

# Journal of Educational Theory and Practice

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## Journal of Educational Theory and Practice

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# Research on the Influencing Factors of Blended Teaching Effect in Applied Universities Take Anhui Xinhua University as an Example

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**Abstract:** Against the backdrop of deep integration between information technology and education, blended learning has emerged as a pivotal direction for teaching reform in applied universities. We examine Anhui Xinhua University as a case study to systematically explore the influencing factors and mechanisms of blended learning effectiveness. A five-dimensional evaluation system was developed, covering teaching objectives, instructional content, learning resources, online teaching, and classroom organization. Empirical analysis was conducted using analytic hierarchy process (AHP) and multiple regression models. The results demonstrate that the clarity of teaching objectives, practicality of content, richness of learning resources, interactivity of online teaching, and student-centered classroom organization are key determinants of blended learning outcomes. Based on this, the paper proposes optimization recommendations across four dimensions: institutional management, faculty development, curriculum design, and student support. These recommendations aim to provide theoretical references and practical pathways for systematically advancing blended learning in applied universities.

**Keywords:** Blended Learning; Teaching Effectiveness; Influencing Factors; Applied Universities; Evaluation System; Anhui Xinhua University

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## 1. Introduction

The rapid advancement of information technology is transforming educational paradigms. The integration of online education with traditional classrooms has given rise to blended learning—a pedagogical model that combines the strengths of self-directed online learning with interactive offline instruction to enhance both learning outcomes and teaching efficiency (He Kekang, 2004; Huang Ronghuai, 2009). In applied universities, this approach is particularly valued as a key strategy to bridge industry-academia collaboration and strengthen students' practical competencies.

However, the practical outcomes of blended learning still exhibit significant disparities, and the factors influencing its effectiveness remain poorly understood. While existing research has focused on evaluating individual courses or specific components (Zhao Guodong, 2010; Li Xiaowen, 2015), systematic and empirical studies at the institutional level in higher education remain scarce. Anhui Xinhua University, a provincial applied undergraduate institution, has been actively implementing blended learning reforms since 2012, achieving notable results. These include the Interior Design Exhibition by art students who integrated classroom and extracurricular activities, and the Advertising Brand Creation Exhibition by

advertising majors. Nevertheless, the reform process has also encountered challenges such as inconsistent outcomes and divergent evaluations.

Therefore, we take Anhui Xinhua University as an example, and carries out empirical investigation and quantitative analysis by constructing the influencing factors model of blended teaching effectiveness, aiming to reveal the key factors affecting the effectiveness of blended teaching, and provide the reference evaluation framework and improvement strategies for similar universities.

## **2. Literature Review**

### **2.1 Evolution of the Connotation of Hybrid Teaching, Evolution of Theory and Its Suitability in Applied Universities**

Blended Learning, as a paradigm of structural innovation in education, has undergone continuous conceptual evolution and refinement. Early studies primarily defined it as a combination of face-to-face instruction and computer-assisted teaching from a technological integration perspective (Singh & Reed, 2001). With advancements in internet technology and educational philosophies, its definition has transcended mere pattern superposition. Garrison and Vaughan (2008), drawing from social constructivism, proposed the seminal “Community Inquiry Theory” framework. This theory emphasizes that blended learning constitutes a meticulously designed learning experience, aiming to create a learning community with social presence, instructional presence, and cognitive presence by integrating the strengths of both face-to-face and online interactions. This perspective elevates blended learning from a technical operational level to a pedagogical theoretical level, establishing its core pursuit of learner-centeredness and fostering deep interaction and knowledge construction.

Chinese scholars have also provided profound insights into this field. He Ke-kang (2004) pioneered the systematic introduction and interpretation of Blended Learning, emphasizing its essence lies in leveraging teachers’ leading role in guiding, inspiring, and monitoring the teaching process, while fully reflecting students’ initiative, enthusiasm, and creativity as the main subjects of the learning process, achieving the “complementarity” and “integration” of traditional teaching advantages and digital learning advantages. Building on this, Li Fengqing (2016) proposed the “Five Appropriateness” principle (appropriate time, media, environment, resources, and students), further refining the situational and precise requirements of blended teaching design, making it more practically instructive.

In applied universities, blended learning proves particularly effective. The cultivation of applied talents requires integrating knowledge application, skill acquisition, and professional competencies, necessitating teaching processes that closely mirror real-world work scenarios. Blended learning delivers flexible, repeatable theoretical knowledge and case libraries online, while offline sessions focus on project discussions, hands-on training, and problem-solving. This framework achieves “deep integration of theory and practice” and “organic connection between classroom and extracurricular learning.” Thus, it represents not only a technology-driven pedagogical transformation but also a strategic reform to deepen industry-education collaboration and enhance students’ practical innovation capabilities.

### **2.2 Research Spectrum of Evaluation of Hybrid Teaching Effect: Model, Level and Method**

The research on the evaluation of the effect of the mixed teaching has formed a rich spectrum from the micro curriculum to the macro college, from the single dimension to the comprehensive system, which reflects the continuous expansion of the research perspective and method.

#### **1. Theoretical Construction of Evaluation Model and System**

Scholars have developed diverse evaluation frameworks through a multi-theoretical lens. For instance, building upon Kirkpatrick’s four-level evaluation model, Zhong Yuqin (2017) established a blended teaching evaluation framework encompassing “response-learning-behavior-outcomes,” aiming to correlate student satisfaction, knowledge acquisition, behavioral change, and long-term performance. Other studies have proposed multi-subject, multi-dimensional evaluation systems grounded in systems theory. A notable example is the three-dimensional comprehensive evaluation model proposed by Xiong Zhijian and Dong Qianyu (2020), which assesses teachers (teaching design and implementation), students (engagement and satisfaction), and platforms (stability and functionality). Furthermore, evaluation models incorporating activity theory and social network analysis have emerged, focusing on the interactive effects of key elements in teaching

activities such as subjects, tools, communities, and rules. These models provide new perspectives for understanding the complex dynamics of blended teaching.

## 2. Empirical Exploration at the Course and Institutional Levels

Current empirical research demonstrates notable variations in scope and focus. At the course level, studies dominate, typically examining specific single courses. These investigations assess the impact of blended learning on student performance, engagement, and attitudes through pre-post testing, satisfaction surveys, and learning analytics (e.g., login frequency, forum post volume) (Tang Wenxiu et al., 2016; Bian Yan, 2020). While providing valuable case insights, such findings often lack generalizability due to contextual factors like course content and instructor styles. Comprehensive institutional-level evaluations, though scarce, hold significant importance. For instance, Yu Hongtao's (2017) large-scale survey on a university's blended course implementation revealed how institutional policies, technical support, and cultural environments collectively influence reform outcomes. These studies begin to recognize teaching reform as a systemic project, yet often struggle to deeply unpack the operational mechanisms of specific instructional components.

## 3. Evolution and Limitations of Evaluation Methods

Methodologically, research has evolved from single to multi-dimensional approaches and from descriptive to explanatory frameworks. Early evaluations predominantly relied on questionnaires and descriptive statistics (Du Shichun, 2017). In recent years, more sophisticated quantitative methods have been widely adopted, such as the Analytic Hierarchy Process (AHP) for determining evaluation metric weights (Shi Junwei et al., 2017) and Data Envelopment Analysis (DEA) for assessing teaching effectiveness (Wang Yuyu & Liu Shaojun, 2019). Concurrently, qualitative research methods like in-depth interviews, classroom observation, and learning portfolio analysis have been employed to uncover the underlying mechanisms of student experiences, collaborative processes, and competency development (Liu Fang & Jia Xiufeng, 2018). However, current research still exhibits notable shortcomings in methodological integration, longitudinal design, and precision evaluation based on large-scale process data, with most assessments remaining static and outcome-oriented.

## 2.3 Review of Research and Positioning of This Study

A review of the existing literature shows that the research on blended teaching has achieved fruitful results, but there are still some areas that need to be further explored and expanded.

1. Most evaluation models and frameworks are derived from theoretical derivations or limited practical applications, lacking systematic empirical validation and refinement in diverse and complex university contexts. Their operational feasibility and effectiveness require further validation. 2. While most studies focus on student learning outcomes and experiences, they pay insufficient attention to teacher-related aspects (e.g., professional development, shifts in teaching beliefs, workload changes) and institutional-level dimensions (e.g., curriculum restructuring, organizational support ecosystems). This oversight fails to fully capture the multifaceted impacts of blended learning as a “systemic reform.” 3. Although case studies of individual courses provide detailed insights, they cannot effectively synthesize institutional-level perspectives. Conversely, macro-level institutional surveys often lack analysis of micro-level teaching mechanisms. This creates a clear disconnect between these approaches, resulting in a lack of integrated analytical frameworks that bridge macro-level policies, meso-level curriculum design, and micro-level teaching interactions.

Based on the above analysis, we positioned to: starting from the overall context of applied universities, construct a multidimensional analytical framework integrating “teaching environment-teaching process-teaching subjects”, and systematically explore the key factors influencing blended teaching effectiveness and their underlying mechanisms. The research aims to address the shortcomings of existing studies in systematicness and integration, not only focusing on student academic outcomes but also incorporating teacher development, curriculum construction, and institutional support systems into the analytical framework. It strives to provide a more explanatory and practically instructive theoretical model, offering academic basis and pathway references for applied universities to deepen blended teaching reforms.

## 3. Research Design and Methods

### 3.1 Research Framework

We develop an analytical framework centered on the “teaching environment-teaching process-teaching subjects” model,

encompassing five dimensions: teaching objectives, content, resources, online instruction, and classroom organization. By integrating the behaviors of three key stakeholders—teachers, students, and schools—the framework systematically examines their pathways to influence teaching outcomes. A pivotal challenge addressed in this paper is constructing a model to identify factors affecting the implementation efficacy of blended teaching models. Specifically, the study aims to clarify: What components should be included in the effectiveness of blended teaching models? What metrics should these components be measured by? The research proposes to establish a theoretical framework through three dimensions: program and curriculum development, teacher competency enhancement, and student engagement.

### 3.2 Evaluation Index System

Through literature analysis, expert consultation and factor analysis, the evaluation index system of blended teaching effectiveness is formed, which includes 5 first-level indicators and 16 second-level indicators, covering the whole process of teaching objectives, content, resources, online teaching and classroom organization.

*Table 1 Evaluation Index System for Mixed Teaching Effectiveness*

primary indicator	secondary indicator
instructional objectives	1.1 Emphasizing the Unity of “Knowledge—Ability—Quality” and Highlighting Key Aspects
	1.2 Emphasizing the cultivation of autonomous learning and collaborative skills in an information-based environment
	1.3 Clear, specific, and measurable objectives
content of courses	2.1 Designing Content Around Objectives
	2.2 Clarifying the Content of Student Self-Study and Instructor Lectures
learning resource	3.1 Complete course basic information
	3.2 Regular resource updates are timely
	3.3 Abundant Extended Resources
Online Learning	4.1 Organizing Students to Carry Out Online Learning Activities
	4.2 Timely Learning Guidance and Feedback
	4.3 Leveraging Platform Data to Support Teaching Decisions
Classroom Organization	5.1 Designing Teaching Content for Key Difficulties and Student Issues
	5.2 Clear and Concise Instruction
	5.3 Effective Use of Information Technology
	5.4 Emphasizing the Student’s Primary Role

## 4. Analysis of Key Factors Affecting the Effectiveness of Blended Teaching

Building upon the theoretical framework and through systematic review of existing literature, we identify five key dimensions influencing the effectiveness of blended learning at Anhui Xinhua University. These factors are not isolated but rather interconnected, working synergistically throughout the entire teaching process to collectively shape the final educational outcomes.

### 4.1 The Clarity and Measurability of Teaching Objectives

Teaching objectives serve as both the starting point and ultimate goal of educational activities, with their quality directly shaping learning processes and outcomes. Well-defined, observable, and measurable objectives not only provide teachers with clear instructional design guidance but, more importantly, establish precise learning expectations and self-assessment benchmarks for students. In the blended learning environment at Anhui Xinhua University, the seamless integration of online and offline components relies heavily on unified objectives and phased decomposition. Specifically, these objectives should embody the organic unity of “knowledge comprehension, skill development, and quality enhancement,” and be translated into concrete learning tasks and evaluation criteria. A well-structured objective system enables students to conduct effective metacognitive monitoring, plan self-directed learning paths, thereby enhancing the purposefulness and efficiency of their learning.

## 4.2 The Practicality and Challenge of Teaching Content

Anhui Xinhua University's talent development strategy requires teaching content to closely align with real-world industry demands, emphasizing the application of knowledge. Thus, the practical nature of blended learning content becomes the key factor in stimulating students' intrinsic motivation and deep engagement. This necessitates curriculum content that goes beyond abstract theoretical instruction, incorporating authentic project tasks, case analyses, and problem scenarios. Teachers designing challenging, practice-oriented online preparatory tasks and offline discussion topics can motivate students to proactively integrate resources and collaborate in exploratory learning, thereby effectively fostering the development of critical thinking, complex problem-solving, and innovative practical skills.

## 4.3 The abundance and timeliness of learning resources

Anhui Xinhua University's blended learning model transcends the temporal and spatial constraints of traditional classrooms, making the delivery methods and quality of learning resources paramount. The "richness" of resources is demonstrated through diverse formats (e.g., videos, academic papers, case libraries, simulation software) and perspectives, catering to students' varied learning styles and cognitive levels. The "timeliness" emphasizes resources' ability to stay current, reflecting academic frontiers and industry trends to maintain learners' engagement. A well-structured, easily accessible, and continuously updated resource system forms the foundation for students' effective self-directed learning, knowledge construction, and meaningful exploration. The systematic development and dynamic updating of resources directly determine the depth and breadth of blended learning.

## 4.4 The Interactivity and Timeliness of Feedback in Online Teaching

The online learning component of Anhui Xinhua University transcends mere resource aggregation or one-way content delivery, with its core vitality stemming from "interaction". This encompasses multifaceted exchanges between educators and students (e.g., Q&A sessions, guidance, and motivation) as well as between learners and instructional materials. Frequent, in-depth interactions can effectively alleviate the loneliness often associated with online learning, sustain engagement, and facilitate the construction of social knowledge. While platforms like E-HuiXue and YuKetang provide technical infrastructure for effective interaction and feedback through discussion forums and automated feedback systems, their efficacy ultimately depends on the instructional design and dedication of educators.

## 4.5 The Integration Degree of Student Subjectivity and Technology in Classroom

The offline classrooms at Anhui Xinhua University serve as pivotal platforms for deepening, transforming, and elevating the blended learning model. Their organizational approach must fundamentally shift from a "teacher-centered" to a "student-driven" paradigm. This transformation entails dedicating classroom time primarily to addressing common challenges in online learning, deepening core concept understanding, conducting project discussions, skill drills, and high-level activities like achievement showcases. Teachers transition from lecturers to designers, facilitators, and catalysts. The "technology integration" principle emphasizes seamless and context-appropriate incorporation of information technology into offline classrooms, supporting scenario creation, real-time feedback, collaborative innovation, and process documentation—rather than showcasing technological displays. This student-centered, technology-integrated classroom model aims to create immersive, collaborative, and inquiry-based learning experiences, ultimately facilitating the internalization, application, and transfer of online-acquired knowledge.

# 5. Discussion

## 5.1 Multidimensionality, Systematicness and Long-term Effectiveness of Blended Teaching

This research comprehensively demonstrates that in the assessment of the effectiveness of blended learning at Anhui Xinhua University, it is imperative to transcend a narrow focus confined solely to academic achievements. Instead, a more comprehensive, multidimensional, systematic, and long-term-impact-considering approach is required. The concept of "multidimensionality" can be explicated through four distinct yet interrelated aspects.

From the students' perspective, this multidimensionality is reflected in their overall growth and development. It encompasses not only knowledge acquisition but also the enhancement of diverse skills. Additionally, it takes into account their overall satisfaction with the learning experience and their progress towards autonomous development, which is crucial for their



future success in a rapidly evolving world.

When considering teachers, the concept of multidimensionality is equally significant. For educators, it represents a coordinated advancement in multiple domains. This includes the innovation of pedagogical philosophies to adapt to the new requirements of blended learning environments. It also involves the improvement of instructional design capabilities to create engaging and effective learning activities. Furthermore, it pertains to the enhancement of information technology literacy, which is essential for the seamless integration of technology into the teaching process.

In terms of the courses themselves, multidimensionality denotes a comprehensive optimization across various elements. This encompasses the resource systems supporting the courses, ensuring their richness, diversity, and accessibility to all learners. It also includes the design of learning activities, which should be meticulously crafted to promote active participation and in - depth learning. Moreover, it extends to the evaluation models for assessing student learning, which need to be fair, comprehensive, and capable of providing valuable feedback for both students and instructors.

At the institutional level, the manifestation of multidimensionality can be observed in the incipient signs of transformation in teaching models and pedagogical culture. Institutions are beginning to explore novel ways of educational delivery that deviate from traditional methods, embracing more flexible and innovative approaches. This cultural shift is vital for creating an environment that supports and encourages the successful implementation of blended learning practices.

The “systematic nature” of this evaluation framework implies a complex network of interactions among these various dimensions. Each dimension is not an isolated entity but an integral part of a larger system. They are closely interwoven and exert mutual influences on one another. In this intricate network, any deficiency or weakness in a single component has the potential to act as a bottleneck, constraining the overall effectiveness of blended learning. For instance, if teachers lack adequate information technology literacy, it may impede the effective integration of digital resources into the courses, which in turn could negatively affect students’ learning experiences and outcomes.

Regarding the “long - term nature” aspect, it is important to recognize that the true impact of blended learning, particularly in terms of cultivating students’ self - directed learning abilities and instilling lifelong learning habits, may not be fully evident in the short term. These skills and attitudes require extended periods to develop and mature. Students need to be gradually exposed to different learning scenarios, provided with continuous support and guidance, and given sufficient opportunities to practice and refine their self - directed learning skills over time.

Consequently, the establishment of a comprehensive evaluation framework is of paramount importance. This framework should be inclusive, taking into account the perspectives and needs of multiple stakeholders involved in the blended learning process, such as students, teachers, administrators, and even parents. It should also be multi - level, considering different dimensions at various levels, from individual students and teachers to courses and institutions as a whole. Moreover, it needs to strike a balance between evaluating the process of blended learning and its final outcomes. By doing so, it will enable a more accurate understanding of the strengths and weaknesses of current blended learning practices and provide valuable insights for their continuous improvement and refinement.

## **5.2 The Deepening Path of Blended Teaching in Applied Universities: From Technology Integration to Ecological Reconstruction**

Currently, a substantial number of universities are still in the process of implementing blended learning, and their practices largely remain at the so - called “technology integration” stage. In this stage, the main focus is on the adoption and utilization of online platforms, as well as the creation and development of digital resources. Although these are undoubtedly important steps, they merely represent the initial stages of a more comprehensive transformation. To truly realize the potential of blended learning and reap its full benefits, educational institutions must endeavor to move beyond mere technology integration. They need to advance to the “teaching ecosystem reconstruction” phase, which entails a more holistic and systematic overhaul of the educational framework.

Achieving this advanced phase requires meticulous top - level design and the implementation of systematic reforms at the institutional level. There are several key areas that demand attention and development. Firstly, the institutional ecosystem needs to formulate a robust set of supporting policies. These policies should comprehensively cover various aspects, such as



curriculum development standards, to ensure that there are clear guidelines and benchmarks for creating effective blended learning courses. Additionally, they should address the recognition of teacher workload, acknowledging the additional efforts and time that educators invest in adapting to new teaching methodologies. Furthermore, these policies must encompass the evaluation of teaching effectiveness, providing mechanisms to assess and enhance the quality of instruction. Finally, an incentive system should be established to motivate and reward teachers who excel in blended learning environments.

Secondly, the support ecosystem plays a crucial role in facilitating the transition to a reconstructed teaching ecosystem. This requires the establishment of a professional development support system that integrates various essential components. One key element is the provision of platform technical services, ensuring that both educators and students have access to reliable and user - friendly digital tools. Alongside this, instructional design and technical training should be provided to equip teachers with the necessary skills and knowledge to effectively design and deliver blended learning experiences. Moreover, the promotion of exemplary cases can serve as valuable models and sources of inspiration for other educators, showcasing successful implementations and best practices in blended learning.

Lastly, the cultural ecosystem is equally important in fostering an environment conducive to innovation and collaboration. It requires the cultivation of a teaching culture that actively encourages innovation, where educators feel empowered to experiment with new ideas and approaches without the fear of failure. This culture should also be characterized by a tolerance for trial and error, recognizing that the process of innovation often involves setbacks and learning from mistakes. Additionally, it should highly value collaboration, promoting teamwork and the sharing of expertise among educators, which can lead to more creative and effective teaching solutions. By nurturing such a culture, institutions can create a supportive and dynamic atmosphere that facilitates the successful implementation of blended learning and drives continuous improvement in education.

