Amazon Crossing has modified this panorama by offering immediate global distribution and digital versions that expand availability.

However, this opening is not always accompanied by sustained promotional campaigns or strategies for insertion into academic or critical circuits. As a result, visibility may be high at the time of launch but quickly declines, leaving no stable imprint on the international literary field.

Finally, the reception dimension shows its own limits. Even when translations reach foreign readers, the reading experience does not always translate into deep comprehension. The slower narrative tempo, the abundance of characters, and the historical density typical of Shaanxi's works contrast with the expectations of a public accustomed to more linear structures and rapidly resolved plots. This sometimes generates divided reviews: on the one hand, those who appreciate cultural richness and epic breadth; on the other, those who feel disconnected or overwhelmed by excessive contextual information. Added to this fragmentation is the lack of interpretive devices, which limits the likelihood that these novels will circulate beyond a specialized audience.

Taken together, the problems described should not be understood as insurmountable flaws but as critical points that require strategic solutions. The challenge is to articulate mechanisms that preserve cultural authenticity while simultaneously opening spaces of accessibility. This implies rethinking translation as a collective process that involves not only translators but also editors, scholars, and cultural mediators. It also implies designing circulation policies that combine institutional, academic, and commercial pathways, avoiding exclusive dependence on a single model. Finally, it requires recognizing the foreign reader as an active agent whose expectations must be taken into account without renouncing the work's identity-rich texture.

Only through such an integrated perspective can the obstacles currently limiting the international projection of Shaanxi's rural literature be overcome. The challenges are considerable, but so too is the potential of these works to become bridges between cultures and universal testimonies of human experience in the context of rural modernization.

5. Optimization Strategies and Proposals

Given the challenges outlined above, it is essential to design strategies that strengthen the international projection of Shaanxi's rural literature. These strategies should not be conceived as isolated measures but as an articulated set of actions spanning translation, cultural mediation, editorial circulation, and public promotion. Four principal lines are proposed below.

First, it is crucial to optimize translation models. Experience shows that neither absolute literalism nor full domestication offers satisfactory solutions. To strike a balance, it is advisable to promote co-translation teams that combine the linguistic competence of native target-language translators with the deep cultural knowledge of Chinese specialists. Such teams can ensure both fidelity to local nuances and stylistic fluency. In addition, it would be prudent to develop pre-established treatment protocols for sensitive elements—dialects, folk songs, religious references—so that decisions are not taken ad hoc in each case [14].

Second, cultural mediation should be reinforced through paratextual and pedagogical resources. The incorporation of glossaries, translator's introductions, explanatory notes, and even visual appendices (maps, family trees, historical timelines) can significantly reduce barriers to comprehension. These tools should not be seen as obstacles to literary enjoyment but as bridges enabling foreign readers to access a dense and complex cultural universe. Likewise, in the digital era there is scope for offering enhanced electronic editions with links to audiovisual materials—songs, photographs, recordings of opera—that intensify the reading experience [15].

The third strategic line concerns diversifying channels of circulation. Publishing printed translations is not enough: multiple formats should be leveraged, such as ebooks, audiobooks, and—where feasible—screen or stage adaptations. Owing to their strong narrative and visual dimension, works of Shaanxi's rural literature hold considerable potential for documentaries, television series, or theatrical pieces. These products do not replace the literary work, but they enlarge its reach and bring it to broader audiences. Similarly, digital review platforms and reading communities can be integrated into promotion campaigns, encouraging reader participation through virtual book clubs, interviews with translators, or events with specialists.

Finally, audience strategy requires special attention.

Segmenting readerships allows for tailored messaging: critical editions with scholarly apparatus for academic readers; fluent translations with minimal notes for general readers; interactive digital versions or multimedia adaptations for younger audiences. By recognizing audience diversity, Shaanxi's rural literature can avoid remaining confined to specialist circles and reach a wider readership base.

In sum, optimization strategies should aim to transform the current fragmented model into a coherent dissemination ecosystem in which translation, mediation, circulation, and promotion operate in an integrated manner. Only then can the rural voices of Shaanxi secure a stable and meaningful place in the international literary imagination—not as exotic curiosities, but as universal contributions to understanding the human condition.

6. Conclusion

The internationalization of Shaanxi's rural literature is advancing, but in an uneven and fragile manner. Translation is a necessary yet insufficient condition: although *Ren sheng*, *Qinqiang*, and *Bailuyuan* have crossed certain borders, language gaps persist (emblematically, the absence of a complete English version of *Bailuyuan*). In terms of circulation, the model has shifted from cultural diplomacy to niche academic editions and, more recently, to global platforms; this widens visibility but also generates commercial dependence. In reception, interest in authenticity coexists with difficulties of intelligibility when mediation on dialects, customs, and social structures is lacking.

The challenges are not purely linguistic: there is a deficit of sustained editorial strategies, paratexts and pedagogical materials, and a better fit between the works' potential and reader expectations. Optimization entails: co-translation teams, cultural mediation devices (prefaces, glossaries, guides), format diversification (ebook, audio, adaptations), and sustained cooperation among institutions, publishers, and universities.

In sum, the strength of Shaanxi lies in narrating universal processes from local experience. Converting that potential into durable legibility requires going beyond translation: contextualizing and articulating circulation so that these works are recognized not as regional curiosities but as central contributions to contemporary world literature.

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Research on the Construction Strategy of Sports Smart Learning Space

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Abstract

The most direct impact brought by intelligent education enabled by intelligent technology is the transformation of learning space. Therefore, to promote sports intelligent education effectively, constructing a sports intelligent learning space is crucial as it serves as a carrier for this educational paradigm and enables scientific and efficient use. This study aims to clarify the relationship between learning spaces and environments, establish strategies for constructing smart sports learning spaces, and identify their applications under new technological environments to facilitate high-quality development in sports teaching reform. The research highlights that building smart sport-learning spaces should be based on their functions while aligning with smart-learning connotations, considering characteristics unique to sport-based education, prioritizing learners' needs by clearly defining how technology will be applied within these settings while establishing principles, functions, and features accordingly. Based on this framework, five directions can guide the application strategies of smart sports learning spaces: connecting virtual and physical spaces; blending online/offline modes; integrating formal/informal approaches; linking school/social environments; transforming evaluation methods."

Keywords

smart Learning space
Sports wisdom learning space
Construction strategy

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1. Introduction

Education informatization is a crucial strategy for the advancement of education in China, as evidenced by the issuance of various policy documents such as Education Informatization 2.0, Artificial Intelligence Education Planning Strategy, 2035 Education Vision Plan and 14th Five-Year Education Development Plan. The most significant impact of smart education on teaching and learning lies in the transformation of learning spaces. Therefore, to effectively promote smart sports education at a practical level, constructing intelligent sports learning spaces serves as both the vehicle for realizing this educational paradigm shift and key to its scientific and efficient. Despite the absence of research topics being found through searches using keywords such as "smart sports learning space," "smart sports teaching space," or "sports learning environment" on CNKI or Web of Science databases, it does not necessarily indicate that

research on these subjects is nonexistent; rather, there are issues with cross-use of concepts between learning environments and semantic confusion within related fields like educational technology. However, over ten literature sources were identified through searches using keywords like “sports smart teaching environment” or “smart sports classroom.” These studies mainly focus on practical significance and theoretical research regarding construction design[1,2] of intelligent sports learning environments/spaces; development[3] and application[4] of innovative technologies within these settings; challenges encountered during implementation; countermeasures taken to address them; and pedagogical approaches based upon environmental factors.

2. Related concepts

2.1. Learning space

The study of learning space is a research topic that has gradually developed with the deepening of people’s understanding of education informatization and the new modes presented in the process of education development. Whether it is digital or physical learning space, it is the most important educational infrastructure[5] in the 21st century. In traditional teaching, the space of teaching and learning is relatively fixed, and few researchers do special research on the learning space from the perspective of the function and effect of promoting the occurrence of knowledge, but usually carry out related design research from the physical space pattern combining spatial design[6] science, pedagogy and psychology.

With the development of modern information technology, learning space can break through the limitations of physical places in the past and extend to the entire living space of students, so that the efficiency of informal learning can be improved. Learning takes place all over the campus, not just in the classroom. Learning space is the medium of educational change and can serve as a supporting condition for the shift from teaching paradigm to learning paradigm.

2.2. Analysis: Learning space and learning environment

For a long time, the connotation of the two concepts of learning space and learning environment and the function of the learning process are often mixed, and the boundary of the connotation of learning space and learning environment is fuzzy. Some scholars regard space as a specific environment, some will interpret the connotation of space by environment in research, and some will use space and environment alternately. Some studies take “learning space” as a specific concept without a specific definition, or take learning space as a part of the learning environment, and summarize the constituent elements of learning experience in smart learning environment into the experience brought by three kinds of stimuli, such as information technology, learning space and teaching method. After studying the existing literature, it is found that such examples are numerous, and it is a common phenomenon not only in sports discipline, but also in the whole field of educational technology research.

Scholars have a common understanding of the function of learning space, and generally compare learning space to a “container”, which plays the role of carrying the learning process, and can provide support and services in the space relying on this “container”. The similarities between the two lie in that both exist outside the learner and play a supporting role in learning as an external supporting condition for learning. Therefore, learning space and learning environment are neither big nor small, nor the relationship between inclusion and inclusion, both of which belong to different functions of a process under certain circumstances.

Chinese scholar Shen Shusheng summarized the learning space as “residence” and “transfer” from the function. “Residence” refers to the location and place where learning takes place. It is an important external support condition for learning and a basic place for organizing and implementing learning activities and behaviors. It can be a classroom for face-to-face learning activities, a network space for online interaction, or even a written space for digital resources.

2.3. Intelligent learning space

Academic circles tend to agree on the definition of the connotation of smart learning space, and generally believe that it can provide support and service for the learning process. Smart learning space is a learning space enabled by intelligent technology to integrate various characteristics of e-learning environment, help teachers

directly monitor the learning environment, understand the conditions of learners, provide real-time adaptive help for learners, and promote independent learning of learners. At the same time, smart technologies are not simply embedded applications, but create a learning ecosystem that enables teachers, parents and others to actively participate in the learning process [7] of learners. The smart learning space also provides real-time and continuous evidence of knowledge change, and seamlessly transfers learning activities from one learning environment to another.

Designed to provide learners with self-directed learning, self-motivation and personalized service, smart learning Spaces should focus on learners and content rather than devices[46], providing information through accessible technical resources to provide a complex learning experience. With the support of smart learning space, teachers can be liberated from tedious and repetitive teaching labor, and instead put into the diversified design of learning content and personalized guidance, so as to monitor the learning process of individual learners in a more fine-grained manner. In addition, learners can have the opportunity to choose and shape their own learning mix, providing support for immediate reflection and review of learners' learning progress. At the same time, the smart learning space can adapt to the choices of learners of various styles, and help students establish the correlation between the curriculum goal system and the realistic problem system, improve the mental structure of learners, and promote the generation [9]of wisdom of learners.

The construction of smart learning space should be guided by advanced educational ideas and theories, supported by appropriate information technology, tools, resources and activities, acquire, analyze and mine the perceived learning situation data, generate personalized learning tasks and activities, guide and help learners to make correct decisions, and effectively promote the development of intelligent ability and the emergence[8] of intelligent actions. Embodies the basic idea [8] of service learning. The aid of intelligent technology can make the teaching method adapt to the needs of learners. When constructing and designing smart learning space, the consistent principle of learning environment design should be considered to meet the needs of smart learning environment. Smart learning space is the learning space under smart learning environment, and smart learning environment is the stimulus to promote the effective occurrence of learning in smart learning space.

The learning space empowered by intelligent technology has three characteristics[41]: intelligent efficiency expression, value-oriented physical and mental state, and emotional resonance and unmasking of the conscious world. At the same time, he also proposed that the empowerment of intelligent technology has formed a distributed spatial system composed of multiple spatial elements. Through the mutual influence of learners, the material properties of the learning space show new characteristics of connectivity and integration, flexibility and openness, and enlightenment and wisdom on the basis of intelligent technology support.

To sum up, the connotation of intelligent learning space can be summarized as intelligent learning space supporting and serving the learning process, giving full play to the functions of the learning space to meet the cognitive, social and emotional needs of individuals and groups in learning. In order to obtain better ability improvement in the learning process, intelligent technology is set up to provide intelligent empowerment, so as to promote the cultivation of ability. At the same time, it helps learners apply individual and group wisdom to construct a new learning field of the trinity of knowledge.

3. Strategies for the construction of sports smart learning space

3.1. Based on the function of learning space

The function of learning space in the learning process is the basis of the construction of sports smart learning space. Learning space has the functions of "residence" and "transfer" in terms of function. "Residence" refers to the location where learning takes place. It can also be a network virtual platform such as online MOOC resources. The increase of learning space brings diversification of learning space, enhancement of functions and expansion of learning process. "Transfer" has the function of learning pathway and learning exhibition area. Pathway refers to the enhancement of learning objects, or some means and tools to help them understand the essence

behind the phenomenon. For example, intelligent technical analysis device is set up in the sports field, and learners can see the details of their own skill learning and compare it with standard movements. So that learners can accelerate the mastery of scientific and standardized technical movements.

3.2. Conform to the connotation of intelligent learning

The core value of sports smart learning space compared with traditional sports learning space is that sports smart learning can reflect all the demands of today's education for talent training, and this value is reflected in the connotation of following smart learning. The learning activities carried by smart learning space should be smart learning activities, and smart learning is to better serve learning, take learners as the center, apply the latest intelligent technologies such as the Internet of Things, big data, artificial intelligence technology, etc., to bring more personalized, accurate, objectified, convenient and social support to the learning process, and have the perception ability of subject and object. Intelligent technology, as the basis for the construction of learning environment, enables learning to take place in an environment full of intelligent technology and stimulates the occurrence of wisdom, and promotes the interaction and negotiation between learners. At the same time, the pursuit of the "people-oriented" concept, to cultivate people's wisdom as the process is also the ultimate goal, in order to promote the cultivation of advanced ability. With the support of intelligent learning, learners can not only gain wisdom, but also learn to correctly apply wisdom to deal with real problems in the real context[9].

Scholars' definition of the connotation of intelligent learning can be summarized into three dimensions: intelligent technology environment (technical perspective), wisdom cultivation(ability perspective), and how to apply wisdom (process perspective). Based on the consensus of the academic circle on the connotation of intelligent learning, this study should construct the intelligent characteristics of sports intelligent learning space from three dimensions, namely, intelligent perception, pointing to the assistance and research and development of intelligent technology; Intelligent development, pointing to the creation of learning environment; And the application of wisdom, which points to the resources produced by wisdom and their utilization[10].

3.3. Learning features around sports

The characteristics of physical education learning are the fundamental and value that make the subject of physical education independent from the forest of educational scientific research. Physical education subjects take motor skills as the object of cognition, body practice as the main form of activity, and embodied cognition process through muscle activity. Therefore, the core position of physical activity as the main form of learning cannot be shaken. It is necessary to build sports intelligent learning space around the body movement, which is the embodiment of the independence of sports learning research under the concept of smart education. Therefore, the learning process should grasp the rules of each stage of sports skill learning, and make the sports intelligent learning space serve and support the efficient learning of sports skills as the carrier of sports skill learning.

3.4. Take learning needs as the center

One of the characteristics of smart learning space is the application of intelligent technology to better serve the learning process of learners. In the construction of sports smart learning space, we should not put on a flashy coat for sports learning to cater to technology, resulting in the occurrence of technicalism and putting the cart before the horse in the construction of sports smart learning space. Malcolm Brown believes that learners should be encouraged to participate in the design of learning space, in order to build a smart learning space that can support active learning, interaction and social participation. Therefore, the curriculum objectives and learning needs should be the core, and the construction of sports smart learning space should be based on how learners can better master sports skills and obtain all-round ability improvement in the process of sports learning. The research and development and application of intelligent technology should be carried out through the real needs of educational practice.

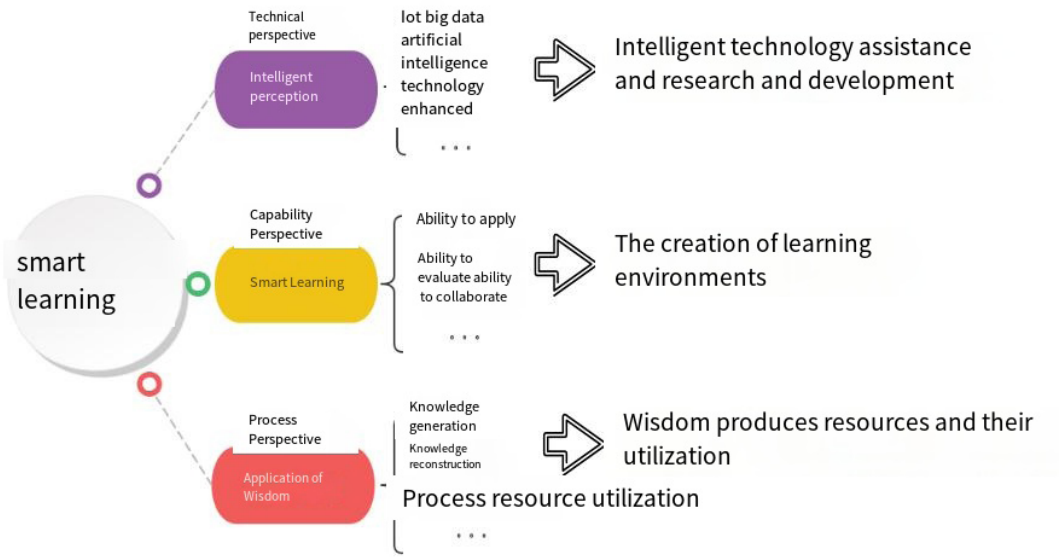

Figure 1. Smart learning

Table 1. Construction principles, characteristics and functions of sports smart learning space

Principles	Element Embodiment
A center	Learner-centered
Two around	Practice around the body and learn rules around motor skills
Three dimensions	Wisdom perception (technology perspective), wisdom development (ability perspective), wisdom application (process perspective)
Five forms	Physical and virtual Spaces are connected; Intelligent technology to assist skill learning; Online learning and offline learning mixed; Combining formal learning with informal learning; And the connection between the school and the society
Five characteristics	Perceptivity, ubiquity, connectivity, resource richness, multi-dimensional negotiation and interaction
Nine functions	Data analysis and decision, mobile learning, cooperative learning, adaptive learning, differential learning, intelligent assistance, social context connection, process monitoring, ubiquitous guidance

3.5. Principles, features and functions of overall construction

In order to better guide the learning practice, it is clear that the construction principles, characteristics and functions of the sports smart learning space are the premise of giving full play to the sports smart learning space to serve sports learning and conform to the rules of sports learning. The construction of sports smart learning space should follow one center, two surrounds, three dimensions, five forms, five features and nine functions (**Table 1**).