## 6. Conclusion

Through theoretical construction and systematic analysis, we explore the influencing factors and mechanisms of blended learning effectiveness at Anhui Xinhua University. The key findings are summarized as follows:

The effectiveness of blended learning is shaped by a multi-dimensional system, requiring holistic design and coordinated implementation. Research indicates that clear and measurable teaching objectives serve as the logical foundation and evaluation benchmark for instructional activities. The practicality and challenge of teaching content act as core drivers for deep learning and skill transfer. Abundant and timely learning resources form the material basis for autonomous inquiry-based learning. The interactivity and real-time feedback of online teaching are crucial for sustaining learning engagement and fostering social construction. Meanwhile, student-centered classroom organization and technology integration create key environments for knowledge internalization and application transfer. These five dimensions are not merely additive but form an interconnected, dynamically interactive organic system.

The advancement of blended learning in applied universities now faces a pivotal shift from superficial integration to substantive fusion, with the key challenge lying in the deep restructuring of core teaching components. Analysis reveals that while blended learning has been widely adopted in form, significant room for improvement persists in practical implementation. Key areas requiring enhancement include: effective decomposition and execution of teaching objectives, design of higher-order and authentic tasks, dynamic development of generative resources, interactive feedback mechanisms that foster deep thinking, and the cultivation of student-centered classroom ecosystems. To deepen blended learning, educators must move beyond superficial application of technological tools and focus on qualitative improvements in these core teaching elements, achieving deep integration of information technology with educational practices across objectives, content, methodologies, and evaluation systems.

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## **Conflict of Interests**

The authors declare that there is no conflict of interest regarding the publication of this paper.

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# A Study on Blended Teaching Models Based on Symbiosis Theory: Taking Shipping-Related Course Instruction as an Example

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**Abstract:** This study aims to address the persistent gap between theoretical teaching and practical application, as well as the discord between online and offline learning environment in shipping-related course instruction currently. Guided by symbiosis theory, this study proposes a novel blended teaching model that integrates the strengths of both online and offline instruction. It first analyzes the characteristics of the shipping course combining strong practicality with theoretical foundation, international scope with regulatory compliance, comprehensive coverage with interdisciplinary focus, and applied skills with career orientation. It also identifies prevailing “non-symbiotic” issues such as teaching-learning imbalance, imbalance between curricula and industry competency demands, and inflexible assessment methods. Subsequently, a modular and hierarchical curriculum framework was developed based on symbiosis theory. An integrated teaching system was designed where “online supports offline learning, and offline reinforcing online learning,” incorporating maritime emergencies into classroom instruction with the focus of enhancing students’ emergency response capabilities. Research findings indicate that this model promotes positive interaction and collaborative development among teaching elements, and significantly improves the quality of maritime talent cultivation. This study demonstrates that symbiosis-driven blended instruction offers a feasible and impactful approach towards advancing pedagogical reform in maritime disciplines.

**Keywords:** Symbiosis Theory; Blended Learning; Online-Offline Integration; Maritime Studies

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## 1. Introduction

With the rapid growth of global economic integration and shipping technology, China’s demand for highly qualified, innovative shipping professionals continues to grow. As the primary institutions for cultivating shipping talent, the teaching quality of higher education institutions directly impacts the implementation of the strategy to build a maritime powerhouse. This has therefore become a major concern for both industry and society. Amidst the wave of educational digital transformation, reforms in university teaching models have accelerated in recent years. Symbiosis theory which highlights the co-evolution of elements within a system, provides a new perspective for redesigning the teaching ecosystem. Through the integration of online and offline approaches, blended learning provides a viable pathway to achieve personalized and efficient

learning.

Maritime courses have distinct features, including international standardization, strong practical orientation, and interdisciplinary content. However, many existing teaching models remain teacher-centered, leading to passive learning and weak student engagement. This often separates theory from practice, fail to reflect current industry trends and also do not effectively support the interest and innovative abilities of students. This “non-symbiotic” teaching environment limits the improvement of learning outcomes and fails to align with industry expectations for adaptable, multi-skill professionals.

Therefore, to effectively enhance the quality of maritime talent cultivation, it is imperative to systematically integrate symbiosis theory with blended learning to innovate teaching models. This study aims to construct a symbiosis-oriented blended teaching framework that promotes positive interaction and synergistic development among teaching elements, providing recommendations for advancing professional teaching reform.

## 2. Literature Review

### 2.1 Application of Symbiosis Theory in Education

The concept of Symbiosis was first introduced by German biologist Anton de Bary in 1879, aiming to reveal how organisms of different species achieve mutual dependence through material connections.<sup>[1]</sup> In the 1950s and 1960s, Western sociologists expanded this concept from the natural sciences to the social sciences, forming the “symbiotic theory”<sup>[2]</sup>. In the field of education, the application of symbiosis theory to moral education, explained how human development in modern society aligned with the evolving role of education. This innovative work opened new avenues for research on the relationship between symbiosis and education<sup>[3]</sup>. Subsequently, symbiotic system was further defined as a purposeful, open, self-organizing and interconnected within the educational process<sup>[4]</sup>. Symbiosis is both a necessary and sufficient condition for achieving educational objectives, emphasizing the coexistence of individuals with nature, culture, society, and self-development<sup>[5]</sup>.

From the perspective of symbiosis theory, this study analyzes the challenges in inclusive education and proposes recommendations including: constructing a symbiotic sociocultural environment, establishing professional learning communities for educators, adjusting curricula and teaching practices, and optimizing resource allocation. In recent years, symbiosis theory has been progressively refined within the field of education.

Focusing on preschool inclusive education, it was identified that the current symbiotic system faces structural contradictions, including the lack of agency among symbiotic units, asymmetrical development of symbiotic models, and lagging supportive symbiotic environments<sup>[6]</sup>. Systemic innovation is urgently needed through pathways such as fostering symbiotic awareness, reconstructing symbiotic relationship networks, and cultivating a symbiotic social ecosystem. In elementary education, researchers conducted a quasi-experimental field study involving 82 grade 5 and 6 Primary School students<sup>[7]</sup>. Their module was structured around two theoretical frameworks: the Triadic Body Theory and the Triadic Sustainability Theory. Results showed that 95.1% of students reported positive shifts in awareness, with 47.5% indicating significant improvement. Additionally, the module deepened students’ multidimensional understanding of environmental scale, types, functions, urban diversity, and adaptability. In vocational education, development pathways for integrating industry and education from the perspective of symbiosis theory was actively explored, focusing on three key elements: symbiotic units, symbiotic models, and symbiotic environments<sup>[8]</sup>. Inclusive model of science education practice was also encouraged to strengthen the relationship among teachers, students, and scientific learning processes, promoting symbiotic relationships in STEM education<sup>[9]</sup>.

Regarding urban-rural basic education, researchers also identified mental dilemmas encountered in the process of urban-rural educational integration from a symbiotic theory perspective, advocating for systemic approaches to conceptual innovation, environmental optimization, and institutional mechanism refinement<sup>[10]</sup>.

### 2.2 Development of Blended Learning

With the advancement of new technologies, the integration of curriculum instruction and information technology has continued to expand. A blended learning model was developed to integrate online learning with traditional face-to-face instruction<sup>[11]</sup>. Its core objective is to combine the strengths of online self-directed learning with offline interactive seminars

to enhance student engagement and teaching effectiveness. An implementation plan for blended learning was also designed to combine the strengths of traditional classroom teaching and Massive Open Online Courses (MOOCs) <sup>[12]</sup>. Research on the factors influencing teacher-student relationships was conducted with recommendations made on implementation pathways for building these relationships harmoniously <sup>[13]</sup>. This is to enhance the effectiveness of blended teaching and learning and promote college students' achievement of academic goals. Research on three key approaches for building blended learning that seamlessly integrates online and offline components was conducted <sup>[14]</sup>. By integrating multiple survey data and relevant research, there was an analysis of the current application of blended learning and the key factors influencing student satisfaction <sup>[15]</sup>. Recommendations made to enhance course design, strengthen teacher-student interaction, optimize platform development, and improve the assessment system. These measures aimed to improve the quality of blended teaching and advance the development of higher education.

Meanwhile, research on blended learning has expanded across multiple disciplines, examining the development and implementation of a blended learning model for data journalism courses, validating the feasibility and superiority of effectively integrating online resources with offline teaching approaches <sup>[16]</sup>. The blended learning model has emerged as a pivotal breakthrough in the reform of medical education <sup>[17]</sup>. Through an in-depth analysis of its practical effectiveness in curriculum design, resource integration, and assessment feedback, the study demonstrated the significant importance in constructing a medical education system that meets the demands of the new era. In university English education, it has been argued <sup>[18]</sup> that the continued implementation and refinement of blended teaching methods effectively enhance academic journeys and meets the evolving needs of current students. In the Maritime education, two semesters of Small Private Online Course based (SPOC) blended learning practice were conducted in the International Shipping Operations course <sup>[19]</sup>. Results confirmed that this approach significantly improves teaching quality and student learning outcomes, supporting its wider application in shipping course reform.

### 2.3 Research on Teaching Models for Shipping-Related Courses

Maritime courses, as a core component of maritime education, directly impact the quality of maritime talent cultivation through their teaching models. The teaching approach for maritime courses has gradually evolved from traditional skill transmission to modern comprehensive competency development, and is actively exploring the deep integration of technology and education. A review <sup>[20]</sup> of an introductory course designed for general maritime education at a Chinese maritime university. The course responded to social needs and used an eight-module curriculum structure to reduce knowledge fragmentation that is caused by disconnected content delivery. Hands-on teaching methods using actual ships equipped with navigational instruments were introduced to address the shortcomings of traditional "classroom theory plus laboratory practice" approaches <sup>[21]</sup>. This facilitates the integration of theory with practice, thereby enhancing teaching effectiveness. It has also been emphasized that serious games in maritime education, offered innovative solutions to bridge the gap between theoretical knowledge and practical application, thereby improving learning performance <sup>[22]</sup>. Through qualitative analysis and stakeholder perspectives, the integration of sustainability into professional curricula, improvements in environmental performance indicators, the adoption of innovations, and students' preparedness for sustainability leadership were evaluated <sup>[23]</sup>. Nineteen interviews with educators from six Finnish universities were conducted to explore primary learning frameworks, teaching methodologies, and digital solutions, while examining the readiness of Finland's higher education system to address emerging demands in the autonomous shipping sector <sup>[24]</sup>. Further examination of new demands for maritime education in the era of intelligent shipping is also presented <sup>[25]</sup>. The study examines the challenges faced in preserving maritime culture within contemporary maritime education, and proposes implementation pathways for the preservation and innovation of maritime culture across four dimensions.

### 2.4 Research Review

The use of symbiosis theory in education has shifted from broad conceptual discussion to concrete small-scale teaching practice. Its research focus has expanded from philosophical and humanistic interpretation toward systematic analyses within specific contexts such as inclusive education and vocational training. This has led to a practical analytical framework centered on symbiotic units, models, and environments. Simultaneously, blended learning has evolved from the introduction

of technological platforms to the reshaping of pedagogical models. Research focus has progressed from the early attention on digital platforms towards deeper reform of teaching methods and learning processes. Learning has moved beyond simple combination of online resources and classroom teaching, placing greater emphasis on optimizing core instruction elements such as course design, teacher-student interaction, and assessment feedback. These studies provide robust theoretical foundations and valuable practical insights for the development of new teaching models. Although existing research has recognized the transformative demands of technology applications (such as serious games and SPOC models) and competency development in maritime courses, it lacks the aspect that treats online and offline instructions as organically linked teaching components that evolve and support each other. The systematic integration of symbiosis theory into the construction of blended learning for shipping courses aims to coordinate and strengthen essential educational relationships between online self-directed learning and offline interaction; theoretical learning and practical training; and educational technology with talent-development goals. This marks an important shift from “Technology-based blending” to “Ecosystem-level integration,” offering both theoretical contributions and practical value. Ultimately, this approach provides a new pathway for developing high-quality, highly adaptable shipping professionals, contributing to the improved model of advanced maritime talent cultivation.

### 3. Analysis of Characteristics and Teaching Models in Three Shipping Courses

#### 3.1 Characteristics of the Shipping Program

Maritime courses possess distinct characteristics that set them apart from other specialized disciplines. These characteristics directly influence the selection and effectiveness of teaching methodologies, as shown in Table 1 below.

*Table 1: Key Features of Shipping Courses and Their Impact on Teaching*

Course Features	Specific manifestations	Requirements for Teaching
Strong integration of practicality and theory	One must master theoretical knowledge and possess practical skills.	Theory and practice are equally emphasized.
Internationality and Normativity	Comply with international conventions and domestic regulations	Standardization and normalization of teaching content
Comprehensive and interdisciplinary	Covering multidisciplinary knowledge in management, economics, law, engineering, and more	Interdisciplinary knowledge integration capability
Applied and career-oriented	Closely aligned with industry needs	Curriculum content is updated in sync with industry developments.

##### 3.1.1 Strong Integration of Practical and Theoretical Aspects

The shipping courses do not only require students to master solid theoretical knowledge but also demands proficient practical operational skills. The International Shipping Management course encompasses both theoretical knowledge: such as process design; decision-making methods; and optimization techniques in vessel operations management, and practical operations including cargo capacity estimation; voyage cost calculation; voyage charter party contract execution; and voyage operations scheduling. This combined learning demands require a teaching model that smoothly and tightly integrate theory with practice.

##### 3.1.2 International and Regulatory Alignment

The shipping industry operates with highly standardized and regulated framework, shaped by both international conventions and national maritime regulations. The Maritime Safety and Policy and Marine Insurance Law must strictly adhere to international and domestic legal requirements for navigation. This strong regulatory nature requires course content to remain closely aligned with industry compliance standards, which places clear and non-negotiable requirements on teaching design and delivery.

##### 3.1.3 Comprehensive and Interdisciplinary Knowledge structure

The curriculum for shipping studies spans multiple disciplinary fields and exhibits distinct interdisciplinary characteristics. The course Multimodal Transport Organization and Management is described as a “foundational course encompassing



multiple contents, multi-layered knowledge, diverse analytical methods, and decision-making frameworks.” It is characterized by “a strong system logic, professional rigor, and comprehensive integration.” The comprehensive nature of this knowledge system necessitates a teaching model capable of effectively integrating knowledge from different disciplines.

### 3.1.4 Practical Focus and Career Orientation

Shipping courses are closely aligned with industry demands and possess a clear career orientation. The course Port Loading and Unloading Technology and Organization, for instance, is explicitly designed to enhance students’ overall competence. Its primary focus is to cultivate familiarity with ship loading and unloading management, maritime cargo handling processes, and decision-optimization techniques. This close industry connection necessitates that teaching content must keep pace with evolving industry dynamics.

## 3.2 Analysis of Teaching Models

Analyzing the current state of shipping course instruction from the perspective of symbiosis theory reveals a distinct “non-symbiosis phenomenon.” This refers to the lack of positive interaction and mutual reinforcement among the various elements within the teaching system, specifically manifested in the following aspects as shown in Table 2 below.

*Table 2: Non-symbiotic Phenomena in Maritime Education and Their Primary Manifestations*

Non-symbiotic phenomenon	Main manifestations	Impact on Learning Outcomes
The imbalance between teaching and learning	Teachers control the classroom, while students passively receive instruction.	Suppressing students’ initiative and creativity
Disconnect between teaching content and industry needs	Course content updates are slow and out of touch with industry realities.	Declining value of knowledge application
Evaluation methods are rigid and inflexible.	Overreliance on test scores, lack of process evaluation	fails to fully reflect students’ abilities
Uneven student engagement	A minority of students take the lead, while the majority follow passively.	Overall learning outcomes show a polarized distribution.

(1) Imbalance in Teaching and Learning: In current maritime education, teachers often exert excessive control over the classroom, leaving students in a relatively passive role. This phenomenon occurs when instructors design the entire teaching process according to their own assumptions, rather than students’ learning needs, resulting in limited opportunities for students’ inquiry, critical discussions and independent thinking.

(2) Disconnect between teaching content and industry demands: Many maritime universities face the issue of “mismatched talent cultivation objectives with societal talent needs,” This gap appears specifically in delayed curriculum content updates, repetitive teaching methods, and insufficient development of students’ problem-solving, innovation and analytical thinking skills. Due to this, students are not fully prepared for the evolving needs of the modern shipping industry.

(3) Rigid and Single-Dimensional Assessment Methods: The current assessment methods for shipping courses primarily rely on a single examination-based evaluation system. This approach does not support long-term learning improvement or measure real operational abilities.

(4) Uneven Student Engagement: Uneven student participation is prevalent in shipping course instruction, where a minority of students dominate the classroom while the majority follow passively. This mirrors group cooperative learning scenarios where one dominant member often completes tasks while others withdraw into supporting roles such as note-taking. Consequently, most students lose opportunities for deep learning and hands-on practice, preventing broad skill development, and contradicting the symbiotic theory’s principle of shared participation and mutual benefit.

## 4. Framework Development for Shipping Courses and Blended Learning Design

### 4.1 Framework Development for Shipping-Related Courses

The course framework serves as the foundation of blended learning and must be scientifically designed based on course objectives, instructional content, and student characteristics. Given the highly specialized and practice-oriented nature of

maritime courses, its framework must be closely aligned with the practical demands of the shipping industry and students' career development plans.

The framework for shipping-related courses should consistently prioritize student competency development, emphasizing the cultivation of professional skills, practical abilities, and innovative capabilities. Taking the course “Ship Principles and Cargo Stowage Design” as an example, its competency objectives include: mastering fundamental theories of ship structure and performance; acquiring the ability to analyze ship navigation performance; and being able to apply professional knowledge to solve practical shipping problems. To achieve these competency goals, the course framework should incorporate corresponding theoretical and practical modules, ensuring that students attain the expected competency level upon completing the course.

#### 4.1.1 Modularization

To address the specific needs of the shipping industry, the curriculum framework should incorporate core modules with distinct industry characteristics. A modular design divides course content into several independent yet organically connected modules, each corresponding to one or more competency objectives. The following outlines the design concepts for two typical modules:

(1) Maritime Safety Management Module: Centered on the International Maritime Organization's (IMO) International Safety Management (ISM) Code as the core framework, this module integrates real-world maritime safety accident investigation reports to cultivate students' systematic safety risk management awareness and compliance operational capabilities.

(2) Green Shipping and Sustainable Development Module: Focusing on cutting-edge regulations and market mechanisms for carbon reduction in international shipping, this module explores emission reduction pathways such as low-carbon/zero-carbon fuels, energy efficiency technologies, and operational optimization. It cultivates students' sustainable development concepts and their ability to design innovative solutions.

#### 4.1.2 Hierarchical

Following cognitive principles and the developmental stages, the content of each module is further organized into three progression learning levels as shown in Table 3 below. The “module-level” matrix structure ensures the systematic nature of knowledge points and the progressive development of competencies.

*Table 3: Curriculum Content Hierarchy Design and Teaching Implementation Methods*

Content Hierarchy	Core Objective	Examples of Main Content	Primary Teaching Methods
Base Layer	Build a knowledge framework and grasp fundamental concepts and principles.	The development trajectory of the shipping industry, fundamental concepts of vessel operations, principles of freight calculation, etc.	Online Self-Directed Learning (Micro-courses, Literature Reading, Online Quizzes)
Application Layer	Apply training knowledge to master core business processes and skills.	Ship voyage scheduling, route economic analysis, shipping cost accounting and control, etc.	Blended Learning (Case Studies, Simulation Exercises, Project Collaboration)
Innovation Layer	Foster critical thinking to explore cutting-edge industry developments and tackle complex challenges.	Digital Transformation Strategies for Shipping, Techno-Economic Analysis of Green Shipping Technologies, Emergency Decision-Making in Extreme Scenarios, etc.	In-person immersive engagement (specialized seminars, integrated project design, corporate expert workshops)

## 4.2 Blended Learning Design

Under the unified course framework, instructional design should follow the symbiotic principle of “online supporting offline, offline strengthening online.” This ensures the achievement of deep integration and complementary advantages between the two teaching formats in terms of objectives, content, and activities.

Core functions of the online sessions lie in knowledge transmission and learning framework construction. It primarily provides systematic teaching concepts, stimulates learning interest, and supports personalized learning paths. Through learning activities such as micro-videos, online quizzes, interactive simulations, and asynchronous discussions, students develop early understanding while getting prepared for deeper in-person class participation. Its design hinges on concise



content and well-guided activities.

Core functions of offline sessions lie in knowledge application, deeper learning and innovation development. This focuses on strengthening advanced thinking, support complex problem solving, and apply learning real professional settings. Through face-to-face interactions such as project-based learning, group discussions, hands-on training, and in-depth debates, these sessions promote deep knowledge internalization, improve professional skills, and develop confidence and professional learning values.

The symbiotic integration of online and offline learning shows in their continuous learning cycles and feedback. Course design should form a structured learning loop of: “online preparation → offline learning → online learning expansion.” Online learning provides the cognitive foundation for offline activities, while new questions and insights generated during offline interactions in turn stimulate further online exploration. This iterative cycle constitutes a continuously evolving learning loop.

### 4.3 Maritime Emergency Learning Integration

Due to the high-risk nature of the shipping industry, emergency response ability is a core competency for maritime professionals. Integrating emergency learning into classroom instruction extends far beyond traditional case study analysis. It should aim to establish a highly simulated, high-pressure training ground for comprehensive skill development. This approach not only bridges the significant gap between theoretical protocols and real-world responses, but it also comprehensively improves students’ ability to integrate professional knowledge, make rapid decisions, collaborate effectively, and maintain psychological resilience.

#### 4.3.1 Establish a Case Library

Authentic shipping emergency cases should be collected, reviewed and organized into a structured online case library to support both teaching and student learning.

Cases should be well-labeled using a tagging system based on incident type and response complexity. Suggested case selection criteria include, but are not limited to: grounding, oil spill, fire, extreme weather risk, and emergency coordination challenges.

A case classification structure is shown in Table 4 below.

*Table 4: Classification Examples for the Shipping Emergency Teaching Case Library*

Event Type	Teaching Focus	Examples of Typical Cases	Core Competency Development Goals
Collision/ Grounding	Accident Cause Chain Analysis, Emergency Decision Sequence, Damage Control and Pollution Prevention	The Ever Given Grounding Incident	Situation Assessment, Regulatory Application, Resource Coordination
Fire/Explosion	Initial Fire Control, Emergency Communication Procedures, Personnel Evacuation and Rescue	Fire Incident on the MSC Flaminia	Emergency Procedure Execution, Team Leadership and Collaboration, Psychological Resilience
Pollution leak	Pollution source control, oil spill contingency plan implementation, international and domestic cooperation mechanisms	Exxon Valdez oil spill Sangji collision and explosion incident	Familiarity with environmental regulations, selection of technical solutions, public relations awareness
Security/Piracy	Application of International Conventions, Non-Military Deterrence Strategies, Personnel Security Protection	Series of Pirate Attacks in the Gulf of Aden	Risk Assessment, Emergency Plan Activation, Cross-Cultural Crisis Communication

#### 4.3.2 Implementation of Simulation Exercises

Based on a structured case repository, virtual simulation technology is employed to recreate maritime emergency scenarios where students are organized to conduct emergency response drills, through a continuous learning cycle. The instructional process follows a seamless simulation training loop, profoundly reflecting the symbiotic relationship between online and offline teaching.

Scenario Setup: Students work in groups on an online platform to either randomly select or are assigned a maritime

emergency case by the instructor. Within a set timeframe, they must collaborate asynchronously to develop an initial emergency response plan. This involves citing relevant international convention provisions, initiating company safety management system procedures, and allocating internal resources. The plan is then submitted to the platform. This process builds students' ability in information analysis, remote teamwork, and preliminary decision-making skills.

**Role Assignment:** At the offline training center, instructors incorporate dynamic variables based on common blind spots identified in online contingency plans to initiate high-fidelity simulation exercises. Students are grouped to assume roles such as captain, chief engineer, first mate, and emergency coordinator, executing response procedures under intense time pressure and incomplete information. The simulator system objectively records all operational commands and communication logs.

**Debriefing and Iteration:** This learning reflection is in two critical phases. First, instructors lead an immediate in-person debriefing, utilizing simulator replay data to focus on key decision points for reflection. Subsequently, the complete exercise recording, data logs, and debriefing report are uploaded onto an online platform for asynchronous, in-depth reflection. Students compare group solutions, receive expert feedback, and ultimately refine an optimized emergency response guide that surpasses the original plan through shared learning. This updated guide is then returned to the case repository, enabling iterative improvement of teaching resources and student competency growth.

### **4.3.3 Strengthening Industry Expert Participation**

The active involvement of industry experts is crucial for ensuring the authenticity and cutting-edge nature of teaching scenarios. Their participation should extend beyond individual lectures and be systematically embedded throughout the full learning cycle.

Experts can contribute by sharing practical experience in ship safety inspections and risk assessments during online preparation stage. During the case construction phase, they can also guide the development of case libraries to ensure technical accuracy. These experts can serve as observers or stress-inducing agents to enhance scenario complexity and realism in simulation exercises while providing forward-looking critiques in debriefing sessions as their professional experience often reveal deep-seated risks and strategic blind spots that are often overlooked by both students and instructors. This continuous involvement seamlessly integrates frontline industry knowledge into the teaching process, significantly enhancing the training's relevance and added value.

## **5. Implementation Pathways for Blended Learning Models in Maritime Education**

Based on the universal framework of symbiotic blended learning, this chapter delves into the specific context of maritime education to design an actionable implementation pathway. Our core objective is to translate the symbiotic concept from theoretical conception into pedagogical practice. Through systematic instructional design, this study aims to catalyze the co-evolution of all elements within the teaching system, ultimately enhancing the effectiveness of maritime talent cultivation. The following pathway design emerges from reflections on current pedagogical challenges and integrates observations and iterations from preliminary teaching experiments.

### **5.1 Transformation of Teacher-Student Roles and Building Symbiotic Relationships**

In symbiosis-driven blended learning, the roles of teachers and students require profound transformation to establish a new cooperative and co-developing learning relationship. This relationship emphasizes mutual dependence and shared development between educators and learners, serving as the cornerstone for the successful implementation of blended learning approaches.

#### **5.1.1 Teacher Role Transformation**

In traditional maritime education, teachers serve as knowledge disseminators and authorities, while students remain passive recipients. Within the blended learning model grounded in this theory, the teacher's role must undergo transformation in the different aspects such as: shifting from knowledge conveyers to learning facilitators, teachers are no longer the sole source of knowledge but rather guides and inspirers of student learning.

Teachers must design appropriate learning tasks and activities based on students' learning needs and ability levels, guiding them toward self-directed learning and exploration. In the Warehousing and Distribution Management course, teachers can guide students to utilize online platforms for learning foundational knowledge of warehousing and distribution, followed by

hands-on practice in classrooms or other offline settings to help students apply theoretical knowledge to practical scenarios. Transitioning from teaching facilitators to learning organizers, instructors must structure diverse learning activities such as group discussions, project-based research, and hands-on practice to foster student interaction and collaboration. In the International Shipping Management course, instructors can organize an “International Liner Route Planning” project where students form teams to collect data, analyze information, and design solutions through blended online and offline methods, and presenting final results and evaluation of outcomes.

Transitioning from evaluators to learning facilitators, teachers must provide personalized academic support and guidance to help students overcome learning challenges. In the Fundamentals and Applications of Intelligent Ship Technology course, instructors can offer online Q&A sessions to address student inquiries in detail. They can also guide students through ship performance testing in laboratories, helping them grasp the practical applications of intelligent ship technology.

From course developers to resource builders, educators must actively develop and construct diverse teaching resources such as instructional videos, courseware, case studies, and simulation software to provide students with rich learning materials. In the Port Loading and Unloading Processes and Organization course, instructors can develop 3D simulation software for port operations, enabling students to perform virtual operations and gain familiarity with port loading and unloading processes and their underlying principles.

### 5.1.2 Student Role Transformation

In the blended teaching model based on symbiosis theory, students’ roles must also shift from passive recipients to active learners and participants.

From passive recipients to active explorers, students must proactively engage in the learning process, acquiring knowledge and skills through self-directed learning, online discussions, and hands-on practice. In the Shipping Economics course, students can actively gather data and information on the shipping market, analyze its development trends and influencing factors, and form their own perspectives and insights.

From individual learners to collaborative learners, students must learn to work with peers through group discussions, project-based research, and other methods to solve problems together and share learning outcomes. In the Container Transportation Management course, students can form teams to complete the “Container Terminal Operation Process Optimization” project. Through division of labor, cooperation, and mutual learning, they enhance their ability to solve real-world problems.

Transitioning from knowledge learners to skill practitioners, students must prioritize the application of knowledge and the cultivation of practical abilities, applying theoretical knowledge to solve real-world problems. In the course Port System Simulation Design, students can utilize simulators for hands-on training, simulating operations such as vessel entry and exit, cargo loading and unloading, thereby enhancing practical operational skills.

From exam takers to lifelong learners, students must embrace the concept of lifelong learning, continuously updating their knowledge and skills to adapt to the evolving shipping industry. For instance, students can utilize online platforms to stay informed about the latest developments and technological advancements in shipping, such as smart shipping and green shipping, thereby broadening their knowledge base and building long-term learning habits.

### 5.1.3 Building a Symbiotic Relationship Between Teachers and Students

The blended teaching model based on symbiosis theory emphasizes building a symbiotic relationship between teachers and students, promoting mutual dependence and shared development. Its characteristics are manifested as shown in Table 5.

*Table 5: Core Dimensions and Implementation Approaches of the Teacher-Student Symbiotic Relationship*

Symbiosis Dimension	Core Philosophy	Concrete manifestation in teaching
A democratic and equal dialogue relationship	Break the monopoly of knowledge authority and respect diverse perspectives.	In maritime law case debates, instructors participate as equal members of the discussion, collaborating with students to build a multi-layered understanding of complex legal issues.
Complementary collaborative relationship	Recognize and integrate generational strengths to achieve co-creation of resources.	Faculty contribute industry insights and business logic, while students bring digital tool application skills. Together, they collaborate to develop market analysis models or new media content.

Symbiosis Dimension	Core Philosophy	Concrete manifestation in teaching
A growth relationship where teaching and learning mutually enhance each other	View teaching as a journey of mutual growth for both teachers and students.	Teachers refine their instructional design by reflecting on student project feedback and platform learning data; students achieve significant skill advancement through personalized teacher feedback and higher-order challenges.
Emotional relationships built on mutual trust	Build emotional connections and psychological safety that transcend mere knowledge transfer.	Teachers foster an inclusive and supportive learning environment. This sense of trust empowers students to pose challenging questions, forming the emotional foundation for deep learning and innovative thinking.

## 5.2 Development and Optimization of Teaching Resources

Teaching resources are essential for effective implementation of blended learning models. The development and optimization of teaching resources for shipping-related courses should be closely aligned with course characteristics and student needs, making full use of information technology and industry resources to create diverse teaching materials.

### 5.2.1 Development of Online Teaching Resources

The development of online resources must go beyond the converting textbooks and slides into digital files. The aim is to create digital learning environments that support self-directed inquiry, scenario simulation, and cognitive interaction.

Record high-quality instructional videos covering fundamental theories, key concepts, difficult points, and case studies. These videos should employ vivid and engaging presentation methods—such as animated demonstrations, live operations, and case analysis—to enhance student interest and participation. Develop interactive digital learning materials such as animations, videos, quizzes, and discussions, enabling students interact through clicks, drags, and other operations to increase engagement and enjoyment and to improve learning outcomes. Develop virtual simulation resources that replicate real shipping scenarios and operational processes, providing students with immersive learning experiences. Establish a digital case repository to collect and organize authentic shipping industry cases, including vessel accident cases; shipping market analysis cases; and corporate management cases. The case repository should employ digital storage and management systems to enable students conveniently access and utilize cases through online platforms.

### 5.2.2 Optimization of Offline Teaching Resources

The optimization of offline physical teaching resources focuses on providing irreplaceable physical spaces and high-end equipment support for the transformation of online learning outcomes and the refinement of skills, thereby fostering an immersive professional environment.

There is the need to regularly upgrade laboratory equipment, teaching instruments and devices to meet the demands of practical instruction. Institutions can purchase the latest ship navigation simulators, ship engine room simulators, shipping management information systems, and other equipment to enhance the quality and effectiveness of practical teaching.

Develop practical teaching materials tailored to the needs of the shipping industry and the characteristics of students, covering practical operation procedures, precautions, assessment criteria, and other relevant content. These materials should be designed for direct skill application. Institutions should also encourage joint development of specialized textbooks by industry professionals and academic instructors to ensure both technical accuracy and professional relevance.

may also organize faculty and industry experts to jointly develop specialized textbooks for shipping courses.

There is also a keen need to improve the teaching environment to foster a conducive learning atmosphere. Schools can establish modern multimedia classrooms, discussion rooms, and learning centers to provide students with excellent spaces for study and interaction. In specialized maritime classrooms, teaching facilities such as ship models, navigational instruments, and shipping charts can be arranged to create a professional learning environment.

### 5.2.3 Integration and Sharing of Teaching Resources

The value of teaching resources increases when they are shared and actively used. A structured resource integration and sharing mechanism must be developed to maximize resource utilization efficiency.

Key resource pathways should include the integration of campus resources: Consolidate various internal teaching resources

such as library resources, laboratory resources, and faculty resources to support blended learning. Institutions can establish shared teaching resource platforms to integrate resources across departments and disciplines, enabling unified management and resource sharing.

There should also be the shared use of School-Enterprise resources: This includes collaborating with shipping enterprises to share teaching resources such as technical documentation, case study databases, and practical training bases to enrich instructional materials. Institutions can partner with shipping companies to access corporate resources like vessel navigation data and cargo transport records for educational and research purposes.

Inter-institutional Resource Collaboration is another method to consider: Partnering with other universities to share teaching resources such as instructional videos, specialized course contents, and virtual simulation systems enhances resource utilization efficiency. Domestic maritime universities can establish teaching resource alliances to jointly develop and share educational materials, thereby elevating the overall standard of maritime education.

### 5.3 Development of the Teaching Evaluation System

The teaching evaluation system is a crucial component of blended learning models serving to guide, motivate, and provide feedback for teaching activities. For shipping-related courses, the evaluation system should be closely aligned with the course characteristics and teaching objectives, employing diverse assessment methods to comprehensively evaluate students' learning outcomes and overall competencies.

#### 5.3.1 Diversification of Evaluation Content

Evaluation criteria must align with the core objectives of shipping talent development, establishing a multidimensional assessment framework encompassing cognition, skills, behavior, and values. The framework in Table 6 below emphasizes the interconnectedness and symbiosis among the various dimensions.

Table 6: A Multi-Dimensional Evaluation Framework Based on Symbiosis Theory

Evaluation Dimensions	Core Essence	Typical Sources of Evidence	Key Evaluation Points
Cognitive knowledge	Understanding and memorization of professional concepts, principles, and regulations.	Online quizzes, periodic exams, literature review reports.	Accuracy, systematicity, and readiness for transfer in knowledge mastery.
Procedural skills	Proficiency and compliance in performing specific tasks (such as route design, and simulator operation).	Simulation operation records, practical assessment videos, project technical proposals.	Process standardization, operational proficiency, and situational adaptability.
Higher-order thinking skills	The ability to analyze, synthesize, evaluate, and resolve complex, unstructured shipping issues.	Case analysis reports, comprehensive project deliverables, and logical chains in decision-making simulations.	Problem decomposition, solution innovation, critical reflection, and metacognitive abilities.
Social Collaboration Competency	The ability to communicate, collaborate, lead, and resolve conflicts within a team.	Contribution to group projects (peer evaluations), quality of discussion forum participation, role-playing performance.	Communication effectiveness, accountability, and team collaboration efficiency.
Professional Value Identification	The tendency to internalize and practice core shipping values such as safety, environmental protection, and compliance.	Safety decision-making in simulation exercises, ethical dilemma selection, and evaluation of internship sites.	Safety awareness, professional ethics judgment, and sustainable development concepts.

#### 5.3.2 Diversification of Evaluation Methods

To evaluate students learning across cognitive understanding, operational skills, learning values, and professional behaviors, assessment design must combine multiple methods and include input and contributions from key stakeholders.

Process-Based Learning Assessment: This includes using online platform to automatically record learning behavior data (video viewing duration, quiz attempt frequency, forum post quality), combined with offline classroom observations (questioning frequency, group discussion contributions), to form a continuous "digital learning profile." This assessment is not for grading



purposes, but to promptly identify learning obstacles, evaluate engagement depth, and provide immediate feedback.

**Performance-Based Competency Assessment:** This is carried out by designing authentic or highly simulated performance tasks targeting specific skills and competencies. For example, in the “Ship Management” course, assessment might involve a comprehensive task comprising “drafting a voyage risk assessment report,” “executing relevant emergency procedures in a simulator,” and “delivering an oral briefing to simulated company management.” Evaluation criteria employ clear rubrics that explicitly define performance characteristics for different competency levels.

**Multi-stakeholder Collaborative Assessment:** Incorporating teachers, peers, industry mentors, and student self-assessment as evaluation entities. Teacher evaluations emphasize academic standards and overall guidance; peer assessments effectively evaluate collaborative contributions and communication skills while fostering metacognitive development through evaluating others; industry mentor evaluations focus on practical application and professional competence; student self-assessment and reflection concentrate on goal-setting and growth awareness. Comparing and triangulating multi-source assessment data significantly enhances the objectivity and educational value of evaluations.

**Differentiated Summative Assessment:** Summative evaluations should avoid one-size-fits-all examinations. Instead, it should adopt a composite format comprising “core module assessments + comprehensive project evaluations + learning portfolio reviews.” The learning portfolio system systematically collects students’ key learning achievements over a semester or academic year, providing the most multidimensional demonstration of their developmental journey and comprehensive competencies.

### 5.3.3 Application of Evaluation Results

The purpose of evaluation lies in its application. Evaluation outcomes should form a closed-loop feedback system that drives collaborative evolution across three levels: students, teachers, and instructional management.

**Teaching Improvement:** Instructors analyze existing issues and shortcomings in teaching based on evaluation results, and promptly adjust instructional content and methods to enhance teaching quality. By analyzing students’ online learning data, teachers can identify knowledge gaps and promptly adjust the focus and difficulty level of in-person instruction.

**Student Development Guidance:** Assessment results are used to provide personalized development guidance to help students identify their strengths and areas for improvement, and formulate academic plans and career paths. Through evaluating students’ practical skills, instructors can recommend enhanced hands-on training to strengthen their practical abilities.

**Teaching Quality Monitoring:** Utilize evaluation outcomes as a key basis for teaching quality monitoring, conducting regular assessments and analyses to ensure continuous improvement in teaching quality. Schools can evaluate course teaching quality and effectiveness through assessments of student learning outcomes, promptly identifying and resolving issues in teaching practices.

## 6. Conclusion

The symbiosis-driven blended teaching model for shipping courses offers an innovative educational approach aligned with contemporary demands. Guided by symbiosis principles, the model connects the strengths of online and offline instruction, emphasizes the construction of a learning community between teachers and students, and promotes the integration of theory and practice. The model provides a new pathway to address current challenges in shipping education, including the gap between theory and practice and the fragmentation between online and offline teaching. It holds significant importance for comprehensively enhancing the quality of shipping course instruction and cultivating high-caliber, versatile shipping professionals who meet industry development demands.

In the implementation process, modern blended learning unavoidably faces multiple challenges. To address these, it is essential to enhance teacher training, enrich teaching resources, innovate evaluation systems, and guide students in adapting to new learning approaches. Simultaneously, continuous modification of teaching models through experience summarization is crucial to provide stronger theoretical support and practical insights for maritime education reform.

As both digital shipping technology and higher education teaching models continue to evolve, the application of blended learning models combined with symbiotic theories offers strong potential for future expansion in maritime education.

Moving forward, this model must strengthen its synergistic integration with the shipping industry, closely track developments

in the sector and shifts in talent demands, continuously optimize teaching content, innovate instructional methods, and refine assessment systems to drive iterative upgrades in teaching approaches. Simultaneously, cross-institutional and cross-regional exchanges and collaborations should be reinforced to share high-quality teaching resources and practical experiences, thereby providing theoretical support and practical case studies for maritime education reform. It is foreseeable that, through the concerted efforts of all parties, the blended learning model grounded in symbiotic integration theory will emerge as a significant paradigm in maritime education. This model is expected to become a key approach in the maritime higher education, supporting

Innovative, highly skilled and adaptable shipping professionals while advancing high-quality maritime education development.

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## Conflict of Interests

The authors declare that there is no conflict of interest regarding the publication of this paper.

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# From “Knowledge Container” to “Shipping Brain”: Redesigning the International Shipping Management Curriculum Driven by Digital Transformation

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**Abstract:** The digital transformation of the shipping industry is reshaping the industrial ecosystem and talent demand paradigm, posing a severe challenge to talent cultivation in universities. As a core course within the Transportation Management (International Trade) major, International Shipping Management plays a crucial role of cultivating students’ international strategic thinking and practical abilities. However, the traditional teaching system following the “knowledge container” paradigm is no longer sufficient to meet the needs of cultivating modern high-end shipping service talents. This study aims to address this challenge by proposing a curriculum redesign scheme aimed at cultivating builders and operators of the “shipping brain.” Core measures include constructing a four-layer modular curriculum system of “foundation-empowerment-application-practice,” building a simulation training and data analysis platform, and implementing a process-oriented and diversified evaluation system. This research provides a systematic theoretical framework and practical path for the digital upgrading of shipping management courses.

**Keywords:** Curriculum Redesign; International Shipping Management; Digital Transformation; Shipping Brain; Outcome-Based Education (OBE)

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## 1. Introduction

### 1.1 Research Background and Importance

As a pillar of global trade, the international shipping industry is undergoing a profound digital transformation driven by technologies such as big data, Artificial Intelligence (AI), the Internet of Things (IoT), and blockchain. Concepts like smart ports, digital twins, and intelligent ships are rapidly being implemented, signifying a shift in industry paradigms from experience-based traditional operations to data-driven intelligent decision-making. As a result, the industry now requires innovative shipping professionals who can combine solid knowledge of shipping operations with competence in digital tools and analytical thinking.