4. Suggestions and vision

The purpose of this study is to provide the construction strategies of sports intelligent learning space, and provide a construction idea for sports education researchers. In the specific process of physical education teaching practice, an educational research design process integrating the whole process of construction and testing in practice should be established. Through the problems and needs arising from real situations in teaching, In collaboration with industrial institutions, management departments and students, the iterative design and development will be carried out to create a "general and effective" framework for sports smart learning space and form a universal model.

Disclosure statement

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A Study on the Development of Young Children's Problem-Solving Abilities in Outdoor Construction Play and Teacher Support Strategies

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Abstract

Guided by Vygotsky's Zone of Proximal Development theory and employing qualitative case analysis, this study delves into young children's problem-solving behaviors during outdoor constructive play and the underlying cognitive-emotional interaction mechanisms. Findings reveal that children exhibit a "trial-adjustment-continuation" problem-solving pattern, with strategy selection jointly influenced by cognitive level and emotional regulation capacity. Teachers effectively facilitated systematic transfer of experiences and the formation of associative thinking through a three-dimensional support strategy: "cognitive groundwork—delayed analysis—emotional reinforcement." Based on practical reflection, this study proposes three pedagogical principles: "timely nurturing, mutual learning empowerment, and trusting autonomy." These principles aim to construct an educational pathway integrating teacher resilience support with children's autonomous exploration, providing theoretical and practical references for cultivating young children's problem-solving abilities.

Keywords

Outdoor Play
Child Psychology
Constructive Play

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1. Introduction

Outdoor play serves not only as an outlet for energy but also as a setting rich in cognitive, social, and emotional demands. It guides children in setting goals, testing ideas, and negotiating with peers. Within this space, construction play using low-cost materials—such as pipes, building blocks, and cardboard—is particularly creative: open-ended materials offer multiple solutions, stimulating iterative design. However, little is known about the precise strategies young children employ to overcome obstacles in such settings, or how specific teacher interventions sustain or guide these efforts. Drawing on social constructivist learning theory [1] and classical scaffolding theory [2], this study examines problem-solving processes during outdoor construction play in a kindergarten classroom. The research poses the following questions:

(1) Can teacher support strategies resonate with

children's developmental levels?

(2) Can teacher guidance and children's experience transfer be mutually empowering?

(3) How do material cognition and problem-solving thinking develop?

Employing naturalistic video observation and a micro-genetic perspective[3], this study seeks to link the enabling characteristics of outdoor building material environments with the developmental process of problem solving. It also explores the tension between adult guidance and children's autonomy, as well as how safety regulations and material accessibility influence participation [4]. This study employs the term "outdoor building play" rather than "building play." In play research, play typically denotes fixed rule sets and externally defined goals, whereas game emphasizes children's autonomy, openness, and flexible objectives [5].

Outdoor construction play refers to children's self-initiated activities in outdoor settings, where they arrange, combine, balance, and transform low-structured materials to realize individual or collective design concepts or functionalities [6]. Typical materials include so-called loose parts—such as cardboard, pipes, wooden planks, crates, fabric, and logs—whose ambiguous properties yield multiple solutions. The outdoor environment, with its uneven surfaces, variable weather, and expansive activity space, creates rich opportunities for problem discovery and resolution[7].

Outdoor construction zones integrate physical space, variable surfaces, and low-structured materials to form what we term "multidimensional problem fields"—where objectives, constraints, and resources flow and intermingle. Unlike fixed equipment, loose-part materials can be reconfigured and reused, amplifying opportunities for planning, testing, and refinement [6]. Existing research indicates that such play is closely linked to spatial reasoning abilities and subsequent STEM-related competencies [8]. In this study setting, recycled materials (paper rolls, wood scraps, corrugated cardboard) prompted children to transition from two-dimensional layouts to three-dimensional constructions. This shift introduced core themes such as stability, balance, and collaborative design. These inherent challenges—allocating scarce materials, coordinating actions, and incorporating others' ideas—transform the construction zone into an effective setting for observing authentic problem-solving processes, rather than artificially designed task scenarios[7].

This study posits that problem-solving ability manifests in children's observable use and coordination of strategies (e.g., trial-and-error, forward planning, analogy reuse, social negotiation) while pursuing play goals, alongside their perseverance and flexible self-evaluation skills [9]. In outdoor construction activities, irregular materials and dynamically shifting social demands continuously trigger cognitive conflicts, guiding children through a cycle of problem identification → strategy exploration → practical testing → evaluation and refinement [6]. Teacher guidance plays a critical role here: timely prompts, discourse restructuring, or implicit tool provision can expand children's "zone of proximal development" [1,2]. Thus, we regard construction play as a natural laboratory for examining how strategy application emerges, stabilizes, and transforms through interactions involving adult scaffolding and peer collaboration[5].

2. Methodology

This study employs a case study approach within a qualitative research paradigm to deeply explore the specific manifestations of young children's problem-solving abilities in a particular context (outdoor construction play) and the interactive mechanisms between these abilities and teacher support strategies[10]. The research design adheres to the principle of "systematic observation in natural settings," emphasizing the capture of children's behavioral details and teacher-child interaction processes within authentic educational practices[11].

3. Research Sample

This study was conducted in a preschool class at XX Kindergarten in XX City. The class comprised 18 children aged 3–4 years (M = 3.5 years). Employing purposive sampling[12], one child—a 3-year-8-month-old boy identified as "Mingming"—was selected as the core observation subject. The selection criteria were: high engagement in play activities, cognitive and social abilities at the class average level, and behavioral patterns

exhibiting good typicality and representativeness. The research setting was the kindergarten's outdoor construction area, equipped with low-structure materials such as paper rolls, wooden blocks, cardboard, and aluminum cans, creating a rich and open problem-solving environment for children.

4. Data Collection and Analysis

Data collection primarily employed two methods to ensure richness and dual verification, with comprehensive analysis conducted using case study methodology.

Non-participatory observation: The researcher conducted outdoor play observations twice weekly for 90 minutes per session between April and June 2025. Employing a combination of time sampling and event sampling methods, continuous and detailed records were made of Mingming and his peers' problem-solving behaviors (e.g., attempts, seeking help, strategy adjustments, success/failure) and teachers' supportive behaviors (e.g., questioning, modeling, emotional encouragement, material provision), supplemented by field notes[13].

Teacher Interview: Following the observation period, a semi-structured interview was conducted with the primary classroom teacher. The interview focused on the teacher's intentions in supporting children's problem-solving, the rationale behind strategy selection, and reflections on intervention effectiveness. This aimed to understand the educational philosophy underlying the teacher's behaviors from their perspective[14].

5. Data Analysis

5.1. RQ1: Can teacher support strategies resonate with children's developmental levels?

In outdoor construction play, young children's problem-solving processes reflect dual trajectories of emotional regulation and cognitive development. On one hand, preschoolers in the younger age group demonstrate nascent resilience when encountering construction challenges. Their "attempt-adjust-persist" behavioral pattern reveals emotional stability and play persistence. On the other hand, their problem-solving efficacy is constrained by cognitive development. When confronted with abstract challenges like material properties, they tend to pursue "indirect development" by shifting the game's direction.

Recording:

Mingming erected two long toilet paper rolls as columns and placed a rectangular block horizontally as a ceiling. After completing the first floor, he attempted to build the second floor using the same method. However, as soon as he placed two cans on top, the first floor collapsed. Undeterred by this first failure, he rebuilt the fallen section. Yet every time he attempted the second level, the long paper roll cores on the first level collapsed. After several failures, Mingming came to me for help: "Teacher, why does my house always fall down?" I replied, "Since your first level keeps collapsing, there must be an issue with it. Can you identify any unsuitable materials in your first level?" Following my advice, he returned to continue building. A short while later, when I checked on him, I found he had stopped building a house and was instead constructing a bridge.

During outdoor construction play, children demonstrate emotional regulation and problem-solving skills when facing failures. In this case, Mingming didn't give up after his initial failure. He kept trying, sought help from the teacher after multiple setbacks, and when his request didn't solve the problem, he calmly adjusted his building plan instead of crying or throwing a tantrum. This shows that children can remain relatively emotionally stable and respond positively when facing challenges. Simultaneously, children's problem-solving abilities are influenced by cognitive development and life experience. Due to limited cognitive levels, preschoolers struggle to comprehend issues like the length, thinness, and material properties of toilet paper rolls affecting structural stability. Mingming, for instance, couldn't grasp the teacher's guidance regarding material limitations. However, they do not halt play due to unresolved problems but instead flexibly adjust their play direction.

During the children's play, the teacher attempted to provide cognitive support by posing questions to help them discover the material issue—that using a long paper roll core was unsuitable for constructing a single layer of pillars. However, due to the preschoolers' limited cognitive development and life experience, they were

unable to effectively understand the teacher's guidance. Consequently, the support provided by the teacher did not effectively resolve the problem the children faced. Subsequently, the children chose to abandon the issue and continue playing. This demonstrates that not every problem encountered in children's play requires immediate resolution. Support strategies that do not align with children's cognitive development and experiential background are unlikely to effectively assist them in solving problems. Teachers can assess whether a particular issue will disrupt the normal flow of play. If children can continue playing using their own methods, there is no need to rush to resolve the problem.

5.2. RQ2: Can teacher guidance and children's experience transfer be mutually empowering?

When solving problems encountered during outdoor play, young children need to draw upon their existing experiences. These experiences stem from all aspects of their daily lives. On one hand, preschoolers in the current small class can already spontaneously draw upon fragmented experiences to achieve cross-contextual strategy transfer, demonstrating the cognitive leap of "assimilation-accommodation." On the other hand, the three-dimensional support system constructed by teachers—through prior cognitive groundwork, delayed experience connections, and positive emotional reinforcement—not only provides scaffolding for children's independent exploration but also subtly advances their experience integration capabilities from "fragmented responses" to "systematic thinking."

Recording:

Mingming was building a house using wooden and plastic blocks. Progress was smooth initially as he selected materials based on his construction pace. When reaching the roof stage, he realized the large triangular blocks he needed were depleted. He searched through various bins, rummaging through boxes only to find small triangular blocks. He took several small triangles and fiddled with them on his house. Soon, he combined two small triangles to form a large one. After assembling it, he excitedly told me, "Teacher, look! I made a big triangle with two small ones!" I praised him: "You're amazing! You applied the skills you learned yesterday with the brain-teaser toys here!" During the game-sharing session, I shared Mingming's successful experience with the other children.

In outdoor construction play, children's problem-solving behaviors fully demonstrate the development of their ability to transfer and integrate experiences. In this case, Mingming encountered an obstacle while building a roof due to a shortage of materials. However, he quickly drew upon the shape-combining skills he had acquired during individualized learning activities. By combining two small triangular blocks into a large triangle to replace the missing material, he successfully overcame the challenge. This process indicates that preschoolers possess the awareness to transfer concrete experiences gained in activity areas to construction scenarios. Especially when play materials share similarities in shape, function, or other attributes with their original experiential carriers, they can proactively establish connections and attempt cross-contextual problem-solving strategies, demonstrating the "assimilation-accommodation" process. Mingming's actions not only reflect a deepened understanding of shape-matching principles but also demonstrate an emerging ability to integrate fragmented experiences into a universal problem-solving approach. This capacity enables him to apply consistent logic to similar challenges across different scenarios.

Teachers effectively fostered children's experiential transfer abilities through multidimensional support strategies. Cognitively, early individualized learning involving shape combination activities helped children accumulate foundational experience with triangle assembly, laying the cognitive groundwork for flexible application in subsequent construction play. During extended support sessions, teachers leveraged post-game sharing opportunities to transform Mingming's successful case into a collective learning resource. This approach reinforced his personal sense of accomplishment while guiding all children to recognize the transferability of experiences across different activity areas, gradually building metacognitive awareness that "learning experiences can be transferred." On the emotional front, timely encouragement and affirmation from teachers not only bolstered children's confidence in facing challenges but also reinforced the positive experience cycle of "attempt-solve-succeed" through positive feedback. This phased, multidimensional support model respects the

learning characteristics of preschoolers—who primarily rely on direct experiences—while subtly advancing their ability to integrate experiences to higher levels.

5.3. RQ3: How do material cognition and problem-solving thinking develop?

In the practical setting of outdoor construction play, young children's understanding of material properties and problem-solving abilities develop dynamically through embodied manipulation. Through emotional encouragement and cognitive guidance, teachers both strengthen children's confidence in exploration and help them transform fragmented experiences into transferable cognitive structures. This "experience-reflection" support model safeguards children's autonomy while cultivating their associative thinking between "material properties and problem-solving," revealing the mechanisms of deep learning within play contexts.

Recording:

Mingming selected wooden blocks and cardboard for construction today. He first used cylindrical wooden blocks as first-floor columns, placing large rectangular cardboard pieces atop them. He then selected various blocks to build a second level on the cardboard, seemingly without a clear pattern. During the sharing session, I asked Mingming to describe his creation while other children could ask questions. Mingming said, "This is the little park I built." Chenchen asked, "What's this tallest roof part?" Mingming pointed and explained, "This is the office. There's a little opening here—it's the park's gate. You go in through here." I pointed to two long cardboard pieces and asked, "What are these long cardboard pieces?" Mingming replied, "These are the roof. You can place blocks on top so the roof won't blow away." I said, "Mingming knows blocks are heavy, while cardboard is light and easily blown away by wind. So he placed blocks on top of the cardboard to weigh it down. This is a very useful method. Next time, we can learn from his clever idea."

During outdoor construction play, children's understanding and application of material properties naturally emerge through specific contexts. In this case, Mingming demonstrated a clear grasp of materials' physical characteristics during building: he observed that thin cardboard is easily affected by wind, while building blocks provide stability due to their weight. He then proactively combined the two materials—using blocks to weigh down the cardboard edges against wind interference. This behavior indicates that preschoolers can accumulate material experience through direct perception and have begun to develop a basic physical understanding of "light versus heavy." When natural factors (like wind) disrupt the building process, children can mobilize diverse materials from their environment (such as construction units of different textures and weights) as problem-solving tools. This demonstrates how the open-ended nature of play materials supports children in responding to challenges.

Teachers deepen children's play experiences and learning abilities through dual emotional and cognitive support. During the sharing session, teachers employed peer-to-peer interactions and teacher-student questioning to guide children's focus on Mingming's material combination strategy. This approach reinforced his sense of accomplishment through peer affirmation while analyzing the principle of "securing lighter objects with heavier ones" through concrete examples, transforming fragmented experiences into transferable cognitive structures. This support strategy safeguards children's enthusiasm for independent exploration while expanding individual experience boundaries through collective wisdom—teachers guided children to observe material weight differences through questioning, making abstract concepts tangible. Timely emotional encouragement combined with cognitive refinement of experiences synergistically propelled children to construct "material properties-problem solving" associative thinking within authentic problem-solving contexts.

6. Conclusions

This study systematically examined preschoolers' problem-solving behaviors during outdoor construction play and their interactive mechanisms with teacher support through qualitative case analysis. Key findings can be summarized in three aspects: First, the problem situations encountered by children in outdoor construction play primarily encompass three categories: structural challenges with materials, scarcity challenges with resources, and environmental

interference challenges. Second, when confronting these challenges, children exhibited a foundational "attempt-adjust-persist" behavioral pattern. They flexibly applied multi-tiered resolution strategies—persistence, experience transfer, and strategic avoidance—based on situational complexity. Most critically, the study revealed that the effectiveness of teacher support is highly contingent upon its alignment with children's cognitive developmental levels. By establishing a three-dimensional support system encompassing "cognitive groundwork, emotional empowerment, and socialized sharing," teachers can effectively facilitate children's transformation of fragmented experiences into systematic cognitive structures. This support helps children establish associative thinking between material properties and solution strategies, provided the intervention timing is accurately calibrated. Based on empirical findings, this study distills three educational principles: "timely nurturing," "mutual learning empowerment," and "trustful letting go." These principles provide theoretical foundations and practical guidance for constructing an educational pathway of collaborative development between teachers and children.

7. Limitations

This study has several limitations that warrant reflection. First, the single-case study design, while enabling in-depth description, limits the generalizability and extrapolation of findings. The subject, Mingming, possesses average abilities; although his behavioral patterns exhibit some typicality, they fail to encompass the diverse problem-solving approaches of children at different cognitive developmental levels and temperament types. Second, data collection primarily relied on observation and teacher interviews, lacking in-depth materials from the children's perspective (such as brief interviews or pictorial representations). Interpretations of children's internal cognitive motivations and emotional experiences thus depended heavily on adult external interpretations, carrying a certain risk of subjective inference. Furthermore, this study focused mainly on the immediate effects of teacher support, failing to track the long-term impact of these strategies on the development of children's problem-solving abilities. Future research should employ more diverse data sources and longer-term designs to reveal the developmental mechanisms of children's problem-solving abilities in a more comprehensive and profound manner.

Disclosure statement

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Analysis of Cultural Education System of Vocational Education at Undergraduate Level Based on Media Field Theory

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Abstract

In response to the current issues of single carriers and fragmented fields in cultural education at the undergraduate level of vocational education, this paper constructs a cultural education system supported by media field theory. The system focuses on three key areas, clarifies the foundational elements of actors, capital, and scenarios, optimizes a framework with horizontal synergy, vertical layering, and student-centered radiation, and establishes interactive, feedback, and incentive mechanisms to ensure its operation. This system innovatively breaks through traditional educational models by integrating resources across multiple fields, providing a new solution for the insufficient effectiveness of cultural education in undergraduate vocational education, and has practical significance for cultivating technical and skilled talents with both professional and cultural literacy.

Keywords

media field theory
undergraduate vocational education
cultural education system
system operation

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1. Introduction

China's vocational education has entered a phase of high-quality development. As an undergraduate-level vocational education bridging vocational and higher education, its cultural edification function has become increasingly prominent. However, current practices in this field face common challenges such as insufficient teacher-student interaction and misalignment between occupational demands and educational objectives, which fail to meet the comprehensive quality requirements for talents in the new era. Media field theory offers innovative solutions by emphasizing the interaction, competition, and integration of various media elements within the field. This theory enables the systematic integration of diverse communication channels and cultural resources in undergraduate vocational education[1]. Guided by this framework, our research establishes a cultural edification system for undergraduate vocational education, clarifying its construction and operational methods. This approach enhances the relevance and effectiveness of cultural

education, ultimately supporting the cultivation of well-rounded talents with disciplinary expertise, cultural literacy, innovative capabilities, and professional competence.

2. The core content of media field theory

2.1. Theoretical connotation and core elements

Pierre Bourdieu first introduced the concept of field, defining it as a social spatial unit where various elements interweave while maintaining independence. Within this space, different elements operate according to specific logic, forming dynamic networks of social relations through continuous competition and interaction[2]. Key characteristics of fields include: autonomy – once established, fields develop their own relatively independent operational rules and value systems, with developmental trajectories unaffected by external environments; competitiveness – actors within fields persistently vie for dominance through capital acquisition; and structural hierarchy – fields exhibit clearly stratified structures where participants occupy positions in power networks based on the quantity and type of capital they control[3].