However, the reform of “International Shipping Management” course, which is the core carrier for cultivating high-end shipping service talents, has lagged significantly behind the rapid evolution of the industry. The current teaching content and methods are still deeply trapped in the traditional “knowledge container” approach, focusing on the indoctrination of static

and isolated knowledge, with clear disciplinary boundaries, making it difficult to stimulate students' systematic thinking, collaborative innovation ability and potential to work with intelligent systems<sup>[1]</sup>. This gap between “teaching” and “business” makes it difficult for the course to shoulder the important task of cultivating core intellectual engines for the future shipping industry.

Therefore, an urgent education reform issue on how to systematically redesign the curriculum and transform it from a closed “knowledge container” into an open “shipping brain” incubator emerges. The “shipping brain” metaphor refers to professionals who operate as the central nerve of digital shipping, possessing abilities in perception (data collection), cognition (data analysis), decision-making (intelligent optimization), and execution (collaborative control). This research aims to respond to this real-world challenge by proposing a redesign framework centered on capability empowerment, supported by digital learning scenarios, and guaranteed by dynamic assessment. This framework provides systematic theoretical guidance and practical steps for the paradigm shift of the “International Shipping Management” curriculum, with the ultimate goal of cultivating “brain” builders and leaders capable of navigating the future digital ecosystem of shipping.

## 2. Industry Digital Transformation and Talent Development Challenges

The rapid development of generative artificial intelligence and large language model technology such as ChatGPT, continuously introduces new ideas and opportunities across many sectors including the shipping industry. Against this background, universities worldwide have been promoting the “artificial intelligence+” strategy, guided by the new knowledge and talent development, reforming the course teaching model and talent training system, and actively responding to the new requirements put forward by the digital intelligence era. The contemporary views of knowledge emphasizes that it is shifting from a static, hierarchical structure to a dynamic, networked ecosystem. With its stability decreasing and updates accelerating, it shows distinct characteristics such as fragmentation and contextualization<sup>[2]</sup>. Under these conditions, traditional “encyclopedia” talent development can hardly adapt to the needs of social development. Instead, new quality talents with continuous learning ability, innovative thinking and human-machine collaboration qualities are needed. Therefore, universities are increasingly focusing on cultivating such flexible interdisciplinary graduates.

Focusing on the shipping industry, its digital transformation is centered on the online collaboration of the entire chain of “ship-port-cargo-chain.” This transformation mainly presents five major directions: smart ships, smart ports, smart cargo and documents (including full digitalization of trade documents, blockchain bills of lading, smart contracts, etc.), smart operation and decision-making (including route optimization, fleet scheduling, carbon emission and green compliance supervision, etc.), and smart customer and supply chain services. Studies have shown that the current digital strategies of major shipping companies focus more on improving operational efficiency and customer service levels by leveraging technologies such as artificial intelligence, big data, and the Internet of Things, thereby enhancing cost control capabilities and market competitiveness<sup>[3]</sup>. However, in the process of transformation, persistent structural challenges such as information silos, process fragmentation, inefficient document processing, and insufficient system collaboration remain<sup>[4]</sup>.

Digital transformation permeates the entire shipping industry chain, involving multiple dimensions such as operations, management, and services. This profound transformation has significantly increased the demands on the capabilities of personnels engaged in advanced shipping roles. Previously, talent with only a strong foundation of textbook knowledge and application was insufficient to meet the current industry needs. Currently, the shipping industry is evolving simultaneously towards digital, intelligent, and green development, with emerging technologies deeply embedded in everyday practice.

Consequently, there is a pressing need for professionals with digital literacy, interdisciplinary thinking, innovative awareness, and practical skills. The growing demand for this new type of talent and the emergence of new job positions are forcing universities to shift their talent cultivation paradigms and systematically reform their curriculum systems.

## 3. Diagnosis of the “Knowledge Containerization” dilemma in the existing Curriculum System

For the past two decades, the “International Shipping Management” curriculum has functioned largely as a self-contained “knowledge container.” The course content is divided into chapters, covering modules such as the shipping market,

international shipping management indicators, and the organization and management of liner and irregular shipping operations. In this model, teachers are positioned as the primary source of knowledge, while examinations mainly measure how well students retain predefined content. Students are often considered qualified shipping professionals simply by “filling” in this predetermined knowledge. This traditional international shipping management curriculum follows a “knowledge container” paradigm, centered on disciplinary boundaries (container), teacher authority (knowledge) and static knowledge (core). Under this paradigm, it is difficult to cultivate high-end shipping service professionals suitable for the needs of the new era. The specific curriculum system faces the following main problems:

- (1) Content lag: The textbook “International Shipping Management” is slowly updated, and cannot keep pace with new developments. Important emerging areas such as smart logistics, carbon emissions trading, and shipping big data analysis are not yet incorporated in a systematic way.
- (2) Structural fragmentation: Topics related to shipping markets, route optimization, voyage estimation, and chartering decisions are taught separately without a central thread to connect them, making it difficult for students to form a comprehensive view. When confronted with complex real-world events such as major canal blockage, fragmented professional knowledge is far from sufficient to solve these problems. Students need integrated thinking and the ability to coordinate across systems.
- (3) Traditional methods: Teaching is mainly teacher-centered and focused on theoretical instruction. Although recent teaching reforms have incorporated classroom case discussions, the overall proportion is still small and the forms are not diverse enough.
- (4) Practice becomes abstract: Supporting activities such as the “Container Liner Company Management Simulation” experiment and “International Shipping Management Course Design” are excellent courses that apply theory to practice. However, they still do not provide students with opportunities to make decisions, experience failure, adjust strategies and improve through iteration.
- (5) Simplified evaluation: The assessment is mainly based on test papers, accounting for more than 60% of the total score. It emphasizes knowledge memorization and neglects the application of skills, and cannot scientifically evaluate students’ data analysis, innovation and collaboration abilities.

The core challenge of curriculum reform lies not merely in updating content, but in achieving a fundamental shift from a “knowledge container” paradigm to a “shipping brain” paradigm—that is, moving from the traditional static, subject-divided, teacher-centered model to a dynamic, systemically intelligent, and student-data-scenario collaborative new form. It is worth emphasizing that the current digital transformation of the industry provides the practical foundation and technological possibility for this paradigm shift, enabling the curriculum to be structured around real-time data, supported by intelligent systems, and utilize complex scenarios in the classroom, truly empowering the cultivation of future shipping talent.

## **4. Implementation Path of “Shipping Brain” Curriculum Paradigm Design**

### **4.1 Curriculum Design and Development Philosophy**

Traditional courses tend to focus on the direct transfer of knowledge. Under this approach, students first ‘receive’ knowledge, and then are encouraged to develop skills of higher-level thinking afterwards. Due to this, knowledge mastery is prioritized while ability development remains secondary. In the digital age, however, the paradigm of knowledge and learning has undergone profound changes where knowledge updates are accelerated. The most important is not how much knowledge students store, but how quickly they can find, understand, and apply new information <sup>[5]</sup>.

The ability to quickly identify and react to information, and to make sound decisions based on it, is the core quality for future professionals. This reality is particularly evident in shipping. Variables such as routes, fuel prices, carbon costs, and berthing conditions change constantly. Even the most complete knowledge base cannot keep pace. The key for practitioners is to “capture information - judge quickly - decide effectively”. For instance, practitioners must read AIS (Automatic Information System), fuel, and carbon quota data in real time, identify congestion or price difference signals at a glance, quickly run the cost-carbon emission-time model, and make timely decisions on adjusting speeds, rerouting, or switching ports. Digital twin sand table should be a standard feature in classrooms, allowing students to complete “data input→scenario

calculation→operational instructions” within a time limit. This will enable “rapid detection, rapid judgment, and rapid decision-making” to become the core competitiveness of new-type shipping talents, so as to navigate the ever-changing global maritime market.

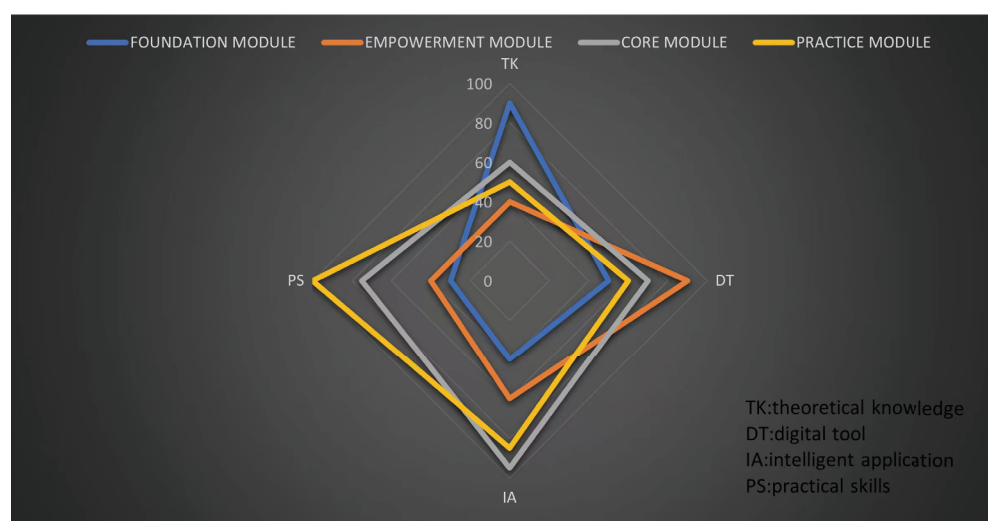
The redesigned curriculum is based on this philosophy, shifting its focus from the accumulating large volumes of theoretical knowledge to building students’ thinking capacity and practical abilities. It emphasizes learning new knowledge, cultivating new skills and ways of thinking, and reorganizing teaching content around practical problems to construct a completely new teaching system. The core concept of this redesign is a shift from “knowledge transmission” to “thinking and ability empowerment,” focusing on cultivating four core competencies: data thinking and analysis, technology understanding and application, system optimization and integration, and cross-disciplinary collaboration and innovation. This means graduates should function like a “brain”: perception (data acquisition), cognition (data analysis), decision-making (intelligent optimization), and execution (collaborative control).

## 4.2 Implementation path: Curriculum System Restructuring, Platform Support and Assessment Innovation

### 4.2.1 Curriculum system restructuring

The transformation of the curriculum from a “knowledge container” into a “shipping brain” model essentially reflects the evolution from traditional teaching to digital and intelligent teaching. To achieve this goal, the curriculum is organized into four major interconnected modules: a foundation module, an empowerment module, a core module, and a practice module. Among them, the ‘foundation module’ focuses on the construction of theoretical knowledge; the ‘empowerment module’ focuses on the application ability of digital tools; the ‘core module’ reaches the highest level in intelligent application and excels in other advanced abilities; and the ‘practice module’ emphasizes the comprehensive cultivation of practical skills, and it highly overlaps with the core module in terms of intelligent application and practical skills, reflecting the deep integration of the two (as shown in Figure 1).

Figure 1: Four modules of the International Shipping Management course



(A) Foundational Module (Cognitive Cornerstone): As shown in Table 1 below, this module builds the knowledge base of shipping operations management, covering an overview of international shipping activities, the fundamentals of international shipping operations, the international shipping market, international shipping management indicators, liner operations organization and management (route design and optimization, vessel scheduling, schedule formulation and adjustment, freight rate formulation and optimization, customer relationship and service management, container chartering, purchasing and allocation); irregular vessel operations organization and management (voyage estimation, irregular vessel decision-making organization and management); transport vessel management (vessel energy efficiency management, fleet renewal and strategy, green shipping and compliance); and shipping enterprise strategic decision-making (characteristics of shipping enterprise business strategies, shipping enterprise strategic objectives, shipping enterprise strategic analysis and evaluation).

Teaching may combine micro-videos + electronic or printed textbooks + quizzes, allowing students to learn at their own pace while receiving guided support from instructors through organized review and Q&A sessions.

(B) Empowerment Module (Digital Tools): This module is a digital empowerment module, which mainly cultivates students' ability to collect, organize and analyze shipping data and master a number of digital tools. For example, digital tools (such as shipfleet, shipwatch, HiFleet, etc.) can be used to collect, organize and analyze shipping data, and at the same time, visualization, prediction, optimization and decision-making can be carried out. This part mainly ensures that students are proficient in the application of digital tools and equips students with key digital tools. This idea of "introducing ships into teaching" is not the first of its kind. In similar course reforms, attempts have been made to realize the remote presentation of the shipping production process in the classroom by using shipfleet, shipping network and electronic chart to track the position of ships in real time <sup>[6]</sup>. This module further systematizes and develops upon this foundation. For example, it converts AIS, shipping schedules, and carbon emissions into dynamic route maps and fleet heat maps, allowing easy identification of congestion and anomalies. The China Classification Society's "Ship Energy Efficiency Data Acquisition and Monitoring Software" enables one-click collection of fuel consumption, mileage, and cargo volume from the ship, automatically generating International Maritime Organization Data Collection System (IMO DCS) or European Union Monitoring, Reporting and Verification Regulation (EU MRV) emission reports and supporting fleet-level data comparison and verification. This allows students to complete digital training in the entire process of shipping operations management, from data acquisition and cleaning to visualization and shipping decision-making reporting.

(C) Core Module (Intelligent Application): This module trains students' core digital literacy and practical skills through Project-Based Learning (PBL) projects. Students work in teams to analyze real industry challenges using data, scenarios and collaborative reasoning to provide solutions to their case studies. This project-based learning method centered on real-world scenarios continues to deepen the concepts of "case teaching method" and "group discussion method" in the early curriculum reform <sup>[7]</sup>. It aims to upgrade traditional case analysis into intelligent deduction that integrates data-driven and collaborative decision-making through structured and systematic project training. The case design of this module is also aligned with cutting-edge research on sustainable shipping management. Its content closely follows key success factors such as "acceptance of new technologies" and "internal resource management of enterprises"<sup>[8]</sup>, ensuring that project training directly targets the core capabilities of sustainable development in the industry. In addition, the case design fully considers the multi-dimensional requirements of sustainable development in the shipping industry, and embeds elements such as environmental resource management (renewable energy utilization), environmental impact assessment (emission reduction and waste management), environmental compliance (IMO/EU regulatory compliance), social sustainability (crew rights and community well-being) and economic sustainability (cost optimization and circular economy) into the project tasks, thereby systematically cultivating students' ability to solve complex sustainability problems as "visible" and "inclusive" talents <sup>[9]</sup>. To support teaching, a special project case library needs to be established. The cases are mainly designed for issues related to liner operation organization management and irregular ship organization management. Each student is required to complete at least two to three projects per semester. The PBL case study library includes the following content: schedule optimization projects (AIS data collection and analysis, on-time performance balancing), voyage estimation projects (from simple to complex, including problems under various constraints such as ship speed, carbon emissions, and fuel consumption), differentiated pricing for a liner route (freight index fluctuation analysis, competitor analysis, strategy and tactics formulation, customer management), shipowners' detour decisions during sudden congestion in the Suez Canal (or Panama Canal), liner companies' route strategy adjustments under trade war tariff changes, analysis of temporary port calls under port strikes and congestion, shipowners' fuel and carbon cost management strategies under the IMO's new low-carbon regulations, fleet planning and vessel renewal strategies (considering the impact of carbon emissions and other factors), the impact of Consortia Block Exemption Regulation (CBER) termination on the liner shipping market, analysis of geopolitical conflicts on shipping security, and comparative analysis of liner freight rate regulatory systems. The case study library needs to be updated annually to keep pace with the realities of the shipping market.

(D) Practical Module (Comprehensive Exercises): This section cultivates students' comprehensive practical problem-



solving abilities, addressing real-world issues in the shipping market and shipping companies. Through the “Comprehensive Simulation Experiment of Shipping Management” and the “Shipping Company Project” at the end of the semester, students will encounter and solve real-world business problems, achieving knowledge integration and skill enhancement. This module requires students to work in groups, collaborating on shipping management issues encountered in actual business operations, with joint guidance from both university and industry mentors.

Table 1: Functional Table of International Shipping Management Course Modules

Module Name	Core Elements (Brief)	Teaching Methods and Tools	Interaction	Reversible Interaction
① Basic Module	Shipping knowledge framework: market, indicators, liner/ scheduled shipping organization, green shipping	Electronic textbooks + micro-lecture videos + online quizzes	Provide a theoretical context for ② and ③.	Students review and fill in the gaps
② Empowerment Module	Shipping data “collection-washing-viewing-strategy”: AIS, shipping schedules, and carbon emissions	Computer lab training + Shipxy.com/HiFleet/Classification Society energy efficiency software + Python/Excel templates	Provide data and models for ③ and ④.	① Practical demonstration of video embedding.
③ Core Module	PBL projects include: schedule optimization, voyage estimation, canal detours, and carbon cost management.	Group discussions + case study library + Gantt chart + Python/AnyLogic model.	Provide a template for solution ④.	② The code can be reused directly.
④ Practical Module	Exam questions for enterprises: route optimization, fleet scheduling, and carbon compliance.	Dual mentorship + 1 week of simulation sandbox + 6 weeks of on-site enterprise training.	Feedback ①②③ Updated case studies.	④ Excellent projects may be approved for funding.

#### 4.2.2 Digital teaching platform and resource construction

The “Smart Shipping Simulation Laboratory” will serve as the core support platform. It will introduce or co-develop professional simulation software and data analysis platforms, and equipping them with anonymized real-world industry datasets (AIS data, freight rate indices, etc.). Simultaneously, a supporting digital teaching case library and micro-course video library will be developed, and practical training bases will be jointly established with leading enterprises. This is to introduce industry mentors to ensure that teaching resources remain current and closely aligned with industry needs.

The intelligent shipping simulation laboratory serves as the “digital foundation” for curriculum reform, but its development goal should not stop at “purchasing advanced equipment.” Instead, it should be upgraded to a growing and evolving shipping education operating system. To this end, we can adopt the Digital Twin Learning Space (DTES) framework, breaking down the platform into a three-layer architecture: physical, data, and algorithm layers. Each layer connects to teaching scenarios, forming a closed loop of “hardware-data-computing power-case studies.” To ensure a dual-drive of “cutting-edge technology + practical application,” the platform introduces two major mechanisms: “dynamic task generator” and “industry mentor responsibility contract.” The case study library is upgraded to a “dynamic task” generator, automatically generating training tasks containing complex scenarios such as sudden risks and capacity fluctuations by connecting to real-time dynamic data from the shipping market, strengthening students’ ability to cope with real challenges. Meanwhile, the university signs a legally binding “Dual Mentor Responsibility Contract” with leading companies. Industry mentors are deeply involved in task design and process guidance according to the contract, ensuring that task logic iterates synchronously with industry evolution, forming a continuously updated educational closed loop. For example, the dynamic task generator automatically captures the latest freight rates, fuel prices, IMO and EU ETS policies every quarter, generating decision-making tasks such as port and route selection, and freight rate formulation. Student groups select tasks, analyze them using digital tools based on their respective company backgrounds, and, under the guidance of both company and university mentors, propose the optimal solution. Finally, the system and mentors provide a solution review. This allows students to compare their solutions with real-world market conditions, intuitively understanding the changes in benefits and risks associated with their chosen solutions.

### 4.2.3 Construction of a Process-Oriented and Diversified Teaching Assessment System

With the rise of new liberal arts and the rapid evolution of digitalization in shipping, the traditional summative assessment of “one exam determining grades” is no longer sufficient to support the talent cultivation goal of international shipping management that emphasizes “higher-order cognition—digital skills—complex situation decision-making” in three dimensions. Process-oriented and diversified teaching assessment is not simply about increasing the number of assessments, but rather about using the learning evidence chain as the core to comprehensively track and dynamically intervene in the entire process of students’ “knowledge construction—tool application—problem solving—value reflection.” This responds to the institutional requirements of continuous improvement in the Outcome-Based Education (OBE) concept and aligns with the industry requirements of immediate feedback and rapid iteration in shipping operations. Based on this, the International Shipping Management curriculum has restructured its assessment framework, forming a three horizontal and three vertical model: horizontally covering cognition, ability, and literacy; vertically integrating pre-class diagnosis, in-class iteration, and post-class transfer, realizing “assessment as learning, assessment as teaching, and assessment as service.” First, the assessment system establishes process-oriented assessment. Process-oriented assessment emphasizes the evidence chain rather than score points. The course uses the essential “ship log” in shipping practice as a metaphor, requiring students to continuously submit digital ship logs throughout the semester. Log templates are embedded in the learning management system, automatically capturing process data upon completion of each task node: viewing time of micro-lectures in the theoretical knowledge module, chapter quiz accuracy, and number of incorrect answers are all recorded and weighted; in core project tasks, PBL group route optimization reports and peer review records; and feedback from corporate mentors in practical sessions are also sequentially uploaded to the blockchain, forming a traceable and verifiable learning trajectory. Simultaneously, assessments need to be diversified. Addressing the context-dependent nature of shipping decision-making, introduces a three-dimensional matrix of “multi-subject, multi-dimensional, and multi-scenario” approaches. Teachers, corporate mentors, data systems, peers, and student self-reflection share a common standard, providing multiple benchmarks for the same ship, avoiding the limitations of a single standard answer. Finally, the assessment results become a new guide for teaching improvement. The course team uses data to iterate teaching: if it finds that students from two consecutive cohorts consistently score low on the “Temporary Port Closure Decision in Port Congestion Situations” module, a teaching diagnosis mechanism will be activated. First, the matching degree between the question design and the students’ abilities will be analyzed. If it is confirmed that the timeliness of the cases needs to be strengthened, the latest front-line cases such as the reopening of the Port of Los Angeles due to congestion and the closure of the Port of Ningbo during the fog season will be introduced first to ensure that the teaching content keeps pace with the pulse of the industry.

Through process-oriented and diversified assessment, the International Shipping Management course moves the classroom into the “bridge” and transforms exams into voyage audits. This not only cultivates students’ lifelong learning ability in the face of complex shipping systems but also provides a replicable, scalable, and verifiable paradigm for the reform of higher education evaluation in the digital shipping era.

## 5. Difficulties and Countermeasures

The redesign of the international shipping management curriculum represents a significant innovation in teaching philosophy. Any standard shift is accompanied by numerous uncertainties and faces considerable difficulties and challenges. These difficulties primarily stem from three aspects: students’ lack of initiative in acquiring knowledge due to longstanding learning habits; teachers’ difficulty in keeping their professional knowledge fully aligned with the new teaching model; and the relatively outdated current teaching management system, which fails to effectively guide and guarantee curriculum reform.

Interestingly, these challenges reflect the deeper structural problems encountered by the shipping industry itself during digital transformation. Empirical studies have shown that the main obstacles to the digital transformation of the shipping industry are not the technology itself, but rather the inertia of organizational culture, the psychological resistance of employees to change, the barriers to cross-departmental collaboration, and the huge shortage of digital talents <sup>[10]</sup>.

Related studies, through interviews with senior executives of several shipping companies, pointed out that “people and culture” and “departmental silos” are the primary challenges hindering transformation. Companies often face the dual

pressure of aging traditional talent skills and a shortage of new digital expertise, while the traditional “waterfall” project management thinking is difficult to adapt to the rapid iteration required by the digital process. From this perspective, the curriculum reform aimed at cultivating “shipping brains” is actually guiding students and teachers to overcome typical obstacles in the macro-transformation of the industry at the micro-level of teaching.

## Conclusion

Only by establishing comprehensive institutional support covering teaching, personnel, assets, quality, and finance can the curriculum reform avoid falling into a “pilot cycle” and truly transform from a short-term project into sustainable, regular teaching. Firstly, the “Shipping Brain” teaching model breaks down the traditional teacher-student binary relationship, constructing a three-dimensional interactive structure of “teacher-student-intelligent system.” Yet ingrained perceptions persist, as teachers are still seen as knowledge authorities, while students are in a passive receiving state. Some students are slow to adapt to active learning roles, which weakens motivation. The teacher’s role shifts from the “center of the lecture” to a “facilitator,” and this power relinquishment can create a sense of “weightlessness” in teaching. This shift can produce discomfort: excessive invisibility leading to a loose learning community, or excessive intervention turning the intelligent tool into mere electronic lecture notes. Therefore, curriculum development must emphasize stimulating students’ learning initiative and assembling a team of teachers with experience in digital teaching.

Secondly, since most digital teaching materials need to be derived from real shipping markets, it is necessary to gradually establish and continuously update a systematic resource system covering textbooks, databases, and case studies. At the same time, the application of new technologies also places higher demands on teachers’ professional capabilities. Given the distinct industry characteristics of this course, industry experts can be introduced into the faculty. On the other hand, a “dual-mentor system” can be implemented by establishing long-term internship bases, allowing industry mentors to bring real projects into the classroom and conduct teaching and evaluation jointly with university teachers, thereby promoting the integration of new technologies and teaching practice.

Finally, institutional guarantees are crucial for the sustainable implementation of curriculum reform. The “Shipping Brain” course must be integrated into the school’s regular teaching management system, rather than relying solely on project-based or temporary funding. Specifically, the Academic Affairs Office can designate the course as a flexible credit unit, allowing dynamic credit hours based on projects and tasks, and reserving a certain amount of flexibility for credit adjustments; the Human Resources Department should incorporate the part-time teaching and guidance work of industry mentors into the management system, linking their contributions with professional title evaluation; the State-owned Assets Management Department should also treat shipping data, software interfaces, and other digital resources as teaching assets for unified management; the Quality Monitoring Department must include data security and information anonymization in the teaching accident evaluation system; and financially, a curriculum reform risk reserve fund can be established to address potential short-term fluctuations and investment needs during the reform process.

The transformation of the international shipping management course still requires the joint efforts of teachers and students, and continuous exploration and innovation in practice, in order to truly achieve the leap from a “knowledge container” to a digital and intelligent course that is the “brain of shipping”.

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## Conflict of Interests

The authors declare that there is no conflict of interest regarding the publication of this paper.

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# Instructional Supervision Practices and Teachers' Job Performance: The Empirical Prism

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**Abstract:** The research paper explored how instructional supervision practices impact the job performance of the public secondary schools teachers in Gusau Metropolis in Zamfara State, Nigeria. Correlational survey research design was taken. The population of this study was 860 teachers in the public secondary schools in Gusau metropolis in Zamfara State. A survey was conducted on a total sample of 291 teachers using a valid and reliable questionnaire. The data were analyzed using descriptive statistics, Pearson correlation and multiple regression at 0.05 level of significance. The results of this research showed that instructional supervision has a significant contribution to job performance of teachers ( $R = 0.61$ ,  $R^2 = 0.37$ , Adjusted  $R^2 = 0.36$ ). Nevertheless, supervisory feedback was established to be the most relevant predictor of teacher performance ( $b = 0.41$ ,  $t = 5.61$ ). This suggests that teacher performance and, by extension, student learning outcomes can be enhanced by reinforcing supervision practices by promoting teacher professional development, intensive, and sustained follow-up. The research concludes that supervision is a developmental instrument that can enhance the quality of instruction and the follow-up and feedback systems confirms the theories of reflective practice and adult learning. The research suggests that school leaders ought to improve the systems of supervisory feedback and follow-up in schools.

**Keywords:** Instructional Supervision; Supervisory Feedback; Follow-Up Supervision; Teacher Job Performance

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## 1. Introduction

### 1.1 Research Background and Importance

Instructional supervision is a significant leadership role that is applied to bring more learning to students through the improvement of teaching skills of teachers and the effectiveness of the school in general. Instructional supervision refers to an organized approach to supporting, leading, and overseeing teachers in order to enhance the quality of their teaching and their professional competence <sup>[1]</sup>. <sup>[2]</sup> has stated, that, the quality of teachers is stated to be the biggest school-based predictor of student learning in any country in the whole world today. The existing approaches towards teacher supervision focus on teacher collaboration, professional growth and reflection. This model promotes the view that teachers are co-operators in the betterment of schools as compared to the control nature of the previous mode that focused on the adherence to regulations <sup>[3]</sup>. A considerable number of educators and researchers are sure that good instructional supervision enhances teaching by means of pedagogical enhancement, improvement of classroom management abilities, and compliance with the curriculum <sup>[4]</sup> <sup>[5]</sup>.

Instructional supervision through effective instructional supervision contributes to teacher growth and encourages reflective teaching practice by creating constructive feedback, coaching, and continuous learning opportunities <sup>[6]</sup>. Also, good instructional supervision assists in establishing an atmosphere of accountability whereby the instructions that the students receive correspond to the targets of the national education system and eventually the skills of the society in the world <sup>[7]</sup>. There are very numerous areas of the work of teachers that are subjected to the instructional performance: lesson plans and their instructional delivery, classroom behavior, evaluation of student learning, and involvement in professional development <sup>[8]</sup>. This is why the leadership of schools is important in defining the extent of motivation, effectiveness of instruction, and dedication to their organization that teachers show <sup>[9]</sup>. It is consistent with the results that high-frequency and positive supervisory feedback help teachers to enhance their teaching practices and become more engaged in their profession <sup>[10][11]</sup>.

Instructional supervision has a direct influence on job satisfaction, morale, and professional identity of teachers, the combination of which leads to overall school effectiveness <sup>[12]</sup>. Although most emerging economies like Nigeria have challenges in establishing effective instructional supervision <sup>[13]</sup>, current educational reforms are concerned with teacher development and quality assurance of school. Implementation of educational leadership is problematic because of the absence of properly trained supervisors, resources, improperly conceived ratios between teachers and students, and lack of supervisory report follow-up <sup>[14]</sup>. Still, there is still a misunderstanding among educators as to the inconsistencies of teachers in the execution of their duties, which directly influence the effectiveness of their teaching and the academic performance of their tutors <sup>[15]</sup>. Through the growing need of quality education and the enhancing the educational achievement, the issue of how the instructional supervision influences the job performance of teachers within the public school systems where the formal systems of supervision are available but applied in an inconsistent manner merits the investigation. The literature has recorded a lot of debate over the effects of instructional supervision on the job performance of teachers with some studies stating that there is a direct relationship and other studies giving a critical perspective. A large portion of the literature confirms the belief that instructional supervision is crucial in enhancing the effectiveness of teaching, as it offers teachers the consistency of performance appraisal and effective feedback, coaching, and other types of continuous improvement of professionalism <sup>[16]</sup>.

In the same manner, according to <sup>[17]</sup>, the teaching and learning (curriculum coordination, teacher development) of teachers that are supported by the specific leadership practices are strongly related to the higher levels of teaching effectiveness. Qualitative research has demonstrated that teachers appreciate developmental, dialogical and reflective supervision because they allow the supervisor to promote professional transformation, foster pedagogical change and assist supervisor and teacher to engage in reflective practice. Teachers can trace the progress in their lesson delivery, classroom management and student involvement to the supervisors who make specific and practical feedback and who present effective instructional practices <sup>[18]</sup>. Also, international policy data, which are congruent with this perspective, exists. The research outcomes of the OECD TALIS survey indicate that the teachers consider supervision to be the most efficient when connected to the professional development, career advancement, and reflective collaboration <sup>[19][20]</sup>. Hence, these articles verify the assumption that in case the instructional supervision is established on the basis of collaboration, professional learning, and positive feedback, it has a positive influence on the job performance of teachers. The arguments above are counters to the argument by scholars, who warn against super stating the effects of supervision because they do not believe that all types of supervision are positive. The critics state that only those sorts of supervisory practice, which are grounded on compliance or evaluation-based approaches, might not be helpful in the supervision of teachers or building their professional aspirations. It has been found that, primarily, supervision, which is founded on formal evaluation, accountability or high stakes observation, might not support the building up of teachers (professional) in any beneficial way, but rather instill artificial compliance, generate anxiety, and restrain creative growth in instruction <sup>[21]</sup>.

Nevertheless, there have been apprehensions about the rising popularity of classroom-based walkthroughs performed within a short duration to provide a superficial feedback that cannot be profound and significant unless designed and guided accordingly <sup>[22]</sup>. The meta-analysis validates the observation that coaching is effective in bringing about an advantage, but the effects of coaching reduce with its use on a large scale, as quality and resources are compromised and the application is irregular <sup>[23]</sup>. The frequency of supervision is another issue of concern in the literature. Likewise, rather than fostering a

constant proximity of the supervisor, the proponents of the structured, scheduled and purposeful supervision cycles suggest that research data point to the fact that planned routines of regular observation and feedback provided within a reasonable time frame, with specific focus on the content-related instructional goals, are more effective than infrequent or excessive requests of observation/feedback <sup>[19] [23]</sup>. Moreover, regular walkthroughs that are not accompanied by substantive interaction are usually not a predictor of better teaching practice though they may introduce enmity or instructional fatigue to the classroom teacher <sup>[22]</sup>. Therefore, it appears that the literature has some consensus regarding the fact that the quality/intentionality of supervisors is more important than the number of visits of an instructor by a supervisor. Supervision through follow-up is also one of the common areas of focus in the literature. It has been shown that the most effective supervision is the one that involves the post-observation discussions, particular feedbacks, the opportunity to discuss the effective practices, and the practice-based opportunities with constant monitoring. According to a study done by Joyce and Showers, follow-up coaching has a significantly high probability of transferring new knowledge and teaching strategies to classroom by teachers <sup>[24]</sup>. Without follow-up coaching, the rewards of supervision are considered to be short-term or surface-level.

According to the modern studies of implementation science, constant supervision is essential to developing habits, strengthening what is expected of instructors, and aligning the instructional practice with the projected outcome of the school <sup>[25]</sup>. Thus, out of this framework, this present research paper can draw a conclusion that instructional supervision can positively result in teachers job performance but the type of supervision, the quality of the supervision, the frequency of the supervision and the way it can be followed up will decide whether this potential is realized or not. An example is that, developmental, collaborative, and supportive supervisory practices are correlated with the most positive results and the punitive, or symbolic, supervisory practices are correlated with the most negative results. Thus, the effective instructional supervision is to be organized according to the professional standards, and with the help of the continuous assistance and support of post-observation to generate the long-term positive change of the teaching practice. Instructional supervision will be developmental, sustained, and closely aligned with professional learning of teachers when all resources of a secondary school system are set in optimal operation. Evidence-based observation will be conducted by leaders, heads of departments, and trained instructional coaches, and actionable feedback and adequate content-focused mentoring will be co-created, as well as regular follow-up cycles of transferring newly acquired information into sustainable classroom practice <sup>[1] [24]</sup>. In such circumstances, better student achievement is going to be achieved by the enhancement of the job performance of the teachers, which is evidenced by coherent lesson planning, effective pedagogy, proper and formative assessment, and orderly classroom <sup>[17] [23]</sup>. Besides that, there are also other large-scale surveys comparing these conditions that teachers perceive feedback to be productive and motivating when supervision is related to professional development, recognized and linked to explicit career ladders <sup>[19] [20]</sup>.

In opposition to the scenario of certain secondary schools in the entire world, particularly in Nigeria, supervisory methods, implemented in most of the secondary schools, are not uniform and are compliance-oriented, and rarely associated with on-a-job assistance <sup>[14] [15]</sup>. The restrictions on supervisor training, student-teacher ratios, lack of sufficient feedback time and resources make observation limited to mere walkthroughs with general checklists, minimal coaching, and nearly no re-observation <sup>[12] [13]</sup>. It is in such environments that teachers have a disposition to think of supervision as an evaluation process, one that is episodic, rather than a continuous process of development, reduces the overall impact of supervision on delivering, climate and assessment of lessons <sup>[18]</sup>. What it creates is an ongoing gap between the policy hope of ensuring quality in education and the actuality that the teacher encounters at the classroom as far as enhancing learning among the students is concerned <sup>[7]</sup>. Studies suggest that properly organized coaching and instructional leadership influences positively both the quality of instructions and the achievement in learning <sup>[16] [17]</sup>. Moreover, it has been observed in research studies that the followers of the supervisory practices of principals are positively correlated with the job performance of teachers as long as the feedback made to them is specific and developmental in nature within Nigeria <sup>[10] [4]</sup>. Nevertheless, this problem remains despite the fact that in the vast majority of education systems, the practice of supervision is implemented on a mass scale but <sup>[24]</sup> the 4 main factors that enhance its effectiveness are not maintained: long-term dosage, subject-focused approach, competent feedback, and a follow-up <sup>[16] [22]</sup>. Moreover, organizational factors (lack of funds to invest in the professional

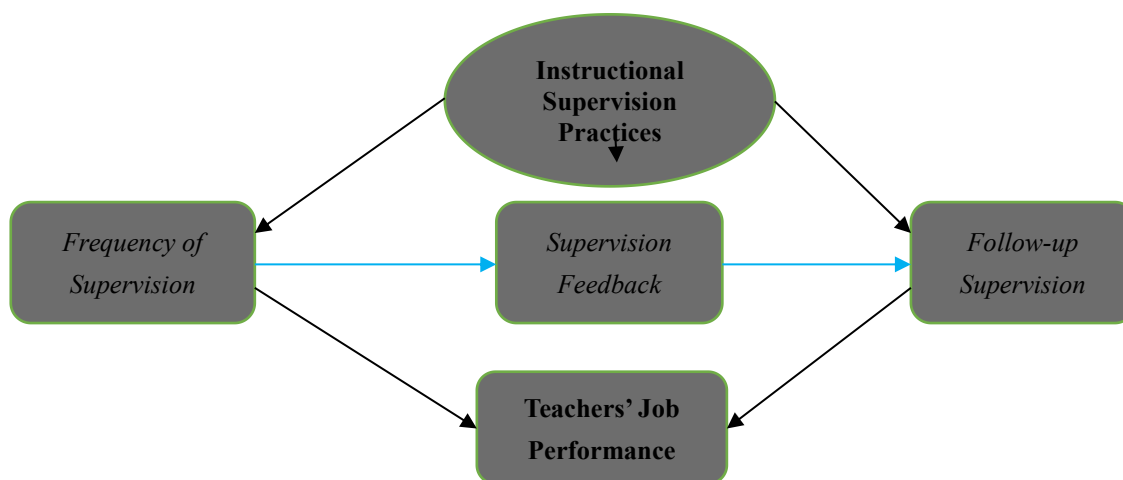
development of teachers, tight schedules of teachers and poor connection between the evaluation process and opportunities to learn as a teacher) do not allow taking into account the feedback provided by teachers on a daily basis<sup>[19] [20] [12]</sup>. When the tasks which supervisory staffs undertake are mainly based on an evaluative paradigm, teachers can only passively follow the instructions given to them by the staff, and will thus not take part in profound instructional change<sup>[21]</sup>.

Although literature both in and outside Nigeria has increased in quantity, there is a dearth of evidence in terms of Nigeria that can be used to identify how frequency of supervision, quality of feedback, and the presence of a follow-up cycle collectively affect the job performance of teachers employed in the public secondary schools within the Gusau Metro Area of Nigeria. The existing research done in Nigeria is typically of multiple regions in the country consolidated into one study or the school of thought. How the supervision should be designed to Adapt to the specifics of the challenges in Zamfara State has not been studied properly to date<sup>[13] [15]</sup>. The Gaps that will be addressed through this Research will be to explore the relationship between the frequency of supervision, quality of feedback and follow-up. The result of this research is that the local school leaders will have an evidence-based model to offer supervision that serves teachers with professional development opportunities, as opposed to the customary approach(s) of offering them each time with an Evaluation, and will eventually result in higher job performance of teachers and higher learning among students in the Gusau Metro Area of Nigeria.

## 1.2 Conceptual Clarification

The study conceptual framework is premised on the premise that instructional supervision is a multidimensional professional support strategy that influences the manner in which teachers act, exhibit technical competence and generally job performance. Instructional supervision is also broadly viewed as a form of development according to which supervisors take teachers to the next stage to make better pedagogical choices, classroom teaching and learning<sup>[5] [1]</sup>. This study framework combines three fundamental dimensions of instructional supervision (frequency of supervision, quality of supervisory feedback, and follow-up supervision) and hypothesizes the nature of interaction between them in determining job performance of teachers in the public secondary schools. Within this framework, the direct causal relationship is offered between all the supervision dimensions and the teacher performance and the fact that feedback and follow-up might have stronger predictive value than the frequency itself.

Figure 1: Theoretical Model of instructional supervision practices and job performance of teachers.



The initial construct, frequency of supervision, is a set of how often the supervisors pay visits to classrooms, observe the instruction, lesson plans, as well as the teaching activities. It is indicated that regular supervisory contacts stimulate teachers to act professionally and to follow the curriculum requirements and keep the instructional quality under control<sup>[23] [19]</sup>. It is also believed that regular supervisory encounters are linked with enhanced teacher motivation and enhanced instructional planning<sup>[12] [26]</sup>. Nevertheless, researchers caution that the quality and meaningfulness of supervisory interactions and not the repetition of supervision are the key to effective frequent supervision<sup>[27] [21]</sup>. Following this literature, the framework presupposes that other dimensions of supervision need to work together with frequency in order to achieve significant performance effects.

Quality of supervisory feedback is the second construct, which denotes the clarity, specificity, actionable value, and developmental orientations of the supervisory feedback the teachers may obtain following the supervisory visits. The feedback has been generally accepted as the most effective element of instructional supervision as it enhances teacher reflection and supports pedagogical judgments<sup>[18] [2]</sup>. Good-quality feedback can help teachers to identify areas of weakness, implement evidence-based teaching methods, and enhance the presentation of the material<sup>[28] [23]</sup>. In recent studies, it is emphasized that timely feedback should be supportive and collaborative to influence teacher learning and behaviour change<sup>[10] [17]</sup>. The framework thus makes quality feedback as an important explanatory variable in the determination of the role of supervision in teacher performance.