As a complex social system, the media field can be analyzed from multiple dimensions[4]. First, the core elements of the field are composed of three groups: content creators (journalists, editors, and content producers), information consumers (audience who receive and provide feedback), and regulatory bodies (government agencies and industry associations) that formulate policies. Second, capital operates through three dimensions: cultural capital (professional expertise and aesthetic value), symbolic capital (brand reputation and social prestige), and technical capital (digital platforms and communication devices). Third, operational rules maintain order through three mechanisms: interaction protocols that regulate communication, adaptive protocols that ensure environmental responsiveness, and integration protocols that coordinate elements. These components interact and constrain each other, collectively forming a dynamic equilibrium system within the media field.

2.2. The congruence between theory and undergraduate vocational education culture

Media field theory and undergraduate vocational education cultural literacy cultivation align in three dimensions: goal, teaching media and process[5]. Both emphasize cultivating society-needs-meeting talents who are comprehensive, professional with expertise and humanity. Vocational education's diverse teaching media correspond to the theory's core elements, serving as both knowledge transmitters and cultural channels. In process, dynamic interactions of media field elements (teachers, platforms, audience) reflect vocational education's teaching, learning, practice and cultivation mode. Integrating the theory into traditional cultural education activates teaching elements, turning cultural literacy cultivation from one-way transmission to multi-stakeholder interactive dialogue.

3. Constructing a cultural education system for undergraduate-level vocational education based on media field theory

3.1. Sort out the elements of the field, screen out the core elements of the cultural education system

First, identify key personnel in the cultural education system. By employing in-depth interviews and social network analysis, we can deconstruct critical roles such as teachers, school administrators, students, industry experts, and corporate mentors to uncover their competency differences. For instance, teachers play a leading role in cultivating professional competence and integrating ideological education into curricula, while students need to develop self-directed learning skills and personalized development needs. Clarifying the power structures and interaction patterns among these stakeholders lays the foundation for building an education system with well-defined responsibilities and collaborative efficiency[6].

Secondly, conduct a comprehensive evaluation of capital resources. By integrating the SWOT analysis method and resource audit approach, we assess the school's technological, cultural, and symbolic assets. Technological capital includes virtual training systems and smart campus infrastructure development. Cultural

capital encompasses school-based teaching materials and vocational case repositories. Symbolic capital encompasses not only traditional skills competition awards but also the influence and scale of campus partnership brands. Through analyzing the potential and transformation pathways of these resources, we establish a dynamic resource allocation framework[7].

Finally, analyze interactive scenarios. Through methods such as focus group interviews, participatory observation, and big data analysis, conduct comprehensive research on core scenarios within the cultural education system. Specific investigation content should include: curriculum instruction, evaluating the integration effects of digital and traditional media; practical training scenarios, analyzing current applications and limitations of smart wearable devices and virtual reality technologies; campus cultural activities, examining dissemination characteristics of new media platforms to optimize educational promotion models; school-enterprise collaboration, conducting in-depth analysis of blended online-offline collaborative education mechanisms. By establishing scenario-based demand analysis models, provide differentiated and context-specific solutions for designing the cultural education system[8].

3.2. Optimize the field structure and build the overall framework of cultural education system

First, horizontal integration to break down barriers between scenarios. By using media as a link, we can bridge the gaps between classroom, practical training, campus and enterprise scenarios, forming a collaborative field of mutual penetration and resource sharing. The main contents of the four media fields are shown in **Table 1**.

Second, vertical stratification, matching career development stages. Design differentiated media field content and carriers by grade, avoiding a one-size-fits-all approach in cultural education, as shown in **Figure 1**.

Table 1. Four main media fields of horizontal integration

Types of media fields	Core content	Implementation method
Classroom	Smart teaching platform	Integrate online course resources with offline interactive media, and simultaneously advance theoretical instruction and cultural immersion.
Practical training	Virtual simulation system + training live platform	Students simulate high-risk and complex practical operations through virtual simulation systems, integrating professional ethics into skill training. Enterprise mentors provide real-time guidance to students' practices via live streaming platforms.
School campus	Online campus culture matrix + offline cultural space	Online operation of campus WeChat public accounts, Douyin accounts, and Bilibili accounts, offline construction of professional culture corridors and innovation achievement display areas, and setting up interactive screens.
Company	University-enterprise collaborative talent cultivation platform	Enterprises upload media resources such as documentary films on their development history through the platform; schools organize students to participate in online job rotations and virtual project practices through the platform.

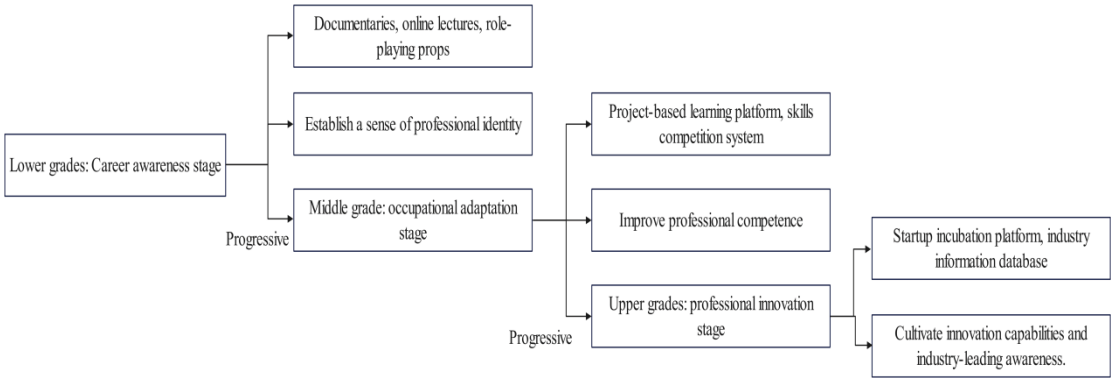

Figure 1. Vertical stratification diagram

Third, Centered Radiation: Building a Field Interaction Network. Resource Radiation: Establish an intelligent recommendation system that matches student needs with resources, collecting students' demands across vocational culture, traditional and innovative cultural dimensions, and automatically matching corresponding media resources. Actor Alignment: Construct a multi-stakeholder collaboration network, maintaining student-centered positioning where corporate mentors, teachers, alumni, and industry experts can establish connections through the student growth support platform[9]. Feedback Radiation: Implement a rapid response mechanism for student feedback and adjustment systems. Students submit evaluations and suggestions on various media resources and activities via the cultural education feedback platform, with all feedback information being instantly synchronized to field managers.

3.3. Establish field mechanisms to ensure the efficient operation of the cultural education system.

To build a multi-level, three-dimensional and multi-dimensional interactive mechanism for cultural education system collaboration, we create an online-offline integrated platform for teaching interaction. In practice, students and enterprise mentors share visualized results via cloud training log platforms. For resource sharing, schools and enterprises co-build a media integration platform to realize real-time sharing of course materials, practice cases and corporate culture videos[10].

To build a dynamic feedback system for precise monitoring and continuous optimization of cultural education effectiveness, we use big data analysis and multi-dimensional questionnaires to track students' participation in courses and practices in real time. We develop a digital enterprise evaluation platform for enterprises to assess students in professional, technical and innovative abilities, and build a cultural education effect monitoring data center to integrate multi-source data (teaching evaluation, practice feedback, social impact) and establish a dynamic evaluation model.

To innovate the capital transformation incentive model in the media ecosystem and stimulate multi-stakeholder participation, we will establish a dual-point accumulation system for students: those publishing papers in core journals get innovation points, and those winning international or national skill competitions receive college admission bonus points and special scholarships.

4. The operation of the cultural education system of vocational education at the undergraduate level based on the field theory of media

4.1. Develop a three-stage cultural education system operation process

Establish the operational process for the three stages of initiation, advancement, and conclusion, to accelerate the practical implementation of the theoretical framework.

In the initiation phase, which lasts for the first 1-2 weeks of the semester, complete the preparatory work before operations. Based on the results of the field element analysis, clearly define the semester task lists for each stakeholder, such as teachers needing to determine the content of the cultural education modules for 3 courses, and enterprise mentors needing to submit their online guidance schedules[11]. According to the inventory of capital resources, complete the resource allocation. Based on the four horizontal integration media scenarios, develop specific activity plans, such as setting the second week of each month as 'Campus Career Culture Week'. At the same time, hold an initiation meeting to clarify operational requirements and collaboration rules for all parties involved.

During the advancement phase, weeks 16-18 of the semester. Promote multi-field collaboration according to the structural framework. Horizontally, each week facilitate resource sharing between classroom and practical training environments, such as synchronizing classroom cases to practical operation references. Monthly, organize campus and enterprise environment linkage activities, such as enterprises participating in campus cultural festival lectures. Vertically, conduct phased activities by grade level, with lower grades watching one occupational documentary per month, middle grades engaging in project-based practices every two weeks, and upper grades participating in two entrepreneurial project discussions per semester. In the central radiation aspect, collect student needs every two weeks, and adjust resource matching and actor response

plans in real-time.

In the final stage, which lasts for 2-3 weeks at the end of the semester, assess the effectiveness and prepare a summary. Utilize the feedback mechanisms within the field mechanism to collect data on student satisfaction and corporate evaluations, and organize a summary meeting with all stakeholders[12]. Review the issues that arose during the system's operation, write a report on the system's operation, and determine the specific optimization directions for the next phase.

4.2. Establish a mechanism to ensure the operation and support of a cultural education system

Based on the interactive, feedback, incentive, and other field mechanisms that have been established, specific safeguard measures need to be designed to avoid the mechanisms becoming mere formalities, which would make it difficult for them to function effectively.

(1)Interaction mechanism execution guarantee. Establish an interaction frequency assessment form, clearly defining interaction requirements for each party, such as teachers having at least 2 online interactions per week, and corporate mentors providing at least 1 offline guidance session per month, which will be reviewed monthly by the academic affairs office; build a unified interaction platform, integrating MOOC discussion areas and training log systems, to achieve real-time recording of interaction data, such as automatically reminding corporate mentors to provide feedback within 24 hours after a student submits a training log.

(2) Feedback Mechanism Implementation. Establish a dedicated Feedback Data Officer to collect monthly feedback from students and enterprises, ensuring a response rate of no less than 90%[13]. Develop a feedback processing workflow: For collected issues such as inadequate practical training guidance, assign them to relevant departments within 3 working days, provide solutions within one week, and publicly disclose the resolution results to all concerned parties.

(3)Implementation guarantee for incentive mechanisms. Develop the 'Details of Incentive Implementation' to clearly define the specific criteria for credit rewards and performance bonuses, such as awarding 2 innovation credits for students publishing papers on professional culture; establish an incentive review committee to complete the qualification review for all parties within one week at the end of the semester. After the review results are publicly displayed without objections, the rewards will be realized within one month, and teachers[14].

4.3. Establish a dynamic adjustment mechanism for the operation of cultural education system

Considering the potential issues that may arise in the actual operation of the cultural education system, establish a dynamic adjustment mechanism to form a good cycle of practice, feedback, and optimization. The specific components of the dynamic mechanism are as follows:

(1) Element Optimization. When identifying underperforming actors (e.g., insufficiently engaged corporate mentors), adjust their responsibilities by reducing online guidance sessions and increasing in-person lectures. For underutilized capital resources (e.g., low adoption of legacy teaching cases), initiate resource updates through collaborative development with enterprises to create new case libraries [15]. Regarding underutilized interactive scenarios (e.g., low participation rates in school-enterprise collaborations), optimize formats by transitioning from physical campus tours to virtual corporate visits.

(2) Structural Optimization. For example, if two lateral fields (such as classroom and campus collaboration) lack coordination, introduce new collaborative activities where classroom cultural works are exhibited on campus. If a grade level in vertical stratification shows poor activity effectiveness, adjust content by replacing project-based practices with real-world enterprise task simulations. For resource matching accuracy issues in central radiation systems, upgrade the intelligent matching system by adding keyword recognition capabilities for demand identification.

(3) Mechanism Optimization. For underper forming online interaction mechanisms, introduce a new points-based system where student participation in interactions can be exchanged for learning resources. To address inefficient feedback processing, streamline procedures by reducing the processing time from 3 to 1 working day. Regarding insufficient corporate engagement in incentive mechanisms, implement additional incentives: companies meeting graduate employment rate targets through corporate recommendations will receive partnership subsidies.

5. Summarize

Based on media field theory's actors, capital and rules, this study builds a cultural education system for undergraduate vocational education. It clarifies key entities, resources and scenarios via field element analysis, optimizes structure into horizontal collaboration, hierarchical vertical advancement and student-centered radiation, and adopts interactive, feedback and incentive mechanisms. Operating in initiation-advancement-closure phases with execution safeguards and dynamic optimization of elements, structures and mechanisms, this theory-practice-integration closed-loop enhances cultural education's relevance and effectiveness, supporting high-quality technical talent cultivation.

Disclosure statement

The author declares no conflict of interest.

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Enhancing Chinese Student Participation in TESOL Classrooms through Culturally Responsive Teaching

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Abstract

Chinese students in TESOL classrooms often demonstrate low verbal participation, which is frequently misunderstood as a lack of language proficiency. However, this silence is deeply rooted in cultural norms that emphasize humility and respect for authority. This paper explores how Culturally Responsive Teaching (CRT) integrates students' cultural identities into instructional practices to address this issue. By examining cultural factors such as Confucianism, reviewing the theoretical underpinnings and practical applications of CRT, and proposing targeted strategies like culturally relevant materials, modified group interactions, and inclusive teaching techniques, this study argues that Chinese students' participation can be enhanced without compromising their cultural identity.

Keywords

TESOL classrooms
Cultural Factors
Culturally Responsive Teaching

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1. Introduction

Culturally Responsive Teaching emphasizes the necessity of integrating students' cultural background into the teaching of academic knowledge and skills to enhance their learning interests and outcomes[1]. In the last thirty years, it has been widely used in Western educational settings and has proven to be effective.

The low participation of Chinese students in Teaching English to Speakers of Other Languages (TESOL) classes is often mistaken for a lack of language proficiency. However, in fact, it is the result of the influence of Chinese culture. Applying Culturally Responsive Teaching allows for a cultural understanding of what contributes to this phenomenon, which can then be targeted to increase their engagement.

This essay explores strategies for applying Culturally Responsive Teaching to improve Chinese students' engagement in TESOL classrooms. First, it explores cultural factors affecting Chinese students' classroom participation, especially Confucianism. Next, it reviews Culturally Responsive Teaching and its practice. Finally, it proposes strategies for applying Culturally Responsive Teaching to enhance Chinese student participation.

This essay argues that Chinese students' reticence in the TESOL classroom is a culturally influenced response rather than a deliberate lack of cooperation or language proficiency. However, culturally responsive pedagogy, if utilized appropriately, can provide effective strategies

to promote students' courage to share their ideas and increase participation.

2. Background: Cultural Factors Affecting Chinese Students' Classroom Participation

Silence has long been used to describe classroom communication among Chinese students studying in TESOL classrooms. One possible explanation for this phenomenon is that they have difficulty in the process of expressing themselves in English. This explanation, while plausible, overlooks the fact that these phenomena also occur in advanced English learners. Hence, language ability is not the key factor. This phenomenon is essentially influenced by deep culture, which has deep roots, guides us in our behavior, and does not change easily with changes in geography[2]. To be specific, it is Confucianism, which has been the mainstream of Chinese thoughts, politics, and culture for generations[3]. From the perspective of Confucianism, "listening attentively" is the primary task of students. Keeping silence shows students' respect for the teacher's authority and is also a sign of humility, which is regarded as a universal moral principle[4].

Even when confronted with a difficult question, Chinese students tend to carefully choose to consult in private to avoid taking up class time. Yu pointed out that Confucianism has shaped people's expression mode in front of the public, and the "moderateness" it promotes is like a black hole that swallows people's words, and people basically express themselves with the minimum words[5]. Nevertheless, Confucianism does not prohibit speaking altogether; instead, it encourages students to share mature opinions on areas they are familiar with for the benefit of others.

When the silence caused by cultural factors occurs in the language class, it seems that the teacher is the only active person in the class, which is undoubtedly embarrassing and discouraging for the teacher. After a certain point, both teachers and students get tired of this one-sided interaction. In the TESOL classroom, such silence is obviously unwelcome, and it will undoubtedly seriously affect the teaching effect because language learning precisely needs participation and interaction.

3. Theory and Practice: Culturally Responsive Teaching and its Practice

Gay introduced the concept of Culturally Responsive Teaching, which she described as the integration of students' cultural backgrounds, lived experiences, and ethnic perspectives into the teaching of academic knowledge and skills[1]. Culturally Responsive Teaching is based on differentiated instruction and advocates for connecting the information being taught to the student's ancestral and current culture[6]. When academic knowledge and skills are taught within the context of the student's experience, they are more engaging and easier for students to master and are more likely to increase student motivation to learn.

Additionally, the introduction of Culturally Responsive Teaching creates opportunities for teachers to gain insight into the cultures that influence students' lives and to understand the cultural causes of student-curriculum gaps. By making an effort to understand students' cultures and identities, teachers are able to establish a positive and inclusive classroom culture that creates relevant learning opportunities[7]. Culturally Responsive Teaching has been practiced over the past several decades in a variety of disciplines within the Western education system and has proven to be effective in increasing achievement while maintaining the cultural integrity of students[8]. Vinogradova and Kang note that although culturally responsive teaching did not originate for language instruction, it has important implications for English language education (ELE) in both English-speaking and non-English-speaking countries[9].

As a proven teaching strategy, under the guidance of Culturally Responsive Teaching, to address the issue of low participation of Chinese students in TESOL classrooms, it is possible to understand the reasons for the low engagement at the cultural level and then to enhance their participation while maintaining their cultural identity.

4. Strategies for Applying Culturally Responsive Pedagogy to Enhance Chinese Student Participation

4.1. Familiarize Yourself with the Student's Cultural Background in Advance.

Applying Culturally Responsive Teaching requires

teachers to learn about students' identities, cultural backgrounds, and other information in advance as part of their teaching preparation. Such knowledge is necessary because teachers should not limit their judgment of students to their own cultural context but also refer to the cultural context of the students. As mentioned earlier, Chinese students' low level of participation is more likely to be characterized by not answering questions or actively participating in group discussions than by not listening to lectures or completing homework. With enough preparation, teachers will understand that culture is actually at work behind these behaviors and habits. Furthermore, students may be motivated by a desire to be humble and friendly, fearing disruption of the classroom by being overly active, rather than by a desire to embarrass the teacher by being uncooperative. One of the misconceptions about Chinese students' lack of interaction is that they lack language skills and specialized knowledge, which can make teachers reflect on whether they should adapt the content to their students' level. However, based on an understanding of the students' cultural backgrounds, teachers can more easily recognize whether the lack of participation is due to the students' cultural factors or lack of language proficiency, and make adjustments accordingly.

4.2. Teaching Content Incorporates Elements of Chinese Culture.

Gay points out that teaching and learning are influenced by individuals' a priori knowledge, such as family and community language, educational experiences, and folklore related to learning. Therefore, teachers should make appropriate adjustments to utilize Chinese students' own cultural resources fully[10]. When students realize that their prior knowledge is not useful at all, they will inevitably feel frustrated and thus less engaged. Therefore, in the TESOL classroom, Chinese elements can be added to attract students' attention. For example, when teaching about western administrative regions such as federal, state, and county, teachers can add the names of the corresponding Chinese administrative regions to aid students' understanding.

In addition, teachers should be sensitive to the festivals and customs of Chinese students and send appropriate wishes on important festivals. Doing so will make students feel respected, bring them closer to the teacher, and increase their sense of belonging to the classroom, which in turn will increase their engagement.

4.3. Utilize Teaching Strategies to Stimulate Student Participation.

In Chinese culture, boastful people are usually viewed as superficial. Influenced by this, Chinese students often resist sharing their opinions verbally, but this is limited to verbal expression. This means that teachers can make adjustments to address this characteristic of students, for example, by allowing students to share their opinions in writing, or anonymously, in order to alleviate the psychological burden of verbalizing them.

Introducing interactive quiz games such as Kahoot, Quizizz, etc. can also increase the fun of answering questions. In addition, grouping can be adjusted to increase students' participation. For example, when the class is full of Chinese students, students with learning experiences in English-speaking countries can be assigned to each group. Because of the influence of Western culture, these students tend to be more active in answering questions, and their vitality can motivate other group members.

5. Conclusion

The low participation of Chinese students in TESOL classes is often mistaken for a lack of language proficiency. Nevertheless, this is the result of the influence of Chinese culture. Confucianism, in particular, emphasizes silence as a sign of respect for authority. Although "culturally sensitive teaching" originated in the West, it can be adapted to provide practical solutions to the problem of low engagement of Chinese students. By adding Chinese elements to the content and using alternative methods of participation, teachers can enhance the interaction and cultural inclusiveness of their classrooms.

In addition, understanding students' cultural backgrounds helps teachers distinguish between cultural and non-cultural behaviors and thus respond more appropriately. In conclusion, Culturally Inclusive Teaching provides a helpful reference for increasing classroom engagement of Chinese students while respecting their cultural backgrounds.

Disclosure statement

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Research on Innovative Pathways for Cultivating Talents in the Business Administration Major of Undergraduate Colleges and Universities Empowered by Artificial Intelligence

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Abstract

The rapid development of artificial intelligence (AI) technology is profoundly transforming the landscape of talent cultivation in the Business Administration major at undergraduate colleges and universities. This transformation commences with a reorientation of talent cultivation objectives, encompassing the construction of a composite knowledge system integrating "AI + Business Administration," the cultivation of practical capabilities in intelligent management, and the shaping of professional qualities suited for the intelligent era, thereby forming a comprehensive cultivation orientation. Building upon this foundation, multiple innovative pathways are further explored by delineating the new connotations of capability requirements and the operational logic of empowerment mechanisms. The curriculum system undergoes intelligent upgrades, integrating AI technologies at different levels while promoting interdisciplinary course integration. Teaching scenarios are digitally reconstructed, with the application of virtual simulation experimental platforms and intelligent teaching assistants enhancing the effectiveness of instruction. Industry-education integration progresses towards ecological co-construction, with enterprises participating in the establishment of AI laboratories and the cultivation of dual-qualified teaching staff, thereby aligning talent cultivation more closely with industry realities. These explorations aim to cultivate Business Administration talents capable of keeping pace with the intelligent era and meeting the new demands of industry development.

Keywords

artificial intelligence
Business Administration major
talent cultivation
curriculum system
industry-education integration

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1. Introduction

Against the backdrop of AI's deep integration into various industries, the requirements for talents in the field of Business Administration have shifted from traditional management skills to composite capabilities combining "AI + management." However, the current talent cultivation in the Business Administration major at undergraduate colleges and universities faces issues such as outdated curricula and insufficient practice, making it difficult to meet industry demands. Therefore, exploring innovative pathways for talent cultivation empowered by AI has become crucial for enhancing the quality of talent cultivation and bridging the gap with industrial development.

2. Goal Restructuring for AI-Empowered Talent Cultivation in Business Administration

2.1. Knowledge Objectives: Establishing a Composite Knowledge System of "Artificial Intelligence + Business Administration"

Students should gain a thorough understanding of the fundamental logic of machine learning, such as being able to interpret cluster analysis reports of customer consumption data and comprehend how algorithms assign labels to different customers. They should master the operational principles of big data analysis tools, such as understanding the statistical methods at work when using Excel pivot tables to process sales data. Additionally, they must grasp the applications of AI in management scenarios, such as how intelligent recommendation systems in marketing push products based on browsing history, how intelligent risk control models in finance identify abnormal transactions, and how demand forecasting algorithms in supply chains reduce inventory backlogs, integrating technical principles with management scenarios [1].

2.2. Competency Objectives: Cultivating Practical Skills in Intelligent Management

Students should be capable of using AI tools to solve real-world problems, such as extracting the most common complaints from a pile of customer feedback texts using sentiment analysis software and adjusting product strategies accordingly. When faced with fluctuations in sales data, they should be able to employ regression analysis models to identify key influencing factors. Moreover, they should learn to collaborate with individuals from different fields, such as clearly articulating management needs and understanding technical constraints when working with the IT department to optimize customer segmentation algorithms, and finding solutions through collaboration. When encountering new intelligent tools, they should not wait for others to teach them but instead experiment and learn through trial and error, such as exploring and developing report templates suitable for their company using newly released automated reporting tools [2].

2.3. Quality Objectives: Cultivate Professional Competence for the Intelligent Era

It is essential to clearly understand the boundaries of data usage. For instance, when analyzing customers' private data, one should know which information can be used for recommendations and which would violate regulations if used, and refrain from indiscriminately using data just to boost performance. In the face of AI technological advancements, one cannot afford to wait for obsolescence. For example, when an intelligent customer service system is upgraded, one should proactively learn the operational logic of the new features and explore how to use them to enhance customer satisfaction. When conflicts arise between AI-driven decisions and human judgment, one must uphold ethical standards. For instance, when an algorithm provides a clearly unreasonable recommendation for layoffs, one should propose adjustments from an ethical perspective to prevent technology from becoming a cold and indifferent tool [3].

3. Logical Framework for AI-Empowered Talent Cultivation in Business Administration

3.1. Reconstruction of Competency Requirements

Driven by the wave of artificial intelligence, the competency requirements for business administration talents are undergoing profound reconstruction,

forming a dynamic competency matrix consisting of a foundational layer, a core layer, and an extension layer. The foundational layer serves as the cornerstone of competency, requiring talents to be proficient in business data analysis skills, enabling them to extract customer preference trends from chaotic sales data. For example, by analyzing changes in quarterly repurchase rates, they can identify customer groups at the highest risk of churn. Simultaneously, they should be adept at using AI tools such as Python and PowerBI to batch-process order data with code and visualize inventory turnover in real-time through dashboards, making data a "barometer" for management decision-making. The core layer focuses on the management essence of the intelligent era, necessitating the cultivation of intelligent decision-making thinking. When facing market fluctuations, they should be able to make judgments by combining algorithmic predictions with industry experience. For example, when formulating promotional plans, they should consider both the data from sales forecasting models and the impact of unexpected weather on logistics. Additionally, they should possess human-machine collaboration leadership skills, enabling them to allocate customer groups for manual follow-up and system auto-responses reasonably when leading teams in collaboration with intelligent customer service systems, thus forming a complementary relationship between technological tools and human strengths [4]. The expansion layer focuses on long-term development, demanding that talents possess a profound understanding of business ethics and AI governance. When using customer consumption data to train recommendation algorithms, they must clearly establish red lines for privacy protection. Additionally, they should have the capability to design digital transformation strategies and construct a transformation path for "AI + supply chain" based on the actual conditions of enterprises. For instance, they can design a comprehensive digital solution for traditional manufacturing enterprises, covering the entire process from intelligent production scheduling to demand forecasting, thus avoiding blindly following technological trends. The reconstruction of this capability matrix essentially enables business administration talents to find a precise positioning at the intersection of technology and management, understanding both algorithmic logic and the essence of business.

3.2. Empowerment Mechanism Design

To empower business administration talent cultivation with artificial intelligence, a tripartite empowerment mechanism integrating technology, curriculum, and evaluation must be established. Technological empowerment should bring teaching scenarios to life. For example, an intelligent case library can be constructed to collect the latest cases of enterprise AI applications in real time. When an e-commerce platform uses intelligent pricing algorithms to enhance profits, the case library can simultaneously update its data models and decision-making processes, allowing students to dissect the variable relationships within. Virtual simulation experiments can simulate intelligent supply chain crises, enabling students to adjust inventory warning parameters within the system and observe how algorithms respond to sudden supply disruptions, thereby understanding the logic of technological applications through trial and error. Curriculum empowerment requires breaking down disciplinary barriers and developing modular "AI + management" courses[5]. For instance, in the "Intelligent Marketing" module, the first half teaches students to scrape social media data using Python, while the second half analyzes the underlying demands in the data through the lens of consumer behavior. The "AI Finance" module first covers the operation of intelligent auditing tools and then explores how algorithm-identified abnormal transactions relate to enterprise internal control processes, ensuring that technological learning remains firmly rooted in management scenarios. Evaluation empowerment should move away from "determining excellence with a single exam" and utilize learning analysis technology to track capability growth. The system can record the frequency with which students use data analysis tools, their approaches to solving virtual cases, and their cross-module learning associations. If a student is found to excel in using algorithms for sales forecasting but neglect data ethics, the system can automatically push relevant cases for supplementary learning. When most students encounter difficulties in human-machine collaboration simulations, teachers can adjust teaching priorities accordingly, ensuring that evaluations truly serve to enhance capabilities [6].

4. Innovative Pathways for AI-Empowered Talent Cultivation in Business Administration

4.1. Intelligent Upgrading of Curriculum Systems

4.1.1. Layered Integration of AI Technologies

The intelligent upgrading of curriculum systems necessitates the orderly integration of AI elements across hierarchical levels. At the foundational course level, courses like "Business Data Analysis and AI Fundamentals" should be introduced, enabling students to master the usage of Python's data analysis libraries when processing real sales data and to extract customer information from enterprise databases using SQL queries, ensuring that technical tools become "handy tools" for management analysis. For specialized courses, modifications should closely align with management scenarios. For instance, "Marketing" can incorporate case studies on intelligent recommendation algorithms, allowing students to dissect the user tagging system behind the "You May Also Like" feature on an e-commerce platform. "Operations Management" can introduce supply chain optimization simulation experiments, enabling students to observe changes in inventory turnover rates by adjusting algorithm parameters and understand how intelligent decision-making reduces costs. Expansion courses should broaden students' horizons. "AI Ethics and Business Decision-Making" can use case studies on marketing disputes caused by algorithmic discrimination to spark discussions, while "Digital Transformation Strategy" can analyze how traditional supermarkets leverage AI to restructure their online and offline businesses, helping students understand the boundaries and future prospects of technological applications [7].

4.1.2. Interdisciplinary Curriculum Integration

Interdisciplinary integration that transcends departmental boundaries is crucial for curriculum upgrading. Collaborate with the School of Computer Science to create a minor program in "Management Science + Artificial Intelligence," designing semester-long practical projects that start with real business problems faced by enterprises, such as "How to Improve Member Repurchase Rates." Management students first outline the business logic, then collaborate with computer science students to build user consumption data models, and finally use AI algorithms to generate personalized marketing strategies, completing a closed-loop training process of "problem identification-data modeling-intelligent solution." A university's "Intelligent Marketing" course adopted this model, where student teams used AI tools to analyze user browsing trajectories on e-commerce platforms, designed time-based dynamic pricing schemes, and compared conversion rates of different schemes through A/B testing. This process not only honed their data analysis skills but also deepened their marketing thinking, resulting in a 40% increase in course satisfaction compared to traditional methods and truly achieving a synergistic effect of 1+1>2 [8].

4.2. Digital Reconstruction of Teaching Scenarios

4.2.1. Construction of Virtual Simulation Experiment Platform

An immersive virtual simulation experiment platform will be established, enabling students to experience the practical operations of intelligent management in simulated scenarios. A "sandbox for enterprise digital transformation" will be developed, integrating AI technology into modules such as finance, human resources, and production. In the financial scenario, students can operate an intelligent bookkeeping system to observe how algorithms automatically identify abnormal invoices. Switching to the human resources module, they can experiment with AI recruitment tools to screen resumes and observe how the system matches candidate tags based on job requirements. Digital twin technology will be introduced to construct a "virtual factory," synchronizing real factory production line data into a virtual space. Students can adjust the parameters of AI scheduling algorithms by dragging sliders and observe real-time changes in production rhythms. For example, after optimizing material delivery routes, they can see how much the downtime of the production line is reduced, thereby understanding the impact of intelligent decision-making on efficiency through trial and error [9].

4.2.2. Application of Intelligent Teaching Assistants

Intelligent tools will serve as "invisible teaching

assistants" in the classroom, precisely meeting students' learning needs. An AI Q&A robot will be deployed to answer various student inquiries at any time, ranging from "How to use pandas for data pivoting in Python" to "How to adjust the parameters of an intelligent pricing algorithm." The robot will provide specific steps based on course examples and even recommend similar practice questions. Natural language processing technology will be utilized to analyze student assignments. For instance, when grading marketing plans, the system can identify issues such as "vague customer segmentation logic" and "insufficient data support," and provide revision directions by comparing them with excellent assignments—e.g., "Refer to the RFM model in Chapter 3 to label customers based on their purchase frequency." One university's "intelligent supply chain" experimental project has reaped significant benefits. Students, wearing VR devices, enter a virtual warehouse and use gestures to command an AI-driven automated sorting system. They can clearly see how robotic arms prioritize orders and pause at any time to adjust sorting rules. The experimental efficiency has increased by 60% compared to traditional physical sandboxes, with students stating, "It's like playing a game while mastering the knowledge" [10].

4.3. Ecological Co-construction of Industry-Education Integration

4.3.1. Co-building AI Laboratories with Enterprises

Collaborate with technology companies to establish an "Intelligent Business Innovation Center," bringing real-world business battlefields into the laboratory. Introduce desensitized datasets from enterprises, such as historical sales data from a chain supermarket and user interaction records from e-commerce platforms, combined with AI development platforms like Alibaba Cloud PAI and Tencent TI-ONE, enabling students to work as corporate data analysts. Both parties jointly design practical projects, such as "Predicting Customer Churn Using Machine Learning," where students start by organizing member consumption records, build predictive models, and ultimately propose actionable retention strategies. In "Optimizing Intelligent Customer Service Systems," students analyze real customer service conversation recordings and adjust question-answering matching algorithms to make system responses more empathetic. A notable example is the "Intelligent Retail" project between a university and JD.com, where the student team trained a demand forecasting model based on JD.com's real sales data, achieving a 15% higher accuracy than the enterprise's original model. The outstanding solutions were directly applied to the inventory planning for the 618 Shopping Festival, and the students were more thrilled to see their self-designed strategies in the festival's battle reports than receiving scholarships [11].

4.3.2. Cultivation of Dual-Qualified Teachers

To enable teachers to excel both in the classroom and in the frontlines of industry, it is essential to establish a regular mechanism for enterprise practice. Each year, teachers should be selected to engage in a 3-6-month "immersive residency" at partner enterprises. This is not a superficial observation of processes but a hands-on involvement in the entire lifecycle of AI projects. For instance, teachers may work with data teams at e-commerce companies to iterate on intelligent recommendation systems, participating from the initial design of user persona tagging systems, through tracking algorithm performance in A/B tests, to adjusting recommendation weights based on repurchase rate data. Throughout this process, they document how algorithm engineers translate business objectives like "increasing user dwell time" into feature engineering optimization plans. These firsthand, practical materials become vivid case studies in the classroom—when discussing user segmentation, teachers can dissect the "new customer-returning customer-lost customer" algorithm model they participated in, analyzing the actual impact of parameter adjustments on conversion rates [12].

Simultaneously, AI experts from enterprises are invited into the classroom as "rotating mentors," bringing not standardized courseware but industry-relevant practical projects. For example, when an intelligent site selection expert from a chain restaurant teaches, they may present students with heatmaps of pedestrian traffic, rental data, and competitor distributions across 50 business districts in a city, asking them to use AI site selection models to recommend locations for new stores. Similarly, when a supply chain algorithm leader from a manufacturing company supervises graduation projects, they may require students to train models that

predict equipment downtime risks based on three years of production failure data from a factory. These mentors also take students to workshops to observe how sensors collect data, pointing out on-site details that textbooks overlook, such as “the algorithm neglected the impact of humidity during the rainy season on equipment.” During student defenses, the questions extend beyond “what is the model’s accuracy rate” to practical challenges like “if you had a $1 million budget, which part of this solution would you implement first?” This pressure from the industry side compels teachers to guide students toward “solving real problems” in their daily teaching, ensuring that classroom knowledge is truly grounded in industry realities.

5. Conclusion

Artificial intelligence (AI) has brought new opportunities and challenges to the cultivation of talents in the field of business administration. Through goal restructuring, framework establishment, and the implementation of multidimensional innovative approaches, it is possible to align talent development with the demands of the intelligent era. This not only enhances students’ comprehensive qualities and competitiveness but also provides a direction for the sustainable development of business administration programs in universities, enabling the cultivated talents to truly play a role in the commercial waves of the intelligent era.

Disclosure statement

The author declares no conflict of interest.

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A Brief Analysis on the Construction of Rural E-commerce Service System in Counties of Northwest Sichuan

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Abstract

Against the backdrop of the rural revitalization strategy and the Digital China initiative, developing rural e-commerce represents a crucial pathway for advancing economic and social development in counties across northwest Sichuan. This paper focuses on the construction of the rural e-commerce service system in these counties, systematically examining the current state and core needs of e-commerce development in the region through literature review and case analysis. The study reveals significant gaps in the current e-commerce service system in northwest Sichuan counties concerning infrastructure, logistics and distribution, talent support, brand building, and multi-element coordination, which are constrained by multiple factors such as geographical location, economic foundation, talent outflow, and institutional mechanisms. To address these issues, this paper proposes an optimized pathway for the service system characterized by "government guidance, market-led, and multi-stakeholder collaboration." It emphasizes the reinforcement of infrastructure and cold-chain logistics, the implementation of localized talent development programs, the creation of distinctive regional brands, and the deep integration of e-commerce with cultural tourism and other industries. The aim is to provide theoretical references and practical guidance for enhancing the efficiency of rural e-commerce development, increasing farmers' and herders' incomes, and promoting sustainable regional development in northwest Sichuan counties.