The third construct is that of the follow-up supervision, which means the additional support and monitoring upon issuing feedback. The follow-up has been perceived as being the connector between the recommendation and classroom improvement, through which teachers are reinforced and given specific help when working on the new strategies<sup>[24]</sup>. Researchers highlight that unless the supervisory feedback is supported by follow-up procedures, the latter is most likely to be theoretical in nature and unlikely to result in the long-term behavioural change<sup>[25] [29]</sup>. Both teacher accountability and reinforcement of learning, as well as bridging the gap between recommended practice and implemented pedagogy, are encouraged by follow-up<sup>[30] [31]</sup>. The structure of this study presupposes that follow-up increases the effectiveness of the frequency of supervision and the quality of feedback. It is assumed that these three supervisory constructs affect job performance of teachers, including the instructional planning, pedagogical delivery, classroom management, assessment practices, professionalism, and support of learners<sup>[32] [33]</sup>. Regularly the literature demonstrates that teacher performance is enhanced when the supervision is systematic, progressive, and in line with the instructional requirements of the instructors<sup>[4]</sup>. Based on the Social Learning Theory, the framework supposes that teachers can change behaviour by observing, interacting, guiding, and reinforcing supervisors<sup>[34]</sup>. Also, the theory of instructional leadership offers principles of instructional leadership as justifying the notion that the supervisors shape the performance by influencing the norms of instruction, expectations, and professional cultures<sup>[35]</sup>. The model is also related to the organizational support theory that suggests that employees work more effectively when they get valuable instructions and constant professional assistance<sup>[36]</sup>. The conceptual framework of this study has a synthesis of the empirical and theoretical view to explain the overall effect of instructional supervision practices (frequency, feedback quality, and follow-up) on teacher performance. It places instructional supervision as a multidimensional construct that directly impacts teacher behaviour but exists in more institutional and leadership contexts. The research thus aims at establishing the degree to which the instructional supervision practices (classroom supervision frequency, quality of supervisor feedback, and post-classroom supervision) are predictive of teacher performance in lesson planning, instructional delivery, classroom management, and student learning assessment at the study area secondary schools (Gusau Metro Area of Zamfara State, Nigeria). The research question of this study is:

RQ 1: Which practices of instructional supervision (frequency, quality of feedback, and follow-up) are most effective in predicting job performance in the study area among teachers?

In the process of this study, a hypothesis was also developed and tested at level 0.05 level of significance.

H0: There are no significant and joint instructional supervision practices that predict teachers' job performance.

The sections below provide the methodological approach in identifying and analyzing the constructs of the study, report the results of the study as an answer to the question, hypothesis and comment on the theoretical and practical implications of the results.

## 2. Material and Methods

### 2.1 Research Design

The study involved a correlational survey design because it aimed at determining the relationship between the elements of instructional supervision (the frequency with which supervisors have meetings with their teachers, the manner in which they offer feedback and follow-up support) and job performance by teachers without controlling the work of the teacher or the work of the supervisor. Besides being a survey design, the correlational survey design enabled the researcher to obtain quantitative data of respondents at a particular time that could be analysed to represent the influence of study variables on job



performance.

## 2.2 Population, Sample and Sampling Technique of the Study.

The population of this study was all the teachers in the public secondary-schools in Gusau Metropolis, Zamfara State. As per the records of Zamfara State Post-Primary Schools Management Board (2024), 860 teachers were employed in 43 state schools that are present in the Gusau Metropolis. This study was going to use the Research Advisors sample size determination table at a 95% confidence level and a 5% margin of error to determine the sample size of this study. According to a population of 860 teachers, the researchers should have had a sample size of 265. Due to the possibility of non-respondents, another 10 percent (26 teachers) was included in the sample to make a total of 291 teachers. The sample selection method was a multi-stage sampling method. To begin with, secondary schools in the Gusau Metropolis which are publicly owned were organized based on educational areas. Second, schools within each zone were chosen with the help of a sampling technique (simply random sampling). Third, individual teachers were selected using simple random sampling by updated lists of school records of teachers. This sampling process was designed in such a way that the respondents were selected fairly and representationally across the total population of all the secondary public school within the study area. The outcomes of the research were founded on the research questions and hypotheses of this study. The research questions were answered using descriptive data such as frequency, mean and standard deviation. The hypotheses were tested at the level of significance of 0.05 by the Pearson Product-Moment Correlation and Multiple Regression Analysis.

## 2.3 Instrumentation

The data collection tool was a questionnaire that was developed by the researcher and was called: Instructional Supervision and Teachers Job Performance Questionnaire (ISTJPQ). There were five questions in the questionnaire including Section A: Demographics (gender, qualification, years of experience, subject); Section B: Frequency of Supervision (X1); Section C: Supervisory Feedback Quality (X2); Section D: Follow-up Supervision (X3); and Section E: Teachers Job Performance (Y). It was a 4-point Likert scale to design all items in Sections B - E: Response Score Strongly Agree (SA) 4 Agree (A) 3 Disagree (D) 2 Strongly Disagree (SD). Three professionals, who were specialists in Educational Management (with a focus on the supervision) and one specialist in Measurement and Evaluation and one experienced school administrator of the Post-Primary School Management Board conducted the face and content validation of the questionnaire. Their remarks resulted in the adjustments of the language understanding, the correspondence of the content, measurement precision, and the research purpose. The tool was considered suitable to use. Pilot test was used to determine reliability of the instrument and involved 30 teachers in the secondary schools in the state of Kaura-Namoda LGA, which is not within the study area. The analysis of the responses was based on Cronbach Alpha and the following were the coefficients: Frequency of supervision (0.81); Supervisory feedback (0.88); follow-up supervision (0.84); and Teachers job performance (0.90). The total coefficients of reliability was 0.86. The values are larger than the acceptable level of reliability of 0.70 thus showing that the instrument was internally consistent and appropriate in the study.

## 2.4 Data Analysis

All the data obtained were analyzed using the Statistical Package of the Social Sciences (SPSS) version 26; both descriptive and inferential statistical tests were performed. The descriptive statistics of mean scores, standard deviations, and frequency distributions were also used to summarize and describe the characteristics of the respondents and central tendencies of their responses. Inferential statistics were applied to test the hypotheses and verify the relationship between the variables. In particular, Pearson Product-Moment Correlation Coefficient (PPMC) was employed to find out the extent and direction of the correlation between the elements of instructional supervision (frequency of supervision, supervisory feedback and follow-up supervision) and job performance of teachers. Moreover, the multiple regression analysis was also performed to determine the overall impact and predictive power of the independent variables on the dependent variable.

## 2.5 Ethical Consideration

A set of ethical principles was followed during the research. The management board of the Zamfara State Post-Primary Schools and the principals of the sampled public secondary schools provided permission to conduct the research. The involvement in the study was on a voluntary basis and the respondents were promised that they could opt out at any point

with no repercussions. All respondents were informed that there will be confidentiality and anonymity; they were not expected to give any personal identifiers and any information gathered was to be handled in maximum confidentiality. The information received was utilized on academic grounds only and was kept in a safe place to avoid unauthorized access. The participants were told the purpose of the study and informed consent was taken before the administration of the instrument. The research was conducted in accordance to the proper ethical standards of research in the field of education, where no participant was disrespected, invaded or harmed in the research process.

### 3. Results

#### 3.1 Demographic Information Analysis

There were 378 questionnaires that were collected and reviewed. The demographic analysis revealed that the majority of the respondents were female with 230 (60.8) and males constituted 148 (39.2). Qualification wise, the most qualified group was NCE holders with a total of 154 (40.7) then it was degree holders with 102 (27.0) and M.Ed holders with 26 (6.9). The average amount of teaching experience of the teachers was 11-15 years and the numbers are 182 (48.1) which show a relatively experienced workforce. In reference to the level of supervision, 182 (48.1) teachers said that they had 2/3 supervisions per term and 99 (26.2) teachers said that they did not have any supervision. Supervision frequency had high inconsistencies, 172 (45.5%), and follow-ups supervision, 284 (75.1%). Only 159 teachers (42.1%), reported to have a feedback system in the schools. These findings show that the supervision is mostly haphazard and unmonitored despite the supervision. These results indicate that although supervision occurs, it is largely ad hoc and it is not effectively followed up.

#### 3.2 Research Questions

RQ: What dimensions of instructional supervision (frequency, the quality of feedback and follow-up) give the best predictors of job performance in the study area by teachers?

*Table 1: Descriptive Statistics of Instructional Supervision Predictors and Teachers' Job Performance*

Variable	N	Mean	SD
Frequency of Instructional Supervision	378	2.56	0.89
Supervisory Feedback	378	3.15	0.94
Follow-up Supervision	378	3.15	0.94
Teachers' Job Performance	378	2.62	0.93
Grand Mean / Pooled SD	378	$\bar{X} = 2.87$	SD = 0.93

Note: Mean  $\geq 2.50$  = Agree and Mean  $< 2.50$  = Disagree

Table 1 gives a description of the statistics of the dimensions of instructional supervision (frequency, quality of feedback and follow-up) which is best predictive of job performance of teachers. The mean rating of items that represent supervision frequency are provided in the table. The mean score of 2.56 obtained was aggregated which shows the moderate level of supervision frequency. The participants of the study concurred that the supervision is done at least once in a term. Another finding of the table also indicates that the high aggregated mean of 3.15 indicates that the teachers strongly believed that supervisory feedback is beneficial, descriptive, and leads to an improvement in teaching. On the same note, the aggregated mean of 3.15 was discovered to suggest that teachers who undergo follow-up supervision (where applicable) regard it as extremely helpful. The average supervision practices grand mean of 2.87 indicates moderate implementation of school practices. Nevertheless, the recorded means in supervisory feedback were comparably high (3.15), and the means in follow-up supervision were relatively high (3.15). As compared to supervision frequency, which was relatively low (2.56). Thus, both follow-up and supervisory feedback are the best indicators of job performance of teachers.

#### 3.3 Hypothesis Testing

Ho: Teachers do not have joint and significant predictors of job performance in terms of instructional supervision practices.

Table 2: Hypothetical Association of Supervision Frequency, Feedback, and Follow-Up with Teachers' job Performance

Variables	N	r	p-value	Decision
Frequency of Supervision vs Job Performance ( $H_{01}$ )	378	0.34	0.001	Rejected
Supervisory Feedback vs Job Performance ( $H_{02}$ )	378	0.52	0.001	Rejected
Follow-Up Supervision vs Job Performance ( $H_{03}$ )	378	0.48	0.001	Rejected

The correlation findings of the hypotheses (1, 2, and 3) demonstrate that all the three dimensions of instructional supervision namely frequency of supervision ( $r = 0.34$ ,  $p = 0.001$ ), supervisory feedback ( $r = 0.52$ ,  $p = 0.001$ ), and follow-up supervision ( $r = 0.48$ ,  $p = 0.001$ ) have a significant positive relationship with the job performance of teachers. This implies that, increased supervision, supportive feedback and frequent follow-up is associated with improved teacher performance. Out of these factors, the strongest correlation with job performance is with supervisory feedback. This implies that the quality of feedback is very important in enhancing the instructional effectiveness by the teachers.

Table 3: Regression Analysis of Frequency, Feedback, and Follow-Up on Job Performance

Predictor	B	Std. Error	Beta ( $\beta$ )	T	p-value
Frequency	0.12	0.04	0.18	2.92	0.004
Feedback	0.28	0.05	0.41	5.61	0.001
Follow-Up	0.22	0.05	0.36	4.87	0.001

Table 4: Model Summary

Model	R	R <sup>2</sup>	Adjusted R <sup>2</sup>	Std. Error
1	0.61	0.37	0.36	0.74

Hypothesis 4 was tested using the multiple regression analysis, which revealed that the three dimensions of instructional supervision predict job performance of teachers in combination. The outcome was  $R = 0.61$ ,  $R^2 = 0.37$ , Adjusted  $R^2 = 0.36$  and Std. Error = 0.74. This is to say that these dimensions explain 37 per cent of the performance variation. Supervisory feedback was the most significant of the predictors,  $b = 0.41$ ,  $t = 5.61$ , and  $p = 0.001$ . This was followed by follow-up supervision,  $b = 0.36$ ,  $t = 4.87$ , and  $p = 0.001$ . The frequency of supervision was also important and  $b = 0.18$ ,  $t = 2.92$  and  $p = 0.004$  but not as influential. This implies that teacher performance is influenced by the quality and feedback of supervision and not only by the frequency of supervision.

## 4. Discussion

The results of the research showed that instructional supervision is a key factor of job performance by teachers particularly in the area that the study was conducted. The middle-level monitoring was performed with irregular classroom observation and monitoring of the lesson plans but partial monitoring already has a positive effect on teacher efficiency as shown in the findings. The given observation confirms the international literature that focuses on the role of instructional supervision in the improvement of teacher quality and professionalism<sup>[2] [1]</sup>. The prevailing aspect of supervision was feedback. The teachers found out that clear, explicit and action oriented feedback provision helps them to optimize the lesson planning, deliver better instruction and solve classroom problems. Such findings can be compared to other researchers that emphasize feedback as a focal element of effective supervision which leads to the professional growth and reflective practice<sup>[19] [10] [17] [3]</sup>. The teachers have also performed excellently during the post-training supervision that follows the training. One of the most significant variables that affected the performance of teachers was also the follow-up supervision. Based on these results, it would seem that sustained observation and counselling following the observation assisted teachers to implement recommendations in their practice. This is in line with the opinions of<sup>[24] [25]</sup> that follow-up is a required component to transform supervision into reality, and measurable changes in classroom practice. Even though the level of supervision was statistically significant, the

effect size was relatively low compared to feedback and follow-up. It means that the quality and meaningful interactions are more effective than presence. This is also in line with claims made by <sup>[24] [21]</sup> that supervision cycles should be structured and developmental instead of focused on frequently monitoring. With feedback, follow-up, and frequency as the combined variables in the analysis of the elements of supervision, the combination of the factors accounted highest percentage in the variation of job performance of teachers as compared to when the variables are analyzed individually with the  $R^2 = 0.37$ . This proves the fact that supervision is a relevant organizational instrument which can be utilized to improve the effectiveness of the instruction. This is correlated with the literature on the importance of well-designed supervisory practices being collaborative, reflective, and, therefore, capable of enhancing the performance and professional skills of teaching <sup>[4] [5] [16]</sup>. Nevertheless, the moderate level of supervision is indicative of certain issues that are observed in the situation in Nigeria such as a lack of visits, scarcity of resources, and the inability to follow up <sup>[13] [14]</sup>. This connotes that the possibilities of instructional supervision are bound by structural and systems problems and therefore their capabilities can only partially improve teacher performance and student achievement.

## 5. Implications of the Study

### 5.1 Theoretical Implications

This study has a number of theoretical implications on the area of instructional supervision and teacher effectiveness. To begin with, the substantial correlation between instructional supervision and teacher performance supports theoretical claims by <sup>[1]</sup> that supervision is a developmental apparatus, which is able to enhance the quality of instruction. The value of feedback shown fully supports theories of reflective practice and adult learning, which state that teachers become better when supervisory processes are more specific, actionable, and cognitively stimulating. Also, the high impact of follow-up supervision substantiates the Joyce and Showers theory on guided practice that emphasizes on continuous reinforcement as a key in applying new instructional behaviours to everyday classroom practices. The conclusion that the impact of the frequency of supervision is less than the influence of feedback and follow-up enriches the theoretical discussions because it demonstrates that the quality of engagements is more important than the number of visits. On the whole, the joint effect on the supervisory variables ( $R^2 = 0.37$ ) confirms the multidimensional supervision theories that view supervision as a system as opposed to a group of insular processes.

### 5.2 Empirical Implications

Empirically, the research study contributes to the factual evidence that is becoming increasingly evident that instructional supervision is a positive predictor of teacher effectiveness. The findings support the previous studies by <sup>[2][16]</sup> as it is applied to the Nigerian setting where hardly empirical data has been provided before, especially in the Northern part of Nigeria. The research offers new findings that feedback is the strongest element of supervision and confirms previous empirical studies <sup>[19] [10]</sup>. It also reaffirms that follow up supervision is still necessary in the maintenance of behavioural change in the teachers. The case of moderate supervision has been associated with longstanding empirical issues in developing nations - irregular school inspections, insufficient logistical backups, and lack of monitoring - that have also been reported in other studies in Nigeria <sup>[13] [14]</sup>. Therefore, the research reinforces the empirical thesis that instructional supervision still is restricted in terms of its full potential of use due to systemic constraints.

### 5.3 Implications/Practices

The implications of the findings to educational practice and policy are significant. To begin with, the preeminence of feedback implies that school administrators need to focus on quality, transparency, and topicality of supervisory interactions as opposed to making regular visits. Feedback must be elaborative, positive and correlated to classroom requirements that can be observed. Second, a powerful impact of follow-up supervision indicates the necessity of institutionalizing the processes of follow-up in order to strengthen the recommendations and facilitate implementation. Third, the moderate level of supervision implies that the Ministry of Education needs to enhance the supervisory logistics, decrease the administrative pressures on supervisors, and create regular and consistent school visits. Moreover, the findings also indicate professional development programs that would prepare the supervisors to coach, mentor, observe their classrooms, and provide instructional leadership training. Lastly, the paper recommends that supervision practices are to be changed to include models that focus

on collaboration, reflection and empowering teachers instead of the current traditional models of supervision based on inspection.

## 6. Conclusion

The scope of this study was to determine the extent through which instructional supervisory practices (frequency of classroom supervision, the quality of supervisory feedback, and follow-up supervision) foretell the performance of teachers in lesson planning, teaching, classroom management, and student learning assessment. In line with the findings, this research paper finds that instructional supervision leads to a high level of job performance among the teachers, and a high level of well-structured, purposeful, and sustained supervision is more efficient than routine or ad hoc visits. Hence, by enhancing supervision activities with the help of professional development, narrow feedback, and regular follow-up efforts, teacher performance will be enhanced and, consequently, student learning outcomes.

## 7. Recommendations

According to the findings and implications, it is proposed that instructional supervisors, educational administrators, policymakers, and practitioners be provided with the following recommendations:

1. Pedagogical weaknesses should be addressed by instructional supervisors to offer specific, timely, evidence-based feedback that aids in planning, instruction and classroom management.
2. The adherence to the recommendations of the supervisory efforts by school leaders and teaching practitioners to structured follow-up procedures should be applied in order to monitor the execution of teacher development and overall performance.
3. To achieve consistency and quality, the educational policy makers and school administrators are supposed to employ uniform observation templates, feedback forms and follow up tools in order to be consistent and quality in all supervisory activities.

## 8. Limitations and Future Research Recommendations

Although it makes contributions, this study has some limitations that give an indication of the future researches. To begin with, the research adopted a cross-sectional survey design, which is disadvantageous as far as causal inference is concerned. Thus, a longitudinal or experimental research would be an appropriate approach to a future study in order to examine the impact of competency-based teacher education on teaching practice in the long run. Secondly, self-reported measures were used to collect the data and therefore, social desirability bias might have been a factor. The next research can implement the classroom observations, supervisor assessment, or student learning outcome to achieve a more precise outcome.

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# Reducing Pragmatic Errors in Translation Through Interlanguage-Aware Pedagogical Strategies

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**Abstract:** Pragmatic competence constitutes a core component of translation competence and directly affects the effectiveness of intercultural communication. However, pragmatic errors frequently occur in translation learning and training, particularly among learners operating in a second-language environment. Drawing on interlanguage theory, this study investigates how the permeability and stability of learners' interlanguage systems contribute to both linguistic and sociolinguistic pragmatic errors in translation output. Rather than treating pragmatic failure as a mere performance problem, the paper conceptualizes such errors as systematic manifestations of interlanguage development. Through theoretical analysis and illustrative examples, the study demonstrates that negative language transfer and fossilization play a crucial role in shaping recurrent pragmatic deviations in translation. On this basis, the paper proposes interlanguage-aware pedagogical strategies for translation education, including input-oriented training, functionalist translation pedagogy, and reflective use of computer-assisted translation tools. The study aims to provide both theoretical insight and practical guidance for improving pragmatic competence in translation teaching and learning.

**Keywords:** Translation Education; Pragmatic Errors; Interlanguage; Language Transfer; Pedagogical Strategies

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## 1. Introduction

Translation functions as a form of mediated intercultural communication, in which the accurate conveyance of communicative intention is of paramount importance. Even when grammatical and lexical accuracy is achieved, pragmatic errors in translation may still result in misunderstanding or communicative failure. In translation education, such errors are often treated as isolated mistakes or performance deficiencies, while their underlying developmental causes receive comparatively limited attention.

Interlanguage theory, originally developed within the field of second language acquisition, offers a productive theoretical lens for examining pragmatic errors in translation learning. Translation learners, like other second-language users, operate within an evolving interlanguage system that is shaped by both their native language and the target language. The permeability and stability of this system influence not only linguistic accuracy but also pragmatic appropriateness in translation output.

This study applies interlanguage theory to the analysis of pragmatic errors in translation, with particular attention to their

pedagogical implications. By examining linguistic and sociolinguistic pragmatic errors through the characteristics of interlanguage permeability and stability, the paper seeks to clarify why certain errors persist despite continued learning and practice. More importantly, it aims to explore how translation teaching can address these issues through targeted pedagogical strategies. In doing so, the study contributes to ongoing discussions in translation education concerning the development of pragmatic competence.

## 2. Pragmatic Competence and Translation Education

Pragmatic competence has long been recognized as an essential component of communicative competence in second language acquisition. In the context of translation education, pragmatic competence occupies an even more central position, as translators are required not only to understand meaning but also to reconstruct communicative intentions across linguistic and cultural boundaries. However, compared with grammatical accuracy and lexical equivalence, pragmatic competence has often been underrepresented in translation teaching objectives and assessment criteria.