Keywords

northwest Sichuan
county
rural e-commerce
service system
rural revitalization

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1. Introduction

With the rapid advancement of digital technology and the in-depth implementation of China's rural revitalization strategy, rural e-commerce has emerged as a crucial engine driving agricultural transformation and upgrading, as well as increasing farmers' incomes and prosperity. Northwest Sichuan, an important ecological functional area and ethnic settlement in Sichuan Province, boasts

high-quality agricultural and pastoral products such as yaks, Tibetan medicinal herbs, and specialty fruits and vegetables, along with rich ethnic cultural and eco-tourism resources, presenting immense potential for rural e-commerce development. However, constrained by factors such as complex geographical conditions, high transportation and logistics costs, a shortage of professional talent, and an imperfect industrial chain, its e-commerce development still faces numerous challenges, particularly an underdeveloped service system that fails to adequately support efficient e-commerce operations. Constructing a systematic and sustainable rural e-commerce service system is key to addressing the difficulties in "getting agricultural products to market" and ensuring the "last-mile delivery of industrial goods to rural areas." Focusing on counties in northwest Sichuan, this paper delves into the current state, issues, and underlying causes of their rural e-commerce service system, drawing on beneficial experiences from both domestic and international contexts. It aims to propose targeted and actionable optimization strategies, with the intention of providing valuable references for enhancing e-commerce development levels, promoting industrial integration, and facilitating rural revitalization in the region.

2. Theoretical Foundations

The service-dominant logic emphasizes that value is co-created by multiple parties through service exchanges. When applied to the field of rural e-commerce, it implies that entities such as the government, e-commerce platforms, logistics enterprises, cooperatives, and farmers need to collaborate and interact to jointly build and improve the service system, thereby achieving value co-creation. The theory of sustainable development provides important guidance for e-commerce development in northwest Sichuan, requiring that economic benefits be pursued while also taking into account ecological protection and cultural heritage. This ensures that development does not come at the expense of the environment, aligning with the region's functional positioning as an important ecological barrier. The regional innovation system theory regards a county as an innovation unit and considers the construction of an e-commerce service system as an important manifestation of regional innovation capability. Its core lies in promoting the flow and integration of knowledge, technology, and resources among different innovation entities, thereby stimulating local economic vitality[1]. The digital divide theory reveals disparities in information access and technological usage capabilities among different groups. In northwest Sichuan, this manifests as farmers and herders being unable to fully participate in e-commerce activities due to insufficient digital literacy. Therefore, the construction of the service system must include mechanisms to bridge this divide, such as popularizing training and providing inclusive information services, to ensure the inclusiveness and fairness of development outcomes[2].

3. Analysis of the Development Status and Demands of Rural E-commerce in Counties of Northwest Sichuan

3.1. Development Status of Rural E-commerce

In recent years, driven by relevant national and provincial policies, various counties in northwest Sichuan have successively launched rural e-commerce development projects. Some counties and cities have been designated as national or provincial comprehensive demonstration counties for promoting e-commerce in rural areas, receiving special fund support and initially establishing a three-tier public service network for e-commerce at the county, township, and village levels. The coverage of broadband networks and mobile communications continues to expand, with most townships having achieved 4G network accessibility, providing basic conditions for e-commerce applications. Some local e-commerce enterprises, specialized cooperatives, and individual operators have begun to conduct online sales through social e-commerce platforms such as Taobao, JD.com, Pinduoduo, Douyin (TikTok's Chinese version), and Kuaishou, mainly dealing in products like yak jerky, dairy products, wild mushrooms, Tibetan tea, ethnic handicrafts, and tourism routes. The upward movement of agricultural products has become a focal point of development, with some counties attempting to integrate production resources through the "cooperative + farmer + e-commerce" model and sell products under a unified

brand. New business forms such as live-streaming e-commerce have also gradually emerged, becoming new channels for promoting local specialty products. Despite achieving initial results, the overall development is still in its infancy[3]. The scale of e-commerce entities is generally small, with limited operational capabilities and high dependence on third-party platforms. Logistics and distribution are slow and costly, especially with a severe shortage of cold-chain logistics facilities, which restricts the long-distance sales of fresh agricultural products. At the same time, there is an acute shortage of professionals in operations, marketing, promotion, and data analysis, resulting in low activity levels of online stores and unsatisfactory marketing effects. A stable and sustainable business model has yet to be formed[4].

3.2. Analysis of the Demands for Rural E-commerce Development

The internal demands for developing rural e-commerce in counties of northwest Sichuan are increasingly prominent. The most urgent need is to solve the problem of "difficulties in selling" specialty agricultural products by expanding sales channels through e-commerce platforms, reducing intermediate links, increasing product added value, and directly driving the income growth of farmers and herders. With consumption upgrading, the demand of local residents for high-quality industrial products and living services is also growing. The downward movement of industrial products helps reduce procurement costs and improve the quality of life. Relying on rich cultural and tourism resources, there is a strong market demand for an integrated model of "e-commerce + tourism," expecting to achieve one-stop services for ticket booking, homestay booking, and specialty product sales through online platforms, thereby extending the industrial chain. The need for industrial integration is equally important. E-commerce can serve as a link to promote the coordinated development of agriculture, culture, tourism, health care, and other industries, forming new economic growth points. In terms of employment, rural e-commerce provides opportunities for returning youth and left-behind women to start businesses and find employment locally, alleviating the pressure of population outflow[5]. In addition, there is a strong demand among farmers and herders for training in e-commerce knowledge, online marketing skills, and smartphone applications. There is an urgent need to bridge the digital divide through systematic education and enhance their ability to participate in the digital economy. These multi-level and multi-dimensional demands collectively point to the construction of a rural e-commerce service system that is well-functioning, operates efficiently, and provides precise services[6].

4. Constituent Elements and Operational Status of the Rural E-commerce Service System in Counties of Northwest Sichuan

4.1. Analysis of the Service System's Constituent Elements

The construction of a rural e-commerce service system in the counties of northwestern Sichuan is a systematic project, whose effective operation relies on the coordinated support of multiple key elements. Infrastructure forms the prerequisite for system operation, encompassing broadband networks, mobile communication signals covering county-township-village levels, and a rationally distributed network of e-commerce service stations. These physical facilities provide the foundation for information transmission and transaction activities. The logistics and supply chain system serves as the core connecting production and consumption, including warehousing, sorting, transportation, and delivery networks from origin to consumer. In particular, there is a pressing need to address insufficient cold-chain logistics capacity in high-altitude areas to ensure the quality of fresh agricultural products[7]. The talent and training system is crucial for sustainable service development, involving the cultivation and recruitment of local professionals in e-commerce operations, online store design, live-stream selling, and customer service, as well as basic skill training for farmers and herders. The platform and operational support system provides technical assistance for merchants, including the development of local e-commerce platforms or special zones, third-party platform store agency operations, and support for online store design and marketing promotion. The financial and payment services system offers essential capital turnover for e-commerce participants through inclusive credit, e-commerce-specific loans,

and convenient mobile payment solutions. The branding and marketing promotion system aims to enhance product market competitiveness by establishing regional public brands, implementing product standardization certification, and executing online marketing strategies (such as live streaming and short videos) to expand market influence. The policy and regulatory service system, led by the government, provides incentives such as fiscal subsidies, tax reductions, and land-use support, while strengthening market supervision to maintain fair competition. The information and data service system collects, analyzes, and disseminates information on market supply and demand, price trends, and consumer behavior, supporting decision-making and precision marketing. These interconnected elements collectively form an integrated framework that supports the development of rural e-commerce[8].

4.2. Current Operation Status and Typical Models

The current operation of the rural e-commerce service system in the counties of northwestern Sichuan exhibits a landscape characterized by government leadership alongside diverse exploratory initiatives. Most counties rely on national or provincial comprehensive demonstration projects for e-commerce in rural areas, with governments funding the establishment of county-level e-commerce public service centers, township service stations, and village-level service points. This creates a basic "center + station" framework where services include business agency, information consultation, and basic training. However, some village-level stations suffer from limited functions and low utilization rates. In terms of logistics, a common model involves cooperation between postal services and courier companies. By integrating resources, basic coverage at the township level has been achieved, but last-mile delivery to villages often still depends on non-professional methods such as passenger buses carrying goods, resulting in unreliable timeliness and consistency[9]. Regarding operational models, the government-led model is most prevalent: the government purchases services and introduces third-party operating companies to manage e-commerce service centers, organize training, connect with platforms, and conduct marketing campaigns. In enterprise-driven models, local leading enterprises or cooperatives leverage their resource advantages to establish online sales channels and drive participation from surrounding farmers—such as yak-breeding cooperatives that centrally purchase, process, and sell members' products. The cooperative-organized model uses farmers' professional cooperatives as carriers to pool members' products and sell them collectively via e-commerce platforms, thereby improving bargaining power[10]. In recent years, a multi-stakeholder collaborative model has begun to emerge, in which the government, e-commerce platforms (e.g., JD.com, Pinduoduo), local service providers, cooperatives, and farmers form a community of shared interests, with each party contributing according to its strengths to jointly promote product sales. Despite this diversity of models, the overall integration among system components remains low. High logistics costs, shortage of specialized personnel, and weak brand influence continue to constrain the effectiveness of the service system[11].

5. Major Challenges and Root Causes in the Development of Rural E-Commerce Service Systems in Counties of Northwestern Sichuan

5.1. Key Problems in the Service System

The rural e-commerce service system in the counties of northwestern Sichuan reveals multiple shortcomings in practical operation, restricting its overall effectiveness. Insufficient infrastructure support is a key issue: although network coverage exists in some remote villages, signal instability persists; while e-commerce service stations have been widely established, their functions remain basic and they have failed to transform into comprehensive service hubs. The inefficiency of the logistics and distribution system stands out as the most critical bottleneck. A lack of professional cold-chain logistics facilities within counties results in high post-harvest losses for fresh agricultural products. Long-distance trunk transportation incurs high costs, last-mile delivery cannot be sustained routinely, and difficulties in delivering parcels to villages—along with slow delivery times and high fees—are widespread problems. There is a severe shortage of professional talent: not only is there a lack of composite professionals skilled in e-commerce operations,

online marketing, and data analysis, but also a scarcity of local personnel capable of operating platforms or conducting live-stream sales. Existing training programs are often superficial and lack continuity, failing to meet real operational needs. On the supply side, agricultural production is predominantly fragmented and small-scale, resulting in low levels of standardization and scale. Product quality varies significantly, brand awareness is weak, development of regional public brands lags behind, and market competitiveness remains insufficient. Platform operation capabilities are generally weak: most operators rely heavily on third-party platforms, lack independent operational capacity, employ limited marketing methods, and have limited ability to leverage new traffic channels such as live streaming and short videos. The financial support system is underdeveloped, with scarce credit products tailored for micro and small e-commerce operators and narrow financing channels. Poor coordination among various service elements leads to fragmented systems, with inefficient collaboration mechanisms between government, enterprises, platforms, cooperatives, and farmers, preventing effective integration of resources. Policy support sometimes emphasizes construction over operation and hardware over software. Meanwhile, regulatory frameworks need strengthening in areas such as product quality traceability, intellectual property protection, and consumer rights enforcement[12].

5.2. Analysis of Root Causes

The emergence of these problems stems from a complex interplay of multiple factors. Geographic and natural conditions constitute major objective constraints: northwestern Sichuan is sparsely populated, with complex terrain and cold climates, leading to high costs for building and maintaining infrastructure and great challenges in organizing logistics. The region's ecologically sensitive environment further restricts large-scale development. At the county level, weak economic foundations and limited fiscal capacity hinder sustained funding for the high-cost operation of e-commerce service systems. Small market entities have weak risk resilience, limiting the market-driven supply of services. Socio-culturally, many farmers and herders have low educational attainment, slower acceptance of new technologies, and generally low digital literacy, resulting in insufficient motivation and capability to participate in e-commerce. At the same time, serious outflow of local talent and difficulty attracting external talent create a "double dilemma" in talent supply. Institutionally, poor inter-departmental coordination exists: e-commerce development involves multiple agencies such as commerce, agriculture, transportation, postal services, and cyberspace administration, whose policies and resources are scattered. A lack of unified planning and efficient coordination leads to fragmented and inconsistent service system development[13]. Market maturity is low: there are few local specialized e-commerce service providers, and their service capabilities are weak, making it difficult to deliver high-quality operational, marketing, and technical support. Furthermore, inadequate understanding of the long-term and complex nature of e-commerce development has led some local governments to adopt a hasty approach. This results in policy designs that are misaligned with actual needs, with support measures failing to precisely target core weaknesses in the service system—particularly sustained investment in "soft power" areas such as logistics, talent, and branding.

6. Lessons from Domestic and International Experiences in Rural E-Commerce Service System Development

6.1. Experiences from Advanced Domestic Regions

The rural e-commerce development practices in certain regions of China offer valuable insights for building service systems. The Suichang model in Zhejiang Province centers on the local e-commerce service provider "Ganji.com," which integrates logistics, training, finance, marketing, and other resources to build a comprehensive ecosystem covering county, township, and village levels. Its success lies in cultivating a localized professional operating entity, enabling market-oriented and sustainable operations. The Shaji model in Jiangsu Province demonstrates the power of grassroots entrepreneurship: farmers spontaneously began selling furniture via e-commerce platforms, forming an industrial cluster. The government later stepped in to provide infrastructure, skills training, and market regulation, illustrating a

collaborative path of "market-led, government-guided" development. Wugong County in Shaanxi Province leveraged its geographic advantages to establish an e-commerce distribution hub with the slogan "Buy Northwest, Sell Nationwide." By consolidating specialty agricultural products from Shaanxi and neighboring provinces and establishing large-scale warehousing, logistics bases, and sorting centers, it effectively reduced logistics costs and enhanced regional aggregation and distribution capabilities[14]. In ethnic minority regions such as Yunnan and Guizhou, rural e-commerce development emphasizes deep integration with ethnic culture and eco-tourism. Through models like "intangible cultural heritage + e-commerce" and "tourism + e-commerce," short videos and live streaming are used to vividly showcase ethnic customs and product-making processes. This approach has successfully created differentiated brand images and achieved dual enhancement of cultural and economic value. These cases demonstrate that successful rural e-commerce service systems typically feature clearly defined local service operators, effective collaboration between government and market forces, deep utilization of regional unique resources, and innovative logistics solutions.

6.2. International Lessons

Agriculturally advanced countries have accumulated mature experience in building agricultural e-commerce service systems. The Netherlands, a global agricultural powerhouse, boasts an efficient cold-chain logistics system and advanced technologies in produce grading, packaging, and pre-cooling, ensuring product quality stability during long-distance transport and providing solid support for agricultural e-commerce. In the United States, agricultural cooperatives play a central role in agricultural distribution. Cooperatives not only organize production but also manage branding, market expansion, and e-commerce sales collectively, effectively solving the problem of smallholders accessing large markets and reducing transaction costs. Countries such as Germany and Japan emphasize agricultural informatization, with governments or industry associations establishing authoritative agricultural information platforms that provide real-time market prices, supply-demand data, and quality standards, supporting decision-making for producers and operators. These countries generally possess well-developed rural infrastructure and inclusive financial services, creating a favorable environment for e-commerce. Their experiences highlight the foundational roles of standardized production, organized operation, specialized logistics, and information-based services within e-commerce service systems[15].

6.3. Implications for Northwestern Sichuan

Drawing on domestic and international experiences, counties in northwestern Sichuan should prioritize practicality and uniqueness when building their rural e-commerce service systems. They must avoid simply replicating models from plains or developed regions and instead develop adaptive pathways based on the region's high altitude, ecological sensitivity, and multi-ethnic character. Efforts should focus on cultivating or introducing local professional e-commerce operating agencies empowered to integrate resources in logistics, training, and marketing, avoiding sustainability issues caused by excessive government control. Inspired by the "distribution center" concept, shared facilities featuring cold-chain storage, sorting, packaging, and centralized shipping could be established in relatively accessible county hubs or regional nodes to improve logistics efficiency. The "cooperative + e-commerce" model should be widely promoted to enhance the organizational level of farmers and herders, enabling scaled and standardized production and strengthening market bargaining power. Unique ethnic cultures and ecological landscapes should be deeply integrated into e-commerce marketing, using storytelling and scenographic content creation to increase product added value. Meanwhile, establishing regional agricultural information service platforms is essential to guide better alignment between production and market demand. The government should focus on addressing infrastructure gaps, improving the policy environment, and providing public services, thereby creating conditions for market mechanisms to function effectively[16].

7. Conclusion

This study focuses on the development of rural e-commerce service systems in the counties of northwestern Sichuan, systematically analyzing their

current status, system components, existing challenges and root causes, and proposing optimization pathways by drawing on domestic and international experiences. The research reveals that while the region possesses significant resource potential for rural e-commerce development, its service system faces clear shortcomings in infrastructure, logistics, talent support, brand building, and inter-element coordination. These limitations are constrained by multiple factors including geography, economic conditions, social dynamics, and institutional mechanisms. Establishing an efficient and sustainable service system is therefore crucial to advancing e-commerce in this region. Going forward, development should adhere to the principles of ecological priority and distinctive growth, strengthen the synergy between government guidance and market mechanisms, prioritize improvements in logistics infrastructure, cultivate localized professional talent, build regional characteristic brands, and promote deep integration of e-commerce with cultural tourism and agriculture. By doing so, a new e-commerce development model suited to the realities of high-altitude ethnic regions can be formed, providing sustained momentum for rural revitalization.

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Research on the Construction and Reform of Practical Teaching in Business-related Disciplines of Private UndeRgraduate Universities in the Context of the Digital Economy

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Abstract

Guided by Outcome-Based Education (OBE), this paper analyzes the problems and contradictions in practical teaching by using the survey data collected from 233 business teachers of private undergraduate universities, 479 in-service students and 265 enterprise staff. Subsequently, it constructs a four-in-one OBE practical teaching framework covering objectives, courses, platforms and evaluation, and clarifies a three-level learning outcome anchoring mechanism, which includes digital tool operation, interdisciplinary project implementation and enterprise problem-solving, as well as team collaboration and innovative design. Furthermore, it puts forward reform paths such as dynamic curriculum update, interdisciplinary teacher training and school-enterprise collaborative education. This study provides a reference for the practical teaching of business majors in private undergraduate universities to adapt to the digital economy and achieve a closed loop of teaching, competence and job positions.

Keywords

Digital Economy
Business Majors in Private Undergraduate Universities
OBE (Outcome-Based Education)
Practical Teaching Reform

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1. Introduction

The 14th Five-Year Plan for the Development of the Digital Economy clearly identifies promoting the in-depth integration of digital technology and the real economy as a core task. This orientation not only drives enterprises to shift their demand for business talents from traditional professional capabilities to a composite structure of "digital literacy + practical ability" but also defines the core direction for the reform of practical teaching in business disciplines.

In the exploration of business practice teaching reform driven by the digital economy, academia has formed a series of focused achievements. Author Li Hua[1] proposes the need to strengthen the deep integration of digital technology with business education, cultivating students' cross-border innovative thinking through

interdisciplinary collaboration. Authors Liu Ying et al.[2] point out that current digital talent cultivation in universities suffers from dual shortcomings: an incomplete educational philosophy system, fragmented top-level design, and a lack of operational mechanisms in industry-education integration. Author Li Haiting[3] further clarifies that reforms must embed "digital genes" into practical teaching systems while utilizing AI and big data to optimize scenario-based management. Authors Huang Bo et al.[4] establish a five-dimensional framework for new business education practice systems, encompassing curriculum, teaching content, organization, resources, and evaluation.

Simultaneously, three core challenges persist in current business practice teaching:

1.1. Misalignment between positioning and curriculum systems:

- Author Shao Xianwu[5] notes that practical teaching fails to integrate effectively into talent cultivation goals.
- Author Zhu Liang[6] further confirms that business courses generally lack practical design, leading to graduates' inadequate employability and entrepreneurial skills.

1.2. Weak resource allocation and faculty development:

- Author Li Mingliang[7] emphasizes the dual dilemma of insufficient investment in practical teaching and faculty's lack of hands-on experience.

1.3. Outdated teaching content:

- Author Zheng Feiyun[8] highlights that traditional content no longer matches industry digitization trends.
- Author Li Haiting[3] adds that outdated teaching scenarios further exacerbate the gap

1.4. The necessity of reform stems from the demand for digital economy-talent alignment:

- Author Shao Xianwu[5] argues that practical teaching is critical for deepening theoretical understanding.
- Author Li Mingliang[7] underscores its role in fostering innovation and cultivating interdisciplinary talents.
- Authors Chen Yun[9] et al. advocate for rethinking practice models in private universities to adapt to digital economies.
- Author Li Haiting[3] emphasizes leveraging digital technologies to enhance teaching efficiency.

1.5. Reform pathways focus on building a "technology integration + industry-education synergy" curriculum system:

- Author Cai Yayuansuggests vocational colleges integrate data analysis and AI applications to emphasize practical orientation.
- Author Li Hua[1]recommends adding modules combining emerging technologies with business disciplines.
- Authors Liu Ying et al.[2] stress the need for government-enterprise collaboration to establish industry-education integration platforms.

1.6. Strengthening industry-academia collaboration remains pivotal:

- Authors He Shan et al.[10] propose creating high-quality internships through corporate partnerships.
- Author He Yajie[11] highlights joint industry-academia projects to enhance innovation capabilities.
- Authors Liu Ying et al.[2] advocate aligning industry-academia initiatives with clear cultivation objectives.

Although existing studies have established a basic analytical framework for the reform of business practical teaching under the background of the digital economy, there are obvious limitations, with the core being gaps in the specific fields of research content. Most existing achievements focus on the design of macro reform paths, while rarely involving the segmented fields of practical teaching in digital scenarios, making it difficult to fully address the micro pain points in practice. Accordingly, this paper explores the above-mentioned shortcomings and strives to make certain contributions to filling the gaps in this segmented field.

2. Analysis of Problems in Practical Teaching of Business Disciplines in Private Undergraduate Universities

2.1. Statistics on Core Problems

As shown in **Table 1**, there are four types of core problems in the practical teaching of business disciplines in private undergraduate universities, including outdated curriculum content, insufficient digital capabilities of teachers, insufficient depth of school-enterprise cooperation, and mismatched evaluation systems.

2.2. Analysis of Key Contradictions

2.2.1. Contradiction between Demand and Supply

91.85% of enterprises list data analysis capabilities as core requirements, yet only 14.82% of students believe that practical courses contain a large amount of digital content, resulting in a mismatch between curriculum supply and enterprise demand.

2.2.2. Contradiction between Concept and Practice

60.94% of teachers agree with a practical teaching system of 4 or more levels (Foundation + Application + Innovation + Integration + Excellence/Flexibility), but only 13.99% of students state that the school has implemented this system in most courses, meaning the hierarchical concept has not been put into practice.

2.2.3. Contradiction between Resources and Goals

74.95% of students hope that the school will provide specialized practical training platforms, however, 51.15% of private undergraduate universities struggle to update digital equipment due to insufficient funds, and resource constraints restrict the achievement of practical teaching goals.

Table 1. Statistics on Core Problems

Problem Dimension	Teachers' Perception (%)	Students' Feedback (%)	Enterprise Evaluation (Average Score)
Outdated Curriculum Content	91.42% (Lagging technical skills)	54.07% (Content fails to reflect digital characteristics)	3.46 (Low alignment with enterprise needs)
Insufficient Digital Capabilities of Teachers	68.24% (Need to improve interdisciplinary skills)	35.28% (Inadequate guidance from teachers)	3.28 (Graduates lack required skills)
Insufficient Depth of School-Enterprise Cooperation	83.69% (Inadequate enterprise resources)	64.51% (Practical projects are disconnected from enterprises)	3.53 (Low depth of cooperation)
Mismatched Evaluation System	59.66% (Need to reconstruct evaluation criteria)	46.76% (Unreasonable evaluation system)	3.36 (Low matching degree between supply and demand)

Note: The enterprise evaluation adopts a 1-5 Likert scale, where 1 = extremely low and 5 = extremely high.

Table 2. Analysis Table for Reverse Design of Curriculum System

Curriculum Level	Core Objective	Digital Tools/Content	Corresponding Learning Outcome
Basic Level	Master basic operation of digital tools	Basic Excel Application, Basic ERP	Proficiency in tool operation
Application Level	Simulate enterprise digital operation	Virtual Simulation Platform, Tableau Visualization	Data-driven decision-making capability
Innovation Level	Complete incubation of innovation and entrepreneurship projects	AI Writing Tools, Low-Code Platform	Innovative scheme design capability
Comprehensive Level	Implement interdisciplinary projects	Python + Business Analysis, Supply Chain Visualization Simulation	Interdisciplinary collaboration capability
Excellence Level	Solve real enterprise problems	Real Enterprise Data, Customized Projects	Career adaptability capability

3. OBE-Oriented Construction Framework for Practical Teaching of Business Disciplines in Private Undergraduate Universities

3.1. Anchoring of Core Learning Outcomes

A three-level learning outcome anchoring mechanism is established. Among them, the core competency objective of core outcomes is innovative scheme design; the core competency objectives of key outcomes are the implementation of interdisciplinary projects and the solution to real enterprise problems; the core competency objectives of basic outcomes are team collaboration and digital tool operation[12].

3.2. Reverse Design of Curriculum System

Table 2 is the analysis table for the reverse design of the curriculum system. As shown in **Table 2**, the core objective of the basic level is to master the basic operation of digital tools; the core objective of the application level is to simulate the digital operation of enterprises, corresponding to data-driven decision-making capabilities; the core objective of the innovation level is to complete the incubation of innovation and entrepreneurship projects; the core objective of the comprehensive level is the implementation of interdisciplinary projects; the core objective of the excellence level is to solve real enterprise problems.

3.3. Construction of a Diversified Evaluation System

Under the OBE orientation, there is a closed-loop logical system for practical teaching covering evaluation, improvement, objectives, and competencies. This mechanism first conducts process evaluation on students' learning processes and outcome evaluation on the results of teaching output; these two types of evaluation jointly generate three-dimensional evaluation scores. Based on these scores, continuous improvement is promoted, and feedback is used to optimize courses or practical platforms. Then, guided by the goal of enterprise needs, core competency indicators are anchored. Thus, a complete cycle from evaluation to competency development and then to continuous optimization is established, ensuring that practical teaching is deeply aligned with enterprise needs and competency objectives[13].

Student Learning Process → Process Evaluation → Three-dimensional Evaluation Scores → Continuous Improvement and Feedback → Enterprise Demand Goals → Core Competency Indicators → Digital Skills

Student Learning Process → Process Evaluation → Three-dimensional Evaluation Scores → Continuous Improvement and Feedback → Enterprise Demand Goals → Core Competency Indicators → Project Achievements Teaching Output Achievements → Achievement Evaluation → Three-dimensional Evaluation Scores → Continuous Improvement and Feedback → Enterprise Demand Goals → Core Competency Indicators → Career Adaptability

4. OBE-Oriented Reform Paths for Practical Teaching

4.1. Dynamic Update of Curriculum Content

In the optimization of curriculum development, it is suggested to add core courses such as Digital Business Analysis and AI Business Applications, and integrate the curriculum content with real enterprise scenarios like live-streaming e-commerce and intelligent investment consulting. A digital economy case library with semi-annual updates should be established, incorporating hot cases such as cross-border e-commerce algorithm operation and AI customer service optimization. For the implementation of hierarchical courses, universities that have not yet established a hierarchical system may first launch pilots in their advantageous majors, and then gradually promote hierarchical courses to all business disciplines[14].

4.2. Interdisciplinary Training of Teaching Staff

In terms of teaching staff development, on the one hand, cooperation with local internet enterprises should be carried out to cultivate "dual-qualification teachers" (teachers with both academic expertise and industry experience), promote school-enterprise cooperative practical training, and require teachers to complete at least 2 digital skill certifications within 3 years. On the other hand, interdisciplinary teaching teams integrating "business + computer science + law" should be formed to jointly develop courses such as Digital Business

Compliance. Meanwhile, local entrepreneurs should be invited to serve as part-time teachers to conduct on-campus teaching[15].

4.3. Deepening School-Enterprise Collaborative Education

In the construction of the practical training system, customized order-based practical training projects can be co-built with small and medium-sized enterprises (SMEs), allowing students to participate in the actual work of enterprises throughout the process. At the same time, the hierarchical construction of practical training bases should be advanced: Level-1 bases need to co-build digital business laboratories with leading regional enterprises to share enterprise data and tools, while Level-2 bases should establish project cooperation databases with SMEs to provide short-term practical training positions. In addition, the certification mechanism for cooperative achievements needs to be improved: enterprise practical training achievements should be included in course credits, and enterprise evaluations should account for a certain proportion of the scores of practical courses.

5. Conclusion

From the perspective of the digital economy, the reform of practical teaching for business disciplines in private undergraduate universities needs to take OBE as the core focus, and solve the problem of supply-demand mismatch through reverse curriculum design, interdisciplinary resource integration, and closed-loop evaluation and improvement. Practical teaching should focus on core outcomes such as digital tool operation and interdisciplinary project implementation, and give priority to meeting the high-demand capabilities of enterprises. Moreover, the flexibility advantage of private universities can be transformed into reform momentum: resource constraints can be reduced through cooperation with small and medium-sized enterprises (SMEs). At the same time, it is necessary to establish a tripartite feedback mechanism involving universities, enterprises, and graduates, and adjust curriculum content and evaluation criteria every academic year based on changes in enterprise needs and tracking data on graduates' capabilities.

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Practical Exploration of Self-Directed Learning Methods in Linear Algebra Course Teaching

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Abstract

This paper expounds the connotation and characteristics of the self-directed learning method. Combined with the characteristics of the Linear Algebra course and with the help of digital and intelligent technology, a teaching practice plan based on the self-directed learning method is designed, including the creation of hierarchical goals, the construction of online resources, the tracking of learning processes, the joint construction of teaching cases, the introduction of AI teaching assistants, and the implementation of multi-dimensional evaluation. The practical results show that this method can effectively improve students' learning autonomy, enhance their thinking ability and strengthen their ability to apply knowledge, providing a useful reference for the teaching reform of the Linear Algebra course.

Keywords

Self-Directed Learning

Linear Algebra

Teaching Practice

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1. Current Situation of Linear Algebra Course Teaching

In the higher education system, Linear Algebra, as a core public basic course, is not only an important branch of mathematics but also a fundamental tool in many fields such as physics, engineering, computer science, and economics. However, the course itself has prominent characteristics like abstract concepts, strong theoretical nature, and complex calculations, which pose considerable challenges to teaching. For a long time, the traditional teaching mode of Linear Algebra has been teacher-centered. Teachers impart knowledge to students through blackboard writing or PPT demonstrations, leaving students with few opportunities for active thinking and exploration, making it difficult for them to truly understand and master the core concepts and methods of Linear Algebra. Many students merely memorize formulas and problem-solving steps mechanically during the learning process and fail to connect the learned knowledge with practical applications, resulting in poor learning outcomes.

The self-directed learning method emphasizes the subjectivity and initiative of learners in the learning process, which can effectively stimulate learners' interest

in learning and their potential. Introducing the self-directed learning method into the teaching of the Linear Algebra course, supplemented by the support of digital and intelligent technology, is expected to break the constraints of the traditional teaching mode, enhance students' dominant position in the learning process, and improve the teaching situation of the Linear Algebra course in application-oriented undergraduate universities. Based on this, this paper conducts a practical exploration of the self-directed learning method in the teaching of the Linear Algebra course, aiming to provide useful references for the teaching reform of the Linear Algebra course.

2. Overview of the Self-Directed Learning Method

2.1. Connotation of Self-Directed Learning

The concept of self-directed learning was first proposed by Malcolm Knowles, an American adult educator. After years of development and improvement, it has formed a relatively mature theoretical system. In the context of modern education, self-directed learning refers to a learning method in which learners, on the basis of clarifying their own learning needs and goals, take the initiative to formulate learning plans, select appropriate learning resources and methods, independently monitor the learning process, and evaluate and reflect on the learning results.

In the process of self-directed learning, learners are no longer passive recipients of knowledge but active participants and leaders of learning activities. They can flexibly adjust the learning pace and content according to their own knowledge foundation, learning ability, and interests, so as to better meet their own learning needs. For example, when learning the concept of matrices in Linear Algebra, some students may choose to first watch micro-lecture videos to gain a preliminary understanding of the definition and basic properties of matrices, and then consolidate the learned knowledge by doing exercises; while others may first read the relevant content in textbooks and then consult online learning resources or ask teachers and classmates for help when encountering unclear points. This personalized learning method can give full play to the subjective initiative of learners and improve learning efficiency and quality.

2.2. Characteristics of Self-Directed Learning

2.2.1. Subject Autonomy

In self-directed learning, students are the subjects of learning and have full autonomy. From the setting of learning goals to the selection of learning resources, and from the implementation of learning plans to the arrangement of learning progress, all are determined by students themselves. This autonomy enables students to participate more actively in the learning process and give full play to their subjective initiative.

2.2.2. Reflective Initiative

Reflection is an important part of self-directed learning. During the learning process, students can continuously reflect on and summarize their own learning behaviors, methods, and results. Through reflection, students can promptly identify the problems and shortcomings existing in the learning process, analyze the causes of the problems, and take corresponding measures to improve.

3. Practical Design of the Self-Directed Learning Method in the Linear Algebra Course

To address the problems existing in the traditional teaching of the Linear Algebra course, the course teaching team has conducted in-depth research on the self-directed learning theory, fully combined the advantages of digital and intelligent technology, and designed a teaching practice plan for the Linear Algebra course from multiple aspects. The specific measures are as follows:

3.1. Create Hierarchical Goals to Provide Learning Guidance

Learning goals are the direction and driving force for students' learning. Scientific and reasonable learning goals can guide students to carry out learning activities in a targeted manner. On the basis of fully investigating the syllabus of the Linear Algebra course and the talent training goals, and combining with the actual learning situation of students, the course team divides the learning goals into three levels: basic goals, advanced goals, and extended goals, providing students with clear learning

guidance.

Basic Goals: Basic goals are mainly for all students, aiming to ensure that students master the basic concepts, theorems, and calculation methods of Linear Algebra. Specifically, they include: understanding the definitions and properties of basic concepts such as matrices, determinants, vectors, and linear equations; mastering the operation methods of matrices, including addition, subtraction, multiplication, transposition, and inverse matrices; being able to calculate the value of determinants using the properties and expansion rules of determinants; and proficiently mastering the solution methods of linear equations, including Gaussian elimination, Cramer's rule, etc.

Advanced Goals: Advanced goals are mainly for students with a good foundation and strong learning ability. On the basis of mastering the basic goals, students are required to further understand the internal connections between concepts and theorems and be able to use the learned knowledge to solve simple practical problems. Specifically, they include: deeply understanding the logical relationships between concepts and theorems such as the linear dependence of vectors and the structure of solutions to linear equations; being able to use the knowledge of Linear Algebra to solve some simple practical problems, such as stress analysis in engineering and input-output analysis in economics; and learning to use mathematical software (such as Matlab, Python, etc.) for the calculation and analysis of Linear Algebra.

Extended Goals: Extended goals are mainly for students who have a strong interest in Linear Algebra and hope to conduct in-depth learning and research. Students are required to be able to deeply explore the application of Linear Algebra in professional fields and carry out innovative thinking and research. Specifically, they include: understanding the cutting-edge applications of Linear Algebra in fields such as computer graphics, machine learning, and cryptography; being able to read relevant academic papers and understand the latest research results in the field of Linear Algebra; and trying to use the knowledge and methods of Linear Algebra to solve some challenging practical problems or carry out innovative research projects.

Through the setting of such hierarchical learning goals, students can independently select learning goals suitable for themselves according to their own knowledge foundation, learning ability, and interests, clarify their learning direction, and thus carry out learning activities in a more targeted manner.

3.2. Build Online Resources to Lay the Foundation for Learning

Abundant learning resources are an important guarantee for students to carry out self-directed learning. The course team makes full use of digital and intelligent technology to construct a multi-dimensional online knowledge system including knowledge graphs, ideological and political graphs, problem graphs, and goal graphs, providing students with accurate and diverse learning resources for self-directed learning.

Knowledge Graph: The knowledge graph displays the knowledge structure of the Linear Algebra course and the internal connections between knowledge points in a visual way. Through the knowledge graph, students can intuitively understand the overall framework of the Linear Algebra course, clarify the position and importance of each knowledge point, and the interrelationships between knowledge points.

Ideological and Political Graph: The ideological and political graph organically combines the knowledge points in the Linear Algebra course with ideological and political elements, exploring the ideological and political contents contained in the Linear Algebra course, such as the spirit of science, the awareness of innovation, and the feelings of patriotism.

Problem Graph: The problem graph collects common problems and typical examples in the Linear Algebra course, classifying and organizing them according to knowledge points and difficulty levels. Each problem is accompanied by detailed problem-solving ideas and methods, as well as links to relevant knowledge points.