Translation competence is widely understood as a multi-dimensional construct, encompassing linguistic competence, cultural competence, textual competence, and strategic competence. Pragmatic competence intersects with all these components, as it governs the appropriate selection of linguistic forms in relation to context, purpose, and audience. From an educational perspective, pragmatic errors in translation therefore reveal not only deficiencies in language knowledge, but also limitations in learners' ability to integrate contextual and cultural information into translation decision-making.

In many translation classrooms, pragmatic issues are addressed implicitly rather than systematically. Learners are often expected to "develop a sense of appropriateness" through exposure and practice, without explicit pedagogical guidance. As a result, pragmatic deviations are frequently attributed to carelessness or insufficient proficiency, rather than being analyzed as developmental phenomena rooted in learners' interlanguage systems. This pedagogical tendency obscures the underlying mechanisms that give rise to recurrent pragmatic errors and limits the effectiveness of corrective feedback.

From the perspective of translation education, pragmatic errors should be treated as diagnostic indicators of learners' interlanguage development. Such errors provide valuable insight into how learners conceptualize meaning, context, and cultural norms during translation. When systematically analyzed, they can inform curriculum design, teaching strategies, and assessment practices. In this sense, pragmatic failure is not merely an obstacle to be eliminated, but a pedagogical resource that reveals the dynamic interaction between language acquisition and translation training.

Integrating pragmatic competence into translation education requires a theoretical framework capable of explaining both variability and persistence in learners' translation behavior. Interlanguage theory offers such a framework by conceptualizing learner language as a structured, yet evolving system influenced by multiple linguistic and cultural inputs. By situating pragmatic errors within this framework, translation educators can move beyond surface-level correction and address the cognitive and developmental factors underlying learners' translation choices.

## 3. Pragmatic Errors in Translation: Typology and Pedagogical Relevance

The concept of pragmatic failure was first systematically discussed by Jenny Thomas, who distinguished between linguistic pragmatic failure and sociolinguistic pragmatic failure within Leech's pragmatic framework<sup>[1][2]</sup>. Linguistic pragmatic failure refers to inappropriate linguistic choices that hinder the intended communicative effect, whereas sociolinguistic pragmatic failure arises from violations of social or cultural norms governing language use.

Subsequent scholars further expanded the concept. Gabriela defined pragmatic failure as a primary cause of communication breakdown in cross-cultural interaction.<sup>[3]</sup> Riley emphasized that pragmatic failure results from the interaction between different sociocultural systems, arguing that communicative behavior constrained by one set of norms may become inappropriate when transferred to another context.<sup>[4]</sup> In China, He Ziran introduced the concept of pragmatic failure and described it as errors in communication that fail to achieve the expected effect due to inappropriate language use or speech style.<sup>[5]</sup> Qian Guanlian and Liu Shaozhong further clarified that pragmatic errors may occur even when linguistic forms are grammatically correct, as long as interpersonal or sociocultural conventions are violated.

Building on these studies, this paper adopts Thomas's binary classification to analyze pragmatic errors in translation. In the

context of translation education, linguistic pragmatic errors typically involve inappropriate lexical choices, literal translation, or mismanagement of grammatical categories, while sociolinguistic pragmatic errors are closely related to insufficient cultural awareness and inappropriate contextual adaptation. Importantly, both types of errors can be interpreted as external manifestations of learners' interlanguage systems rather than accidental mistakes. Table 1 summarizes the relationship between major types of pragmatic errors in translation, their interlanguage origins, and corresponding pedagogical strategies.

*Table 1. Types of pragmatic errors in translation and corresponding pedagogical strategies*

Type of pragmatic error	Typical manifestations in translation	Interlanguage feature	Pedagogical focus
Linguistic pragmatic errors	Inappropriate lexical choice; literal translation; unnatural collocation	Interlanguage permeability; negative transfer	Input enhancement; contrastive analysis; usage-based learning
Sociolinguistic pragmatic errors	Cultural misrepresentation; inappropriate register; symbolic mistranslation	Interlanguage stability; fossilization	Functionalist pedagogy; contextual analysis; reflective evaluation

## 4. Interlanguage Theory as an Explanatory Framework

Interlanguage refers to an independent linguistic system developed by second-language learners during the process of language acquisition. Corder described interlanguage as a transitional competence that evolves as learners test and revise hypotheses about the target language. Nemser characterized it as an approximate system that continuously approaches the target language without necessarily fully converging with it. Selinker emphasized the systematicity and observability of interlanguage, arguing that it constitutes a structured system distinct from both the native language and the target language.<sup>[6]</sup> Later studies further confirmed that interlanguage is dynamic, rule-governed, and empirically observable. In China, Lu Jianji and Lv Bisong contributed to the localization and refinement of interlanguage theory, highlighting its relevance to foreign language learning and error analysis.<sup>[7]</sup>

Beyond its structural properties, interlanguage is also characterized by permeability and stability. Permeability refers to the openness of the interlanguage system to influence from both the native language and the target language, resulting in positive or negative transfer. Stability, often associated with fossilization, describes the tendency of certain interlanguage features to become resistant to change despite increased exposure to the target language.

In translation learning, these characteristics significantly affect pragmatic performance. Pragmatic errors can thus be understood as the result of interlanguage rules being activated in translation tasks, particularly when learners rely on stabilized or negatively transferred forms that are pragmatically inappropriate in the target language.

### 4.1 Interlanguage Permeability and Linguistic Pragmatic Errors

The permeability of the interlanguage system allows translation learners to continuously incorporate new target-language input. At the same time, it also enables negative transfer from the native language, which is a major source of linguistic pragmatic errors.<sup>[8]</sup> Such errors often arise from incomplete mastery of target-language rules or overreliance on native-language structures.

In Chinese–English translation, lexical ambiguity frequently poses challenges. For instance, the Chinese term “政客” may correspond to both politician and statesman in English. Although semantically related, the two words differ significantly in pragmatic connotation: politician often carries a negative or neutral implication, whereas statesman is generally positive. Translation learners who fail to distinguish these pragmatic nuances may produce translations that distort the speaker's intended evaluation.<sup>[9]</sup>

These errors are not simply lexical inaccuracies but reflections of interlanguage permeability, where native-language conceptual categories exert undue influence on target-language expression. Literal translation and structural calquing further exacerbate this problem, leading to translations that are formally accurate but pragmatically inappropriate or stylistically unnatural.

From a pedagogical perspective, linguistic pragmatic errors highlight the need for sustained and context-sensitive target-language input. Translation education should therefore emphasize not only vocabulary expansion but also pragmatic differentiation and usage-based learning, helping learners gradually refine their interlanguage systems.

## 4.2 Interlanguage Stability and Sociolinguistic Pragmatic Errors

Building on existing pragmatic theories, pragmatic errors in translation can be broadly classified into linguistic pragmatic errors and sociolinguistic pragmatic errors. While this binary classification has been widely applied in studies of cross-cultural communication, its pedagogical relevance in translation education deserves further elaboration.<sup>[10]</sup>

Linguistic pragmatic errors in translation typically involve inappropriate lexical selection, rigid syntactic mapping, or excessive reliance on formal equivalence. These errors occur when translators choose linguistically correct forms that fail to achieve the intended communicative effect in the target context. For translation learners, such errors often reflect incomplete pragmatic differentiation within the target language, where semantic equivalence is prioritized over contextual appropriateness.

Sociolinguistic pragmatic errors, by contrast, arise from misalignment between translation choices and sociocultural norms. These errors frequently involve culturally embedded expressions, honorifics, evaluative language, and symbolic imagery. In translation education, sociolinguistic pragmatic errors are particularly challenging because they are less visible at the level of linguistic form and more resistant to correction through rule-based instruction.

From a pedagogical standpoint, distinguishing between these two types of pragmatic errors allows educators to design targeted instructional interventions. Linguistic pragmatic errors are more amenable to correction through enhanced input, contrastive analysis, and usage-based learning. Sociolinguistic pragmatic errors, however, require explicit discussion of cultural assumptions, communicative purposes, and audience expectations.

Importantly, both types of pragmatic errors should be understood as systematic rather than random. Their recurrence across learners and tasks suggests that they are rooted in shared interlanguage features shaped by common learning experiences. Recognizing this systematicity shifts the focus of translation education from error elimination to developmental support, encouraging educators to address pragmatic competence as an integral component of translation training.

## 5. Interlanguage-Aware Pedagogical Strategies for Translation Teaching

From an interlanguage perspective, pragmatic errors in translation are not accidental deviations but systematic outcomes of learners' evolving linguistic systems. Consequently, pedagogical strategies in translation education should aim not merely at correcting surface errors, but at reshaping the underlying interlanguage mechanisms that give rise to such errors. This section proposes an interlanguage-aware pedagogical framework for translation teaching, focusing on input enhancement, functionalist-oriented instruction, and reflective, technology-assisted learning.<sup>[11]</sup>

### 5.1 Input Enhancement and the Development of Pragmatic Awareness

Input plays a decisive role in interlanguage development, as it continuously reshapes learners' hypotheses about the target language. In translation education, however, input is often treated primarily as a source of linguistic forms rather than pragmatic norms. From an interlanguage-aware perspective, input enhancement should explicitly target pragmatic awareness, particularly in relation to context-sensitive meaning and usage.

For translation learners with an intermediate or advanced language foundation, input should be diversified and contextualized rather than limited to decontextualized texts.<sup>[12]</sup> Authentic materials such as speeches, interviews, news reports, and institutional discourse provide rich pragmatic cues related to register, stance, and audience orientation. Exposure to such materials enables learners to observe how meaning is pragmatically constructed and negotiated in real communicative settings.

Listening-based input, when combined with guided reflection, is especially effective in cultivating pragmatic sensitivity. Unlike written texts, spoken discourse foregrounds implicit meaning, evaluative language, and interactional norms, all of which are crucial for translation competence. By engaging with multimodal input, learners can gradually internalize pragmatic distinctions that are often obscured in purely text-based instruction.

Pedagogically, contrastive analysis should be integrated into input-oriented activities. By systematically comparing native-language and target-language realizations of similar communicative functions, learners become more aware of negative transfer tendencies within their interlanguage systems. Such awareness facilitates the restructuring of interlanguage representations and reduces the likelihood of recurring linguistic pragmatic errors.

## 5.2 Functionalist Pedagogy and Contextual Decision-Making in Translation

While enhanced input contributes to maintaining interlanguage permeability, addressing sociolinguistic pragmatic errors requires pedagogical approaches that directly engage with context, purpose, and audience. Functionalist translation theory provides a particularly suitable framework for this purpose. By prioritizing communicative function over formal equivalence, functionalist pedagogy encourages learners to view translation as a goal-oriented activity rather than a process of linguistic substitution.

In translation teaching, a functionalist approach shifts instructional focus from “correctness” to “appropriateness.” Learners are guided to analyze translation tasks in terms of intended function, target readership, and situational context. This orientation helps destabilize fossilized interlanguage patterns that rely on default equivalence and promotes more flexible pragmatic decision-making.

Classroom activities grounded in functionalist pedagogy may include purpose-driven translation assignments, comparative analysis of multiple translations for different audiences, and guided discussions on alternative translation strategies. Through such activities, learners develop the ability to justify their translation choices pragmatically, which in turn enhances their metacognitive awareness of translation processes.

From an interlanguage perspective, functionalist pedagogy plays a corrective role by challenging stabilized pragmatic assumptions embedded in learners’ interlanguage systems. By repeatedly confronting learners with context-dependent translation decisions, this approach facilitates the gradual reconfiguration of sociolinguistic representations that are otherwise resistant to change.

## 5.3 Reflective Use of CAT Tools in Translation Education

Technology-assisted translation has become an indispensable component of contemporary translation education. While computer-assisted translation (CAT) tools and machine translation systems are often introduced for efficiency and professional relevance, their pedagogical potential extends far beyond instrumental use. From an interlanguage-aware perspective, CAT tools can serve as powerful resources for reflective learning and pragmatic awareness development.

Machine translation systems, despite their increasing sophistication, still exhibit limitations in handling ambiguity, idiomatic expressions, evaluative language, and culturally embedded references. These limitations mirror many of the pragmatic challenges faced by translation learners. By systematically comparing human translations with machine-generated output, learners can identify pragmatic inadequacies and reflect on their own translation choices.

Such comparative activities externalize learners’ interlanguage systems, making implicit assumptions visible and open to evaluation. When learners analyze why machine translations fail pragmatically and how human translators can improve upon them, they engage in higher-order reflection on pragmatic norms and communicative intent. This process is particularly effective in addressing sociolinguistic pragmatic errors associated with interlanguage stability.

In addition, translation assessment and self-evaluation should be integrated into CAT-based activities. Learners can be encouraged to develop individualized evaluation criteria focusing on pragmatic adequacy, audience orientation, and cultural appropriateness. Over time, this reflective evaluation process contributes to the gradual destabilization of fossilized interlanguage patterns and supports sustained pragmatic development.

*Table 2: Reflective use of CAT tools for pragmatic awareness in translation education*

Teaching activity	Learning objective	Focused pragmatic issue	Expected pedagogical outcome
Human–machine translation comparison	Develop pragmatic judgment	Idioms; cultural references	Awareness of pragmatic inadequacy
Error annotation and revision	Identify interlanguage patterns	Fossilized equivalence	Reduction of stabilized pragmatic errors
Peer evaluation using CAT output	Enhance metapragmatic reflection	Audience orientation	Improved contextual decision-making

## Conclusion

From the perspective of interlanguage theory, pragmatic errors in translation can be understood as systematic outcomes of



interlanguage permeability and stability. Linguistic pragmatic errors are largely associated with negative language transfer and insufficient differentiation of target-language usage, while sociolinguistic pragmatic errors are closely linked to stabilized interlanguage patterns and cultural fossilization.

This study argues that pragmatic failure in translation should not be viewed merely as an individual performance issue, but as a pedagogically meaningful indicator of learners' interlanguage development. By adopting interlanguage-aware teaching strategies, including enhanced target-language input, functionalist translation pedagogy, and reflective use of CAT tools, translation education can more effectively address the root causes of pragmatic errors.

Reducing pragmatic errors is essential for ensuring effective intercultural communication through translation. Future research may further explore empirical classroom-based studies to test the effectiveness of these pedagogical strategies and refine their application in different translation teaching contexts.

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# Research on the Innovation of the Carrier of the Vocational Education-Enterprise Cooperation System from the Perspective of Industry-Education Integration

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**Abstract:** The integration of industry and education is the core engine for the high-quality development of vocational education in the new era. The carrier of the school enterprise cooperation system is the key support for the implementation of industry education integration, and its innovation level directly determines the adaptability of vocational education to industry needs. This article is based on the current research status of vocational education school enterprise cooperation system carriers at home and abroad, combined with the practice of vocational education reform in China. It systematically analyzes the problems of theoretical lag, single mode, and insufficient collaboration in the current school enterprise cooperation system carriers, and constructs an innovative framework from the theoretical system, research perspective, and content dimension. It explores the construction path and operation mechanism of diversified system carriers, integrates digital transformation and diversified collaboration concepts, enriches the research depth and practical breadth, and provides solid theoretical support and feasible practical reference for promoting the deep integration of vocational education school enterprise cooperation and serving industry upgrading.

**Keywords:** Integration of Industry and Education; Vocational Education; School Enterprise Cooperation; Institutional Carrier; Innovation Path

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## 1. Introduction

The Implementation Plan for National Vocational Education Reform clearly proposes to deepen the integration of industry and education, school enterprise cooperation, and promote the resonance between vocational education and industrial development. With the deepening implementation of the Double High Plan and the rapid iteration of emerging industries, technological changes and industrial upgrading have put forward higher requirements for vocational education talent cultivation. Vocational education is facing the practical challenge of accurately matching the supply side of talent cultivation with the demand side of the industry<sup>[1]</sup>. The carrier of the school enterprise cooperation system, as the core link connecting the education chain, talent chain, industry chain, and innovation chain, undertakes multiple functions such as resource integration, collaborative education, and technology research and development, and is an important support for achieving deep integration of industry and education<sup>[2-3]</sup>. However, the traditional carrier model is constrained by concepts, mechanisms<sup>[4]</sup>, and resources, making it difficult to meet the high-quality development needs of vocational education in the new era<sup>[5]</sup>, and unable to

effectively solve the problem of talent cultivation being disconnected from industry demand<sup>[6-7]</sup>.

Currently, although China's vocational education school enterprise cooperation has achieved certain results under policy promotion and various cooperation carriers have gradually emerged, there are still many shortcomings in the institutional carriers<sup>[8]</sup>. Some cooperation carriers are merely formalities, lacking stable operating mechanisms and institutional constraints, and cooperation relationships rely heavily on short-term interests to maintain, making it difficult to form a long-term cooperation pattern; Carrier innovation focuses on traditional industries, but lacks adaptability to emerging formats and digital transformation trends<sup>[9-10]</sup>. Professional settings and curriculum system updates lag behind industrial technological changes, and cannot match the industry's demand for new technology and skilled talents; The coordination mechanism among multiple stakeholders is not perfect, the motivation for enterprise participation is insufficient, the bridging role of industry associations has not been fully utilized, and the government's guidance and regulation efforts and precision need to be improved, resulting in frequent problems such as imbalanced resource allocation, difficulty in balancing interests and demands, and vague division of responsibilities in the cooperation process. In this context, systematic research on the innovative path of vocational education school enterprise cooperation system carrier from the perspective of industry education integration, solving cooperation difficulties, and constructing a new system carrier that adapts to industrial development and education reform, has important theoretical value and practical significance for promoting high-quality development of vocational education, assisting industrial transformation and upgrading, and building a skilled society.

Domestic and foreign research has clearly identified the core position of the carrier of school enterprise cooperation system in the development of vocational education, forming a number of theoretical achievements and practical models with reference value. The carrier model of school enterprise cooperation in foreign vocational education has become mature after long-term development, forming distinctive development paths. However, influenced by institutional background, industrial structure, and cultural traditions, its core logic and implementation path are difficult to directly apply to the practice of vocational education in China. It needs to be localized and adapted according to China's national conditions. Domestic research mostly revolves around traditional carrier models. Although breakthroughs have been made in some areas, there are still common problems such as a disconnect between theory and practice, insufficient adaptability to emerging business models, and imperfect mechanisms for stakeholder collaboration. Existing research mostly focuses on a single type of carrier, lacking a systematic construction of the carrier system. The exploration of the integration of digital technology and carriers is not deep enough, making it difficult to support the promotion of school enterprise cooperation to a deeper level. At the critical stage of high-quality development of vocational education in our country, it is urgent to break through the limitations of traditional research and achieve carrier innovation from three dimensions: theory, perspective, and content. We need to construct a vocational education school enterprise cooperation system carrier system that is in line with China's national conditions, adapts to industry needs, and is both systematic and forward-looking.

This article takes the vocational education school enterprise cooperation system as the research core, and comprehensively sorts out the research status and practical experience at home and abroad through a combination of literature research, case analysis, and empirical research. It absorbs cutting-edge concepts such as digital governance and stakeholder collaboration, clarifies the core goals and content of carrier innovation, constructs a multidimensional innovation framework, and proposes targeted optimization strategies. The research aims to promote the transformation of vocational education school enterprise cooperation from shallow docking to deep integration, break down traditional cooperation barriers, improve collaborative education mechanisms, inject new momentum into the high-quality development of vocational education, and achieve resonance between vocational education and industrial development.

## **2. The core content and framework construction of innovation in the carrier of school enterprise cooperation system from the perspective of industry education integration**

### **2.1 Innovation dimensions and core content**

Breaking through the limitations of traditional research, integrating interdisciplinary theories such as education, management, and economics, absorbing cutting-edge achievements such as stakeholder theory, collaborative governance theory, and digital governance theory, and constructing a systematic theoretical framework for the carrier of school enterprise cooperation

system. Focusing on the problem of theoretical lag, deepening the analysis of the connotation of carriers, clarifying the constituent elements, operating mechanisms, and influencing factors of carriers, and clarifying the inherent relationship between carrier innovation, industry education integration, and industrial upgrading. Strengthen the research on the theory of multi subject collaboration, deeply analyze the interests and role positioning of enterprises, schools, students, industry associations, governments and other entities, break down the barriers to collaboration between entities, and build a multi subject collaboration mechanism with clear rights and responsibilities, shared interests, and efficient collaboration, providing solid theoretical support for carrier innovation.

From a single institutional perspective to a multi stakeholder perspective, comprehensively examine the construction and operation of the school enterprise cooperation system carrier, take into account the interests and demands of all parties, balance the educational and industrial attributes, and achieve the scientific and inclusive innovation of the carrier. At the same time, based on the development trend of emerging industries and new business forms, we focus on carrier innovation under the background of digitization and intelligence, deeply integrate digital technology with carrier construction, explore the construction path and operation mode of digital carriers, and enhance the adaptability of carriers to industrial changes. Breaking through regional and industry limitations, considering carrier layout and resource allocation from a global perspective, promoting the alignment of carrier construction with regional industrial layout and national industrial strategy, and enhancing the forward-looking and systematic innovation of carriers.