Goal Graph: Corresponding to the hierarchical learning goals created earlier, the goal graph lists in detail the knowledge points, learning requirements, learning resources, and assessment methods corresponding to each learning goal.

Up to now, the course team has built 80 core knowledge points, 537 associated test questions, and 890 associated learning resources on the online learning

platform, providing contents including micro-lecture videos, teaching courseware, unit tests, and extended resources. These online resources cover all aspects of the Linear Algebra course and meet the learning needs of students at different levels. The online learning platform has been in full operation for 4 semesters, with more than 9 universities and 2,480 students participating in the course learning, and the number of visits has reached 3.85 million. Students can independently select learning resources, formulate learning plans, and carry out personalized independent learning according to their own knowledge background, thinking characteristics, and learning needs.

3.3. Track the Learning Process and Generate Learning Paths

In order to guide students to develop self-directed learning habits and ensure that students can carry out learning activities in accordance with the established learning goals and plans, the course team has taken a series of measures to track the students' learning process and generate personalized learning paths for them.

Firstly, guide students to formulate learning plans. At the beginning of the course, the course team guides the enrolled students to formulate learning plans including knowledge points to be learned, learning schedule, selection of learning resources, learning tasks, and goals according to their own learning goals and time arrangements. Secondly, use the online learning platform to record learning data. The online learning platform has powerful data analysis functions, which can record the students' learning progress and knowledge mastery throughout the process. These data can not only reflect the students' learning attitude and efforts but also accurately evaluate the students' mastery of each knowledge point. Thirdly, generate personalized learning paths. Based on the students' learning plans and learning data, the online learning platform uses big data analysis and artificial intelligence technology to generate personalized learning paths for students. Finally, optimize and adjust teaching strategies. By regularly analyzing the students' learning data and learning paths, the course team can keep abreast of the students' learning situation and needs in real-time and adjust the teaching strategies and contents in a timely manner.

3.4. Jointly Build Teaching Cases to Drive Application Practice

The abstract nature of Linear Algebra often makes it difficult for students to connect theoretical knowledge with real life, resulting in weak knowledge application ability. To solve this problem, the course team innovatively proposes a "teacher-student joint construction of teaching cases" model, allowing students to transform from "passive acceptance of cases" to "active creation of cases". In the process of case exploration and construction, students can deepen their understanding of abstract knowledge and improve their ability to apply knowledge.

Firstly, guide case topic selection. Before the start of teaching each chapter, teachers will put forward several case topic directions related to real life and professional fields based on the core knowledge points of the chapter. At the same time, students are encouraged to independently select topics based on their own professional backgrounds or life interests. Secondly, collect case materials. After determining the topic, students, individually or in groups (2-3 people), collect case-related materials by consulting academic papers, industry reports, enterprise practice cases, or conducting field investigations and data collection. Thirdly, construct case models. On the basis of collecting sufficient materials, students need to transform practical problems into Linear Algebra models, clarify the variable definitions and constraint conditions in the models, and figure out how to use relevant knowledge points to solve the problems. Finally, display and optimize case results. After completing the first draft of the case, students need to submit the case report (including the background of the topic selection, source of materials, model construction process, solution steps, application effect analysis, etc.) through the online platform and display the case in class to share their exploration process and experience. Other students and teachers will comment on the case and put forward modification suggestions. Students will revise and improve the case according to the comments, and finally form a mature teaching case, which will be included in the course case library.

Through the teacher-student joint construction of teaching cases, students not only deepen their understanding of the abstract knowledge of Linear

Algebra but also cultivate their ability to apply knowledge and innovative thinking. Up to now, the course case library has collected 128 cases independently constructed by students, covering multiple fields such as computer science, engineering, economics, and medicine. Among them, excellent cases such as "Simplified Model of Face Recognition Based on Matrix Transformation" and "Application of Linear Equations in the Optimization of Logistics Distribution Paths" have been used for classroom teaching demonstrations and become examples for other students to learn from.

3.5. Introduce AI Teaching Assistants to Empower Learning Support

To solve the problem in traditional teaching that "teachers have limited energy and cannot meet the real-time and personalized learning needs of all students", the course team has introduced an AI teaching assistant system to provide students with full-time and interactive learning support, and built a learning closed loop of "independent learning - real-time Q&A - self-assessment" to help the effective implementation of self-directed learning.

The AI teaching assistant has natural language understanding ability, which can quickly respond to students' questions and answer questions such as concept doubts and problem-solving confusion in the learning of Linear Algebra. Based on the students' learning data (such as the mastery rate of knowledge points, learning progress, types of wrong questions, etc.), the AI teaching assistant will recommend personalized learning resources to students. The AI teaching assistant supports students to independently initiate evaluation activities such as unit tests, chapter tests, and mock exams, and the system will generate personalized test papers according to the students' learning progress and mastery of knowledge points. In addition, for complex questions raised by students or questions that the AI teaching assistant cannot answer in a timely manner, the system will automatically transfer the questions to the course teachers. After the teachers answer the questions, they will feed back to the students, ensuring the accuracy and completeness of the Q&A.

Since the introduction of the AI teaching assistant, students' learning efficiency and learning experience have been significantly improved. Data shows that the average response time for students to ask questions through the AI teaching assistant is less than 3 minutes. Compared with the traditional mode of "asking questions after class - teachers answering in the next class", the Q&A efficiency has increased by more than 90%; 85% of students said that the learning resources recommended by the AI teaching assistant "meet their personal learning needs" and help them quickly make up for their knowledge gaps.

3.6. Implement Multi-Dimensional Evaluation to Provide Learning Feedback

The traditional teaching of Linear Algebra mostly adopts a single evaluation method of "final exam + usual homework", which is difficult to fully reflect the students' learning process and comprehensive quality. To meet the needs of self-directed learning, the course team, based on big data analysis, has constructed a multi-dimensional evaluation system combining "process evaluation + summative evaluation", evaluating students' learning results from multiple dimensions and providing students with timely and comprehensive learning feedback.

The course team provides students with real-time evaluation feedback through the online learning platform. Students can check their process evaluation scores, performance in various dimensions, and teachers' comments and suggestions at any time; after the summative evaluation, the system will generate a personalized exam analysis report, pointing out the students' weak knowledge links and recommending targeted review resources.

4. Practical Results and Analysis

In the early stage of practicing the self-directed learning method, some students, who were accustomed to traditional passive learning, felt unadaptable when facing independent learning tasks and knowledge exploration, resulting in slow learning progress or the emergence of a sense of fear of difficulties. With the continuous guidance of the course team, students gradually adapted and adjusted their learning strategies, actively communicated their learning experience, selected appropriate learning materials according to their own shortcomings, and explored their personal learning paths. The analysis of the practical results over 4 semesters shows that the overall

teaching effect has been continuously improved.

4.1. Improvement of Learning Enthusiasm

Through data monitoring, the course team found that at the beginning of the semester, the average daily number of visits to the online resource platform was about 60. With the deepening of teaching practice, the number of visits continued to increase, reaching about 150 per day in the 8th week, and then remained stable at 130-150 per day until the end of the semester. At the same time, the "three rates" (attendance rate, head-up rate, and front-row seating rate) in the classroom have increased significantly, and the frequency of active questioning and participation in discussions has also increased significantly, from 2-3 times per class to 8-10 times. In group cooperation projects, students can also carry out active learning behaviors such as independent planning, project decomposition, and task assignment. These data changes indicate that students have gradually adapted to the self-directed learning method, and their learning enthusiasm and initiative have been continuously improved.

4.2. Improvement of Comprehensive Quality

By independently exploring textbooks, online resources, and conducting after-class extended learning, students have a deeper understanding of the concepts of Linear Algebra. In the final exam, even though the proportion of subjective questions has increased, the students' scores have still improved significantly. At the same time, students' ability to apply knowledge has been significantly enhanced. For example, the number of awards in the National College Students' Mathematics Competition in 2023 has increased by 60% compared with that in 2022, and the number of awards in the National Undergraduate Mathematical Modeling Competition has increased by 90%. In addition, students who are preparing for the postgraduate entrance examination have significantly enhanced the agility and logic of their problem-solving thinking for Linear Algebra questions by independently planning their learning paths and making rational use of online resources. Their average score has increased by 10-15 points, laying a solid foundation for their postgraduate studies.

5. Conclusions and Prospects

This practice of applying the self-directed learning method in the teaching of the Linear Algebra course closely aligns with the course characteristics of Linear Algebra, such as "abstract concepts, rigorous theories, and wide applications". Supported by digital and intelligent technology, a teaching plan was designed from six dimensions: "establishment of hierarchical goals, construction of online resources, tracking of learning processes, joint construction of teaching cases, introduction of AI teaching assistants, and implementation of multi-dimensional evaluation". This effectively addresses the shortcomings of the traditional teaching mode and achieves remarkable teaching results. The teaching reform practice of the self-directed learning method shows that this method effectively compensates for the shortcomings of the traditional teaching mode and greatly stimulates students' enthusiasm for independent exploration of knowledge. However, there are still some problems in the practice process, such as insufficient self-management ability of some students and inadequate utilization of learning resources. In the future, it is necessary to further optimize the teaching practice plan, strengthen the cultivation of students' self-management ability, and improve the integration and recommendation mechanism of learning resources. This will better exert the role of the self-directed learning method in the teaching of the Linear Algebra course and promote the in-depth development of the teaching reform of the Linear Algebra course.

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Disclosure statement

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Application of 3D digital orthopedic technology combined with PBL teaching model in traditional Zhuang medicine and orthopedics teaching

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Abstract

Objective: To explore the application effect of 3D digital orthopedic technology combined with PBL teaching mode in the teaching of traditional Zhuang medicine and orthopedics, and to explore possible efficient teaching methods for traditional Zhuang medicine and orthopedics. Method: 54 medical students who studied in the Zhuang Medicine and orthopedics major at Guangxi International Zhuang Hospital from January 2023 to December 2023 were selected as the research subjects and divided into a control group and an observation group, with 27 students in each group. Two groups were divided into an observation group (using 3D digital orthopedic technology combined with PBL teaching mode) and a control group (using traditional teaching mode) using different teaching methods. Statistical analysis was conducted on the exam scores, teaching effectiveness evaluation, and teaching satisfaction of the two groups to compare their teaching effectiveness. Result: The observation group had better exam scores, teaching effectiveness evaluation, and teaching satisfaction than the control group, and the differences were statistically significant ($P<0.05$). Conclusion: The combination of 3D digital orthopedic technology and PBL teaching mode can help improve overall teaching effectiveness and may be an efficient teaching method for Traditional Zhuang Medicine and Orthopedics.

Keywords

3D digital orthopedic technology;PBL teaching model

Zhuang medical science

teaching

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1. Introduction

The Zhuang Medicine Traumatology constitutes a vital component of Zhuang Medicine, being a discipline of profound practical application. Presently, instruction in Zhuang Medicine Traumatology primarily relies on textbooks and anatomical atlases, lacking the intuitive representation afforded by three-dimensional anatomical structures [1]. This deficiency may hinder students' accurate comprehension of key diagnostic and therapeutic principles for traumatological conditions,

thereby impeding clinical practice within Zhuang Medicine Traumatology and potentially jeopardising its transmission and advancement.

Recent domestic and international pedagogical research indicates that problem-based learning (PBL) demonstrates excellent teaching efficacy in clinical medical education, effectively enhancing students' problem identification and analytical capabilities [2-4]. Digital orthopaedics, an emerging interdisciplinary field integrating computer science with orthopaedics, employs information technology to achieve the digitalisation, visualisation, virtualisation, operability, and intelligentisation of orthopaedic diagnostic and therapeutic procedures [5]. Research indicates that digital 3D orthopaedic technology fosters image-based cognition rather than textual comprehension, simplifying complex problems [6]. The organic integration of digital 3D orthopaedic technology with modern teaching methodologies significantly enhances clinical trainees' interest and practical skills [7]. Current literature offers limited reports on the application of these approaches in Zhuang medicine trauma science education. This study investigates the application of digital orthopaedic technology integrated with the PBL teaching model in Zhuang medicine traumatology education, contrasting it with traditional teaching approaches. Findings are reported below.

2. General Data

2.1. Case Grouping Information

The study cohort comprised 54 medical students enrolled in the Zhuang Medicine Traumatology programme at Guangxi International Zhuang Hospital between January and December 2023. The control group comprised 27 participants (12 males, 15 females) aged 21–24 years (mean age 22.5 ± 0.7 years). The observation group comprised 27 participants (13 males, 14 females) aged 21–24 years (mean age 22.3 ± 0.8 years).

2.2. Inclusion Criteria

① Medical students who actively participated in the entire course of Zhuang Medicine Traumatology instruction for this study; ② Voluntary participation with full knowledge of and consent to cooperate with this research.

2.3. Exclusion Criteria, Dropout, and Exclusion Standards

① Poor compliance; ② Individuals who had previously received training in Zhuang Medicine Traumatology; ③ Those who withdrew midway for any reason and could not continue participating in the study.

2.4. Methods

All subjects utilised the third edition of Zhuang Medicine Traumatology (People's Medical Publishing House) as the textbook. Instruction and clinical supervision were provided by faculty members with extensive clinical and teaching experience in Zhuang medicine traumatology. Assessment and evaluation were conducted upon completion of the learning programme.

2.4.1. Control Group

The control group employed traditional teaching methods. Specific implementation steps were as follows: ① Instructors delivered theoretical knowledge on Zhuang Medicine Traumatology via PowerPoint presentations. ② Students discussed relevant case studies presented by instructors, who posed questions to stimulate critical thinking and analysis. Students shared their insights before instructors provided concluding summaries.

2.4.2. Observation Group

The observation group utilised a combined 3D digital orthopaedic technology and PBL teaching model. The specific implementation steps were as follows: ① Problem-centred introduction: Utilising typical Zhuang orthopaedic trauma cases, the instructor guided students in collecting and compiling clinical case materials, summarising key disease aspects, and formulating critical questions. ② Guided group-based literature review and analysis: Each group member was required to gather and synthesise materials related to the actual teaching case questions, followed by literature analysis and summarisation. ③ Preparation of 3D-printed teaching aids: Prior to lectures, instructors distributed 3D-printed models of relevant teaching cases. Each group member prepared knowledge related to Zhuang orthopaedic trauma science. During lectures, groups presented and analysed findings using PowerPoint presentations alongside the 3D models to deepen understanding; ④

Inter-group discussion: Each group member shall present and summarise findings. The teaching instructor shall conduct a comprehensive assessment to guide trainees in identifying optimal evidence-based diagnostic and therapeutic approaches.

2.5. Assessment Criteria

2.5.1. Examination Results

A closed-book written examination, uniformly set by Associate Professors or above in Zhuang Medicine Traumatology, will be conducted. The content and duration of the examination will be identical for all participants, with a maximum score of 100 points.

2.5.2. Teaching Effectiveness Evaluation

Following the conclusion of both learning groups, evaluation forms and questionnaires will be distributed uniformly. Students' comprehensive abilities will be assessed by instructors based on professional competence, clinical analytical skills, clinical collaboration capabilities, and clinical practice proficiency, with each criterion scored out of 10 points.

Student questionnaires employed a Likert scale [8], comprising five response options: Very Satisfied, Satisfied, Fairly Satisfied, Dissatisfied, and Very Dissatisfied. Satisfaction rate = (Number Very Satisfied + Number Satisfied) / Total Group Participants × 100%. A total of 57 questionnaires were distributed, achieving a 100% valid response rate.

2.6. Statistical Methods

Data analysis was performed using SPSS 26.0 statistical software. Quantitative data are expressed as (x ± s), with intergroup comparisons conducted via t-tests. Categorical data are denoted by n and analysed using χ^2 tests. Differences were considered statistically significant at $P < 0.05$.

3. Results

3.1. Comparison of General Characteristics and Examination Scores Between Groups

No statistically significant differences were observed in general characteristics between the two groups ($P > 0.05$), indicating comparability.

Following the training programme, the observation group achieved higher examination scores than the control group, with statistically significant differences ($P < 0.05$). Details are presented in **Table 1**.

Table 1. Theoretical and Practical Examination Scores for Both Groups (Mean ± SD, points)

Group	Examination Results
Observation group（n = 27）	85.04±7.30
Control group（n = 27）	80.15±9.02
t -value	1.657
P -value	＜ 0.05

3.2. Questionnaire Survey Comparison of Comprehensive Competencies Between Two Student Groups

The observation group demonstrated superior clinical analytical skills, clinical collaboration abilities, and clinical practice capabilities. Both self-reported competency enhancement and teaching effectiveness evaluations were higher than those of the control group,

Table 2. Questionnaire Survey Results Comparing Comprehensive Competencies Between Two Student Groups (Mean ± SD, points)

Group	Professional Competence	Clinical Analytical Skills	Clinical Collaboration Skills	Clinical Practice Skills
Observation group（n = 27）	8.26±0.66	7.96±0.50	7.74±0.46	7.15±0.57
Control group（n = 27）	8.03±0.29	7.33±0.54	7.00±0.30	6.70±0.57
t-value	1.295	4.132	5.405	2.371
P-value	＞ 0.05	＜ 0.05	＜ 0.05	＜ 0.05

Table 3. Teaching Satisfaction Outcomes for Both Groups (n, %)

Group	Very satisfied	Satisfied	Neutral	Dissatisfied	Very dissatisfied	Satisfaction level
Observation group（n = 27）	7（25.93）	16（59.26）	4（14.81）	0	0	85.19
Control group（n = 27）	3（11.11）	14（62.96）	8（29.63）	2（7.41）	0	62.96

with statistically significant differences ($P < 0.05$). See **Table 2** for details.

3.3. Comparison of Teaching Satisfaction Outcomes

Following the conclusion of both groups' placements, teaching satisfaction survey results indicated that students in the observation group, who utilised 3D digital orthopaedic technology and the PBL teaching model, demonstrated significantly higher satisfaction levels than their counterparts in the control group, as detailed in **Table 3**.

4. Discussion

Zhuang Medicine Traumatology constitutes a vital component of traditional Chinese medicine. It represents an indigenous traditional medical system developed by the Zhuang people through prolonged engagement in production, daily life practices, and the struggle against disease. Its therapeutic approach is characterised by simplicity, efficacy, and affordability [9]. Although Zhuang Medicine was formally incorporated into China's higher education curricula in 2011, transforming the traditional mode of transmission through oral tradition and apprenticeship, current teaching still predominantly relies on lecturers delivering theoretical instruction and demonstrations. with post-lecture student learning predominantly reliant on literature review. This approach lacks visual clarity and practical applicability, nor does it permit individualised guidance for student practice. Consequently, student engagement remains low, with insufficient initiative and proactivity. This results in suboptimal mastery of theoretical knowledge and clinical skills, failing to meet modern educational standardisation requirements or clinical demands.

Zhuang medicine has long recognised human anatomy as fundamental to understanding disease pathogenesis. During the Northern Song Dynasty, the Lingnan Zhuang ethnic group produced the Ouxifan Five Viscera Diagram, China's earliest documented illustrated anatomical chart. It depicts human visceral structures with remarkable accuracy and detail, incorporating medical observations on pathological mechanisms during dissection [10]. However, owing to the scarcity of human anatomical specimens, clinical teaching in Zhuang medicine's trauma science has predominantly relied on illustrated atlases or models. These substitutes fail to accurately reflect local anatomical features, leading to comprehension difficulties among students.

In recent years, advances in 3D digital orthopaedic technology have offered novel approaches to addressing clinical teaching challenges in orthopaedics. This technology enables the digitalisation, visualisation, virtualisation, operability, and intelligent application of clinical orthopaedic diagnostic and therapeutic procedures [11-12]. Compared to traditional human dissection, 3D-printed models are more cost-effective, readily available, and easier for medical novices to comprehend [13]. Addressing the current challenges of specimen scarcity and the inability of conventional organ models to intuitively and effectively demonstrate pathological features, 3D-printed models offer a solution for medical education [14]. Research indicates that 3D printing technology significantly enhances the quality of orthopaedic education [15-17]. Further studies reveal that the organic integration of 3D digital orthopaedic technology with modern teaching methodologies improves the quality of clinical practice instruction [18]. Therefore, fully leveraging the visualisation advantages of 3D digital orthopaedic technology and flexibly combining it with diverse modern teaching approaches can stimulate students' initiative and enthusiasm for learning, continuously improving their learning efficiency and thereby enhancing overall teaching effectiveness and quality.

The Problem-Based Learning (PBL) model is a contemporary, student-centred teaching approach centred on problem-oriented learning, emphasising active student engagement and collaborative problem-solving. Currently, PBL is widely applied across numerous clinical departments, particularly in orthopaedic clinical teaching. It enhances students' autonomous learning and collaborative abilities while facilitating pedagogical transformation and elevating teaching standards [19-20]. Wei Lei et al. [21] observed that applying PBL in sports medicine education not only improves students' assessment outcomes but also enhances their self-directed learning abilities, problem-solving skills, learning motivation, and literature retrieval capabilities, demonstrating clinical practical value. Therefore, fully leveraging the strengths of the PBL model and dynamically optimising its application during Zhuang medicine trauma science teaching can progressively standardise instructional practices, broaden pedagogical perspectives, and elevate teaching efficiency and quality.

Currently, the integration of 3D printing with PBL teaching has been extensively applied in orthopaedic clinical education, significantly enhancing teaching outcomes and quality [22]. This study compared the clinical teaching of Zhuang Medicine Traumatology using a combined 3D digital orthopaedic technology and PBL teaching model against traditional teaching methods. Results revealed that the organic integration of 3D digital orthopaedic technology with the PBL teaching model not only significantly improved students' examination scores but also markedly enhanced their clinical analytical skills, clinical collaboration abilities, and clinical practical competencies. It is evident that the organic integration of 3D digital orthopaedic technology with the PBL teaching model fully engages multiple sensory modalities in student learning, stimulates their enthusiasm for active participation, and contributes to enhanced teaching outcomes and overall teaching satisfaction.

In summary, the synergistic integration of 3D digital orthopaedic technology and the PBL teaching model achieves multi-level optimisation in Zhuang Medicine Traumatology instruction. This approach not only ignites students' interest and enthusiasm for self-directed learning but also enables more intuitive comprehension of local anatomical relationships and relevant theoretical knowledge in pathological conditions. Concurrently, it enhances peer-to-peer and teacher-student interactions, elevating students' clinical analytical skills, collaborative abilities, and practical competencies. This approach improves both the teaching quality and satisfaction levels in Zhuang Medicine Traumatology instruction. Furthermore, it assists educators in refining teaching methodologies, thereby elevating overall instructional efficacy. This approach warrants wider adoption.

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Research on the Pathways and Challenges of Constructing Legal Corpus

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Abstract

Legal corpus serves as the core data foundation for Legal AI, playing an increasingly important role in fields such as natural language processing, legal reasoning systems, intelligent legal question-answering platforms, and legal policy analysis. However, constructing high-quality, secure, and compliant legal corpus still faces numerous practical pathways and challenges. This paper systematically explores the multidimensional pathways for constructing legal corpus, including data source selection, the collaboration between manual and machine annotation, the standardized management of legal terminology, the intelligent processing framework for legal corpus, and the data integration mechanism for multiple institution collaboration. At the same time, this paper analyzes the main challenges faced during the construction of legal corpus, such as data quality and standardization, the identification and handling of legally sensitive content, and the ongoing adaptability to legal policies. The research suggests that a combined approach of technological empowerment and institutional guarantees can effectively enhance data quality, ensure compliance and security, and achieve intelligent management in the construction of legal corpus. Finally, the paper proposes future research directions and practical recommendations, aiming to provide theoretical guidance and practical support for the construction and application of legal corpus.

Keywords

Legal Corpus Construction
Multi-source Data Fusion
Intelligent Annotation
Legal Semantic Model

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1. Introduction

1.1. Research background and significance

With the rapid development of artificial intelligence and big data technologies, legal corpus has become an important infrastructure for promoting legal intelligence. Legal corpus is not only used for NLP tasks such as text classification, entity recognition, and sentiment analysis, but also plays a key role in training legal reasoning models, intelligent legal question-answering, and legal policy prediction. To ensure the effective operation of these application scenarios, constructing a high-quality, secure, and compliant legal corpus has become a core issue in legal technology research [1].

1.2. Research issues and challenges

The construction of legal corpus faces numerous practical challenges. First, the diversity and complexity of legal texts pose a major dilemma. Legal documents typically include various types such as legal provisions, judicial documents, administrative files, policies and regulations, and legal consultation records, each with significant differences in data collection, annotation, and management methods. How to achieve unified processing and storage of cross-type legal texts has become one of the key issues in constructing the legal corpus [2].

Second, the annotation process of legal corpus has long relied on manual efforts, leading to low annotation efficiency and the potential for subjective bias. Although existing research has explored automated annotation methods based on natural language processing (NLP), these technologies still have certain limitations when faced with the semantic complexity of legal texts and the frequent changes in legal terminology. Therefore, establishing a collaborative mechanism between manual and machine annotation, as well as constructing a high-quality legal corpus annotation system, is an important task in the current construction of legal corpus.

1.3. Research objectives and innovations

The research objectives of this paper are mainly threefold:

(1) Systematically outline the construction path of legal corpus: by analyzing the core components of legal corpus (such as data collection, annotation management, privacy protection, and compliance governance), clearly define their technical implementation and management processes to provide scientific guidance for the construction of legal corpus.

(2) Reveal the main challenges in legal corpus construction: by addressing challenges related to data standardization, privacy protection, annotation accuracy, and legislative dynamics, this paper proposes corresponding categories of issues and analyzes their impact on the construction of legal corpus.

(3) Explore solutions and technical support: by combining cutting-edge technologies such as natural language processing, machine learning, big data analysis, and blockchain, this paper proposes strategies for constructing legal corpus and discusses their application prospects in legal intelligent systems[3].

The innovations of this research lie in the following aspects:

(1) Proposing multi-source data fusion pathways: unlike traditional single-source data collection methods, this paper emphasizes the cross-institutional, multi-type, and multilingual integration of legal corpus to address the uneven sources of legal texts.

(2) Constructing an intelligent annotation system: based on the combination of natural language processing and deep learning, this paper proposes an annotation system that balances human intervention and automated processing, effectively improving the annotation accuracy and efficiency of legal corpus.

(3) Designing a privacy computing and compliance governance framework: by introducing privacy computing technologies such as differential privacy and federated learning, along with governance mechanisms driven by legal policies, this paper aims to achieve intelligent, secure, and compliant management of legal corpus.

2. Path to Constructing Legal Corpus

2.1. Data collection and multi-source integration

The construction of legal corpus primarily relies on a stable and diverse data collection system. Currently, the sources of legal corpus mainly include legal documents, judicial rulings, legal consultation records, legal journals, and legal literature. Legal texts from different sources have varying linguistic expressions and text structures, making unified management and integration a key aspect of constructing a legal corpus.

To achieve the integration of multi-source legal corpus, this paper proposes a cross-source data collection and preprocessing mechanism. First, the data collection system needs to interface with multiple legal databases, such as the China Judgments Online, legal consulting platforms, government policy disclosure systems, and legal literature from academic publishers. Second, due to

the lack of uniformity in legal text formats, the collected data needs to undergo standardization processes, including the removal of irrelevant information, unification of terminology definitions, and adjustment of text structures to facilitate subsequent annotation and semantic analysis.

2.2. Annotation system and human participation mechanism

Annotation is an indispensable part of the construction process of legal corpus; it not only determines the quality of the corpus but also affects the training effectiveness and reasoning capabilities of legal AI models. The annotation content of legal corpus typically includes aspects such as recognition of legal entity, reasoning of legal relationship, classification of legal events, and segmentation of legal texts. However, the complexity of legal text content makes annotation challenging, and traditional annotation methods often rely on manual annotation, which is inefficient and carries the risk of subjective bias[4].

To improve the efficiency and accuracy of legal corpus annotation, this paper proposes a hybrid annotation system that combines manual and automatic annotation. First, by introducing pre-trained language models (such as BERT, RoBERTa, etc.), the system can automatically perform preliminary annotations on legal texts, providing a reference for subsequent manual review and optimization.

2.3. Data standardization and terminology unification

Data standardization and legal terminology unification are another important aspect of constructing a legal corpus. Due to the diverse sources of legal texts, legal terminology may vary across different institutions and regions, affecting the consistency and scalability of the corpus. Therefore, the construction of the legal corpus must ensure the uniformity of data structure and terminology definitions to support the training and reasoning of legal NLP models.

This paper proposes a method for unifying legal terminology, combining legal knowledge graphs and natural language processing techniques to achieve automatic recognition and unified mapping of legal terminology. First, based on the analysis of legal texts, the system can identify common legal terminology and construct a legal terminology graph.

2.4. Intelligent analysis and legal semantic model construction

The construction of a legal corpus not only requires high-quality data and accurate annotations but also necessitates the development of intelligent legal semantic models to support semantic understanding and legal analysis capabilities of legal texts. The application of legal semantic models can significantly enhance the intelligence level of the legal corpus in scenarios such as natural language processing, legal reasoning, and legal queries.

This paper proposes a framework for constructing legal semantic models based on deep learning and natural language processing. First, through the automatic preprocessing and feature extraction of legal texts, the system can provide accurate input data for the legal semantic model. Second, by utilizing deep learning models (such as Transformer, BERT, RoBERTa, etc.) to perform semantic analysis and semantic modeling of legal texts, it can acquire the ability for legal knowledge reasoning and understanding of legal texts.

2.5. Multiple institution collaboration mechanism and legal data sharing

The construction of a legal corpus often requires the collaborative participation of multiple legal institutions, including courts, procuratorates, law firms, legal research institutions, and government regulatory departments. There are differences in data structures, collection standards, and annotation methods among different institutions. Achieving data integration from multiple institutions while ensuring data quality is one of the significant challenges in constructing a legal corpus.

To this end, this paper proposes a multiple institution collaboration mechanism based on legal data sharing standards. First, by formulating a unified legal corpus sharing agreement, it ensures that the data access methods of different institutions are consistent and meet data protection and legal compliance requirements. Second, by adopting a decentralized data sharing model, such as Federated Learning and Privacy Computing technologies, it achieves cross-agency data sharing while ensuring data privacy and security.

3. Major Challenges in Constructing a Legal Corpus

3.1. Data quality issues

The data quality of legal corpus directly affects the training effectiveness and reasoning ability of legal AI models. However, the current construction of legal corpus faces issues such as low data quality, semantic inconsistency, and inaccurate annotations. First, during the data collection process, there may be problems such as data loss, data duplication, and data noise, which directly impact the comprehensiveness and accuracy of the legal corpus [5].

3.2. Complexity of legal terminology and annotation difficulty

The diversity and complexity of legal terminology make the annotation work of legal corpus particularly challenging. On one hand, legal terminology often has specific legal definitions and application scenarios; certain terminology may belong to a particular legal domain or a specific type of legal content, and these differences make standardization and unified annotation a challenge. On the other hand, there are significant differences in the semantic structures and expressions of different legal texts, leading to difficulties in maintaining consistency during the annotation process.

Therefore, accurately identifying legal terminology during the construction of legal corpus and establishing an annotation system that can adapt to changes in legal terminology is one of the core challenges faced in the construction of legal corpus.

3.3. Personalized data governance and privacy protection issues

The personalized governance capability of legal corpus determines its balancing strategy between public data and sensitive data. On one hand, legal corpus need to support various data governance models to meet the requirements of different legal systems and policies. For example, China's Personal Information Protection Law imposes strict management requirements on privacy information in legal corpus, while the European Union's General Data Protection Regulation (GDPR) requires stricter controls on query and usage permissions for legal data. How to achieve personalized data governance and privacy protection in the construction of multi-jurisdiction legal corpus has become an important topic in the design of legal corpus governance mechanisms.

These privacy and compliance issues not only affect the scope of use of legal corpus but also relate to the traceability and auditability of legal data.

3.4. Training needs of annotation consistency and legal AI model

The consistency of annotations in legal corpus directly affects the training effectiveness and reasoning ability of legal AI models. However, there is still significant inconsistency in the annotation work of current legal corpus, mainly reflected in the following aspects:

(1) Large differences in the professional backgrounds of annotators: different annotators may have varying interpretations of legal terminology, leading to inconsistent annotation of the same legal term across different corpora.

(2) Ambiguity and context dependence of legal terminology: certain terminology in legal texts may have multiple layers of meaning and are closely related to context, resulting in different outcomes for annotation tasks in different contexts.

(3) Lack of unified annotation standards: due to the diversity of legal corpus, annotation rules may vary depending on the source of the text, leading to inconsistencies in the training data for legal AI models, which affects the model's generalization ability and reasoning accuracy.

3.5. Classification of legal texts and adaptation to legal AI scenarios

The classification of legal texts is a key step in the construction of legal corpus, and its classification results directly affect the application effectiveness of legal AI models. Legal texts typically include civil judgments, criminal judgments, administrative cases, intellectual property texts, and legal consultations. Different types of legal texts exhibit significant differences in semantic expression, structural characteristics, and application scenarios, which poses certain challenges for the classification task[6].

4. Solutions and Technical Support

4.1. Multi-source data fusion and standardization processing path

The construction of legal corpus requires the integration of legal texts from different institutions and of different types, which places high demands on data fusion and standardization. However, there is still a widespread phenomenon of data silos in current legal corpus, making it difficult to meet the demand for high-quality legal texts across data sources for legal AI systems.

To address this issue, this paper proposes a multi-source legal data fusion path, which mainly consists of the following steps:

(1) Cross-institution data access mechanism: first, design a cross-institution data access system to efficiently aggregate legal texts from different sources such as courts, law firms, legal research institutions, and government agencies.

(2) Unified processing of legal texts: second, by means of cleaning, deduplication, and format standardization of legal texts, unify the representation of legal texts to enhance the generality and scalability of the legal corpus.

(3) Unified mapping mechanism for legal terminology: furthermore, construct a legal terminology graph to achieve unified mapping and definitions of legal terminology, making the use of terminology in legal texts more standardized and avoiding inconsistencies in the corpus content due to terminology differences.

4.2. Intelligent annotation and manual review mechanism

The annotation of the legal corpus is a key step in constructing high-quality legal text data, and its effectiveness directly impacts the training accuracy and reasoning ability of legal AI models. However, the annotation of legal corpus currently faces many challenges, such as low annotation efficiency, poor consistency, and high costs [7].

4.3. Privacy protection and data compliance framework

In response to the privacy data issues in the legal corpus, this paper proposes a data management framework centered on privacy computing and data compliance. This framework aims to ensure the security of legal data during the processes of collection, storage, usage, and sharing through privacy protection technologies.

4.4. Legal semantic modeling and adaptation to legal AI application scenarios

The construction of the legal corpus must not only consider data quality and annotation accuracy but also the adaptability of legal semantic modeling to application scenarios. Currently, the application of legal semantic models in scenarios such as legal reasoning, legal prediction, and legal consulting services is significantly influenced by the quality of legal texts.

To address this, this paper proposes a path for adapting legal semantic modeling to legal AI applications. First, by utilizing natural language processing (NLP) and deep learning technologies, this paper builds a legal semantic model to accurately understand and reason about legal texts. Second, based on different legal AI application scenarios (such as legal question-answering systems, legal analysis tools, and legal prediction platforms), the structure and training methods of the legal semantic model are adjusted to enhance its adaptability.

4.5. Multiple institution collaboration construction and legal data sharing model

Multiple institution collaboration construction is one of the important paths for constructing the legal corpus, but how to achieve cross-institutional data sharing and collaborative governance remains a practical challenge. On one hand, legal corpus needs to involve multiple legal institutions for data collection and annotation to improve data comprehensiveness and accuracy; On the other hand, there are differences in data collection standards and annotation methods among different legal institutions, leading to issues such as inconsistent data formats and difficulties in data integration between legal corpora.

5. Conclusion and Outlook

5.1. Research conclusions

This paper systematically explores the construction paths and main challenges of legal corpus, proposing a comprehensive solution suitable for the construction of

legal corpus. The construction of a legal corpus involves multiple aspects such as data collection, annotation management, terminology standardization, privacy protection, data compliance, and multiple institution collaboration, each of which is crucial for the quality and secure use of the legal corpus.

Research findings indicate that the core pathways for constructing a legal corpus include: multi-source data collection and standardized processing, a combination of intelligent annotation and manual review, unified management of legal terminology, establishment of legal privacy computing and compliance governance mechanisms, as well as multiple institution collaboration construction and the traceability of legal data flows. These pathways can effectively enhance the quality, security, and intelligent application value of the legal corpus, providing solid data support for the construction of legal AI systems[7].

5.2. Practical application value

The construction and optimization of the legal corpus hold significant practical implications for the development of legal technology. As legal AI technology continues to mature, the legal corpus will become an important foundation for legal intelligent systems. However, the current legal corpus still has many deficiencies, such as low data quality, untimely updates, and poor annotation consistency, which severely affect the training effectiveness and reasoning capabilities of legal AI models.

The pathways and solutions proposed in this paper for constructing a legal corpus can effectively address the main issues currently faced by legal corpus. For example, by introducing a multi-source data fusion mechanism, the legal corpus can achieve more comprehensive data collection; by constructing a legal terminology graph and a unified annotation rule scheme, the legal corpus can adapt to changes in legal terminology and improve annotation consistency; through privacy computing and blockchain technology, the legal corpus can achieve secure data management; through a multiple institution collaboration construction mechanism, the legal corpus can achieve cross-institutional data sharing and the integration of legal liability elements.

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