Focusing on the innovation of emerging industry carriers, keeping up with the trend of industrial digitization and intelligent transformation, exploring school enterprise cooperation carrier models in digital economy, new energy, high-end manufacturing and other fields, and promoting resonance between carrier construction and industrial development. Strengthen research on cultural integration and collaborative innovation, explore effective paths for the integration of school enterprise culture, organically integrate corporate culture with campus culture, consolidate cooperation consensus through cultural identity, cultivate collaborative innovation culture, promote deep upgrading of cooperation, and build a cooperative culture that combines educational attributes and industrial characteristics. Improve the evaluation and supervision mechanism for carriers, establish a multidimensional and scientific evaluation system, conduct comprehensive evaluations from aspects such as talent cultivation quality, resource utilization efficiency, cooperation and collaboration, and industrial service capabilities, establish a dynamic adjustment mechanism, and ensure the efficient operation and sustainable development of carriers.

## **2.2 Construction of Innovation Framework**

Based on the above innovative content, a three-dimensional integrated innovation framework for the carrier of school enterprise cooperation system is constructed, which includes theoretical support dimension, carrier type dimension, and operational guarantee dimension. Each dimension is interrelated and collaborates to form a complete innovation system, providing systematic support for carrier innovation practice.

The theoretical support dimension is based on interdisciplinary integration theory, integrating industry education integration theory, collaborative governance theory, human capital theory, absorbing stakeholder theory and digital governance concept, and constructing a theoretical foundation for carrier innovation. Through theoretical innovation, clarify the direction, principles, and paths of carrier innovation, clarify the interactive relationships and mechanisms between various subjects, provide solid theoretical guidance for carrier construction, and avoid blind and arbitrary carrier innovation. At the same time, strengthen the linkage between theory and practice, improve the theoretical system through practical feedback, and form a virtuous cycle of mutual promotion between theoretical innovation and practical exploration.

Construct a diversified carrier system based on the dimension of carrier types, including physical carriers and virtual carriers, single carriers and composite carriers, forming a carrier pattern of complementary advantages and collaborative linkage. The physical carrier focuses on industrial colleges, school enterprise cooperation bases, joint research and development centers, etc., strengthens the practical education function, builds a platform for connecting real production scenarios with teaching practice, and promotes the deep integration of theoretical teaching and practical training. Virtual carriers rely on digital technology to build virtual simulation training platforms, online course co construction platforms, etc., breaking through the limitations of time and space, expanding the breadth and depth of cooperation, and solving the problems faced

by traditional training such as resource shortages and limited scenarios. Integrating multiple resources through composite carriers, building an integrated platform for industry, academia, research and application, achieving collaborative promotion of talent cultivation, technology research and development, achievement transformation, and social services, and creating a comprehensive and multi-level cooperative ecosystem.

The operational guarantee dimension constructs a guarantee system from three levels: policy, mechanism, and resources, providing strong support for carrier innovation. At the policy level, improve relevant laws and regulations on the integration of industry and education, clarify the rights and obligations of all parties, increase policy support, strengthen policy implementation, optimize policy supply structure, form a normalized policy support mechanism, and create a good cooperation environment. At the mechanism level, establish a multi-party collaboration mechanism, interest distribution mechanism, evaluation and supervision mechanism, clarify the boundaries of rights and responsibilities of all parties, take into account the interests and demands of all parties, and ensure the standardized and efficient operation of the carrier. At the resource level, we will strengthen the guarantee of teachers, funds, equipment, technology and other resources, build a diversified resource supply system, promote resource sharing and optimized allocation, strengthen the construction of a "dual teacher" teaching staff, improve the quality of resource supply, and provide sufficient resource support for carrier innovation.

### **3. The practical path of innovation in the carrier of school enterprise cooperation system from the perspective of industry education integration**

#### **3.1 Optimize the construction of physical carriers and strengthen the practical education function**

Upgrade traditional physical carriers, upgrade existing school enterprise cooperation bases, industrial colleges, and other carriers, break free from the constraints of traditional cooperation models, clarify the rights, obligations, and responsibilities of both schools and enterprises in carrier construction, and build an equal, mutually beneficial, and long-term stable cooperative relationship. Optimize the carrier management and operation mode, establish a scientific decision-making mechanism and supervision system, promote the physical operation of carriers, improve daily management and assessment mechanisms, and avoid cooperation becoming a formality. Improve the governance structure of the Industrial College, establish a collaborative governance model between schools and enterprises, promote the joint participation of both parties in major decisions such as development planning, professional settings, curriculum development, faculty construction, and practical training management, achieve deep integration of education and industry development, and enhance the efficiency of sports personnel and industry service capabilities.

Create physical carriers for emerging industries, combine the development needs of emerging industries with technological trends, construct targeted physical carriers, and promote precise integration between carrier construction and industrial layout. In the field of digital economy, joint enterprises are building digital skills training bases, updating digital teaching equipment and software resources, introducing cutting-edge industry technologies and projects, and cultivating digital technology skilled talents. In the field of high-end manufacturing, we will jointly establish a precision manufacturing joint laboratory, focus on key industrial technologies and common problems for research, achieve synchronous promotion of technology research and development and talent cultivation, and promote the transformation and application of scientific research achievements. In the field of modern service industry, we aim to create a training center that integrates industry and education, optimize service scenarios and teaching resources, integrate intelligent service technology and concepts, and achieve deep integration between teaching and service processes. Through carrier innovation, promote precise matching between vocational education majors and emerging industry demands, and enhance the pertinence and adaptability of talent cultivation.

#### **3.2 Developing virtual carriers and expanding cooperation space**

Build a virtual simulation training platform, relying on advanced technologies such as virtual reality, artificial intelligence, and big data, to build a cross regional and cross industry virtual simulation training platform, simulate real production scenarios and workflows, and solve the problems of resource shortage, high risks, and limited scenarios faced in traditional training. The platform integrates technical resources from multiple enterprises and teaching resources from vocational colleges, achieving high-quality resource sharing, providing students with diverse practical training opportunities, helping them familiarize themselves with job operation norms and technical requirements, and enhancing practical skills



and emergency response capabilities. Relying on virtual platforms to carry out personalized practical training teaching, customized training content and processes based on students' cognitive characteristics, career planning, and skill foundations, promoting hierarchical teaching and personalized guidance, meeting the learning needs of different students, and improving the quality of practical training teaching.

Build an online collaborative innovation platform, establish virtual platforms such as school enterprise online course co construction platform and technology research and development exchange platform, break the limitations of time and space, and promote deep cooperation between schools and enterprises in curriculum development, teacher training, technology research and development, and achievement transformation. Through online platforms, enterprise technicians can deeply participate in course design, teaching guidance, and textbook development, integrating cutting-edge industry technologies, job requirements standards, and practical work cases into course content to enhance the practicality and pertinence of the course. College teachers can participate in enterprise technology research and development, project tackling, and technological transformation, understand industrial technology dynamics and job demand changes, enhance professional practical and scientific research innovation capabilities, and achieve two-way empowerment of school enterprise talents. Utilize the platform to collect industry dynamics, enterprise needs, and technical information, establish a dynamic adjustment mechanism, timely optimize teaching content, professional settings, and talent development plans, and enhance the adaptability of talent development to industry needs.

### **3.3 Building a composite carrier to achieve collaborative development**

To create an integrated carrier for industry university research and application, integrating resources from various sources such as universities, enterprises, and research institutions, and constructing a composite carrier that integrates talent cultivation, technology research and development, achievement transformation, and social services. The carrier focuses on key technologies and common problems in the industry, carries out joint research and development and achievement transformation, forms cross disciplinary and cross unit R&D teams, promotes the sharing of scientific research resources and complementary advantages, and accelerates the industrialization process of technological achievements. Timely integrate research and development achievements into the teaching process, update teaching content and methods, develop project-based courses and practical training materials, and promote deep integration between teaching research and industry needs. Relying on the carrier to carry out project-based teaching, allowing students to participate in real research and development projects and production practices, accumulate practical experience, enhance innovation ability and job adaptability, and achieve coordinated promotion of talent cultivation, technology research and development, and achievement transformation.

Building a regional carrier for the integration of industry and education, relying on regional industrial clusters, constructing a regional public service platform for the integration of industry and education, integrating resources such as vocational colleges, enterprises, industry associations, and governments within the region, and providing comprehensive services for school enterprise cooperation. Establish information docking channels on the platform, break down communication barriers between schools and enterprises, release industry talent demand information, university education resource information, and cooperation project information, and promote precise resource matching. Establish a dynamic monitoring mechanism for industrial talent demand, track regional industrial development trends and changes in talent demand, and guide vocational colleges to optimize their professional structure and talent training programs. Carry out skills training, technical exchanges, competition exhibitions and other activities, build a platform for school enterprise exchange and cooperation, and enhance the overall level of regional skilled talents and industrial competitiveness. Through the construction of regional carriers, the deep integration of vocational education and regional economy can be achieved, promoting the transformation and upgrading of regional industries and the high-quality development of vocational education.

### **3.4 Improve operational mechanisms to ensure sustainable development of carriers**

Establish a multi-party collaborative mechanism, clarify the role positioning of government, universities, enterprises, industry associations and other entities, and build a collaborative mechanism guided by the government, led by universities, participated by enterprises, and coordinated by industries. The government strengthens policy support and macroeconomic regulation, improves laws and regulations and incentive policies, optimizes resource allocation, creates a good cooperation



environment, and strengthens supervision and guidance of the cooperation process. Colleges and universities leverage their educational resource advantages, proactively connect with enterprise needs, optimize talent training models, strengthen faculty development, and enhance their ability to carry sports personnel and provide industry services. Enterprises should strengthen their main responsibility, actively participate in talent cultivation, technology research and development, and carrier construction, provide practical resources, technical support, and job docking services, and achieve win-win cooperation between industry and education. Industry associations play a bridging role, providing services such as industry standards, talent evaluation, and technical exchanges, promoting standardized cooperation and development, reflecting industry demands, and assisting the government in industry management.

Optimize the distribution of benefits and incentive mechanisms, establish a reasonable benefit distribution mechanism, take into account the interests and demands of both schools and enterprises as well as students, and achieve mutual benefit and win-win results. In terms of technology research and development achievement transformation, it is necessary to reasonably divide the profit distribution ratio, fully consider the investment and contribution of all parties in the research and development process, and stimulate the innovation enthusiasm of all parties. In terms of talent cultivation, enterprises prioritize hiring students trained through cooperative carriers to reduce recruitment and training costs; Colleges provide technical support, talent training, and scientific research services to enterprises, helping them upgrade their technology and build their talent teams, forming a symbiotic pattern of interests. At the same time, we will improve incentive policies, provide policy support and recognition publicity to enterprises that actively participate in school enterprise cooperation and achieve significant results, commend and reward outstanding teachers and students with development support, stimulate the enthusiasm of all parties to participate, consolidate cooperation achievements, and promote continuous deepening of cooperation.

Establish a scientific evaluation and supervision mechanism, establish a multidimensional and full process carrier evaluation system, with evaluation indicators covering aspects such as talent cultivation quality, technological research and development achievements, resource utilization efficiency, cooperation satisfaction, and industrial service capabilities. Adopt a combination of quantitative and qualitative evaluation methods to regularly evaluate the effectiveness of carrier operation. Introduce third-party evaluation agencies to ensure the objectivity and impartiality of evaluation results, and avoid bias caused by stakeholders' self-evaluation. Establish an application mechanism for evaluation results, linking evaluation results with resource allocation, policy support, and assessment rewards and punishments, and promoting carrier optimization and upgrading. At the same time, establish a supervision mechanism, strengthen the supervision and management of the construction and operation process of the carrier, clarify the supervision subject and responsibilities, improve the supervision process and feedback mechanism, timely discover and solve problems, standardize the behavior of all parties, and ensure the sustainable development of the carrier.

Strengthen the empowerment of digital governance, rely on technologies such as big data and artificial intelligence, build a digital governance platform for the integration of industry and education, integrate resources and data information from all parties, and achieve intelligent management of carrier operation. The platform monitors the real-time operation status of the carrier, collects and analyzes various data during the cooperation process, evaluates the effectiveness and existing problems of the cooperation, and provides data support for decision-making optimization. Realize intelligent matching between talent demand and training supply, and improve cooperation accuracy and efficiency. Build online communication and collaborative office channels, simplify cooperation processes, improve cooperation efficiency, promote the transformation of carrier operations towards digitization and intelligence, and enhance carrier governance capabilities and service levels.

## 5. Conclusion

From the perspective of the integration of industry and education, the innovation of the carrier of vocational education school enterprise cooperation system is the core path to promote the high-quality development of vocational education, and it is also a key measure to solve the mismatch between talent training supply and demand and the transformation and upgrading of the service industry. This article draws the following conclusions through systematic research.

The current research on the carrier of school enterprise cooperation system at home and abroad has problems such as

theoretical and practical disconnection, single mode, and insufficient collaboration, which are difficult to meet the needs of high-quality development of vocational education and industrial transformation and upgrading in the new era. It is urgent to innovate from the theoretical, perspective, and content dimensions, build a carrier system that is in line with China's national conditions, and solve the traditional cooperation dilemma. The core goal of carrier innovation is to reveal the laws of development, improve the theoretical system, construct development models, and innovate training models. Its effectiveness is influenced by multiple factors such as carrier type, resource investment, and degree of cooperation. It is necessary to comprehensively consider the demands of all parties, balance educational and industrial attributes, achieve diversified collaborative development, and enhance the adaptability and operational efficiency of carriers.

Building a three-dimensional integrated innovation framework of theoretical support, carrier types, and operational support can effectively enhance the innovation level and operational efficiency of carriers by optimizing physical carriers, developing virtual carriers, constructing composite carriers, and improving operational mechanisms. This will promote the transformation of school enterprise cooperation from shallow docking to deep integration, and form a comprehensive, multi-level, and sustainable school enterprise cooperation ecosystem. Carrier innovation needs to strengthen digital empowerment and diversified collaboration, integrate industry development trends and era characteristics, and build a long-term cooperation mechanism with clear rights and responsibilities, shared interests, and shared risks. Practice has shown that diversified and composite carrier models can effectively integrate resources from all parties, achieve precise alignment between school enterprise collaborative education and industry demand, improve the quality of talent cultivation and industry service capabilities, and have good promotion value and application prospects.

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# A Study on the Temporal Agenda Effects of Media and the Public in the Context of Online Agenda-Setting

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**Abstract:** With the development of digital technology and the proliferation of new media, the agenda-setting power of traditional media has gradually weakened, making online agenda-setting a research hotspot. Using the flood incident in Zhuozhou, Hebei Province as a case study, this paper employs time-series analysis to examine the temporal characteristics and causal relationships among traditional media, social media, and public agendas during emergencies. Data sourced from Weibo and the Wises News database were cleaned and analyzed. Results indicate: public agenda exerts stronger influence on social media during the early stages of an event, while traditional media gradually takes the lead in the middle and later stages; traditional media's agenda-setting power over social media follows a similar pattern. Based on these findings, this study recommends leveraging social media's real-time dissemination advantages during emergencies while strengthening traditional media's guiding role in the middle and later stages to calm public sentiment and stabilize public opinion. This research provides new empirical support and methodological innovation for agenda-setting theory.

**Keywords:** Media Agenda; Public Agenda; Temporal Relationship; Public Opinion Dissemination

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## 1. Introduction

With the rapid advancement of digital information technology and continuous economic progress, the internet's role in social life has grown increasingly prominent. As traditional media's agenda-setting power gradually diminishes, the rise of social media has enabled more diverse and liberated public expression. During sudden incidents, on-site individuals often become the primary source of information dissemination through social media. Emergent events typically encompass natural disasters, accidents, public health crises, and social security incidents, characterized by suddenness, complexity, destructiveness, persistence, and urgency. During their dissemination, such events exhibit rapid speed, broad reach, and strong anonymity, potentially triggering widespread rumors that exacerbate public panic and may even lead to abnormal collective behavior, threatening social stability.

Understanding the interactive mechanisms between media and public agendas becomes particularly crucial when confronting sudden events. Time series analysis, a research focus since the 20th century, provides scientific tools for examining the dynamic shifts in media and public agendas throughout an event's entire lifecycle. Through time series analysis, we can uncover the temporal characteristics and causal relationships between media and public agendas, predict future event

trajectories, and assist media and policymakers in better guiding public discourse while reducing uncertainty and confusion in information dissemination. Therefore, integrating time series analysis into agenda studies of sudden events not only represents theoretical innovation but also provides scientific support for practical public opinion management and social governance, thereby promoting harmonious and stable societal development.

## 2. Research Review

The agenda-setting theory was first proposed by American scholars Maxwell McCombs and Donald Shaw in their 1968 “Town of Chapel Hill Study.” It primarily explains how mass media can influence public attention and perception of events through varying degrees of prominence in reporting. Their 1972 publication *The Agenda-Setting Function of the Mass Media* marked the formal establishment of this theory (McCombs M, 2008). Subsequently, the theory underwent multiple expansions and developments, with the 1997 introduction of “attribute agenda setting” enriching its conceptual framework (McCombs M et al., 1997). With the advent of the internet era, traditional agenda-setting theory gradually struggled to adapt to the new media environment. In 2014, Guo Lei and McCombs et al. proposed the “network agenda setting theory,” emphasizing that media can reconstruct public memory networks by linking new and old information through cognitive networks (Guo L, 2015). This theory breaks through the traditional framework, offering a new perspective for agenda-setting research.

In recent years, with the rapid development of new media, network agenda setting has become a research hotspot. Studies focus on comparisons between emerging and traditional media in agenda setting, the dynamic changes in network agenda structures, and their impact on public cognition (Xi Y & Luo H, 2018). Particularly in social media environments, the public is not only passive recipients of agendas but also active agenda-setters. Related research encompasses multiple dimensions, including the interactive agendas between emerging and traditional media, networked cognitive structures, and time-lag effects. However, compared to international research, studies in China on online agenda setting began relatively late, and empirical research within the new media context remains underdeveloped.

As a crucial statistical method, time series analysis traces its application back to ancient Egyptians observing the Nile’s flood patterns (Li D, 2018). In the 1920s, Jule first proposed the autoregressive (AR) model, marking the entry of time series analysis into the field of mathematical statistics (Luo F & Wu C, 2009). In the 1970s, Box and Jenkins developed the ARIMA model, further refining the theoretical framework of time series analysis and establishing a comprehensive analytical process encompassing data smoothing, model identification, parameter estimation, and model testing (Box Get al., 1970). China only began in-depth research on time series analysis methods in the 1980s, achieving certain progress in the field of nonlinear time series, such as studies on the stationarity of nonlinear autoregressive models. Application domains include psychology, financial analysis, and social welfare research. Zhao Bei and Zhang Hongzhong used the COVID-19 pandemic as a case study to establish a VAR model, employing Granger causality and impulse response analysis. They revealed temporal lags between social bots, media, and the public. The research found that both social bots and media exert positive influences on the public agenda, with media’s contribution to the public agenda gradually increasing over time (Zhao B & Zhang H, 2023). In these fields, time series analysis is employed to uncover patterns in data changes, forecast trends, and model complex social phenomena.

Despite significant achievements in both theoretical and applied research on time series analysis, certain limitations persist. Domestic research generally lacks systematic approaches and theoretical depth, with models requiring further optimization in predictive accuracy and applicability. Moreover, as data within the new media context grows increasingly complex and dynamic, existing models exhibit limited analytical capabilities for networked time-series data. Future research should prioritize model innovation and optimization, strengthen the integration of theoretical research with practical applications, and leverage international academic exchanges to absorb advanced methodologies. This approach will elevate the standard of time-series analysis research domestically, thereby providing scientific support for agenda-setting studies in the era of networked data.

## 3. Research Design

### 3.1 Research Event

This study focuses on the severe flooding in Zhuozhou City triggered by Typhoon Duli starting July 29, 2024. Torrential rains caused extreme flooding in Zhuozhou, with water depths exceeding 6 meters, affecting 130,000 people. The primary cause of the flooding was the immense rainfall, which exceeded the design standards of Zhuozhou's flood control infrastructure, resulting in insufficient flood discharge capacity. Rescue operations proved highly complex, with teams in some areas needing to clear debris before effective assistance could be provided. The National Flood Control and Drought Relief Headquarters and social rescue forces responded urgently, dispatching expert teams to the disaster zone to support relief efforts and initiate post-disaster recovery work. As floodwaters gradually receded, reconstruction efforts commenced intensively. This study collected relevant reports and comments from Weibo platforms and traditional media using data collection tools (such as Souke and Baidu Baike). The data is categorized into two main types: media reports and public comments, covering content from official media, commercial media, and influential individual accounts.

This study confined its timeframe to the entire process of the public opinion cycle surrounding the Zhuozhou, Hebei flood incident: incubation, outbreak, peak, and decline phases. Data collection spanned 17 days of relevant reports and blog posts from July 30 to August 16, 2023. According to the data, July 30–31 constituted the emergence phase; August 1–3 represented the outbreak phase; August 4–5 marked the peak phase; and August 6–16 formed the decline phase. This classification of public opinion stages was determined based on the characteristics of reporting volume across different media types.

### 3.2 Research Questions and Hypotheses

This study aims to examine the relationship between media coverage and the public's temporal agenda during sudden events, as well as the patterns of their evolution. Specific questions include: How do the temporal characteristics of media coverage influence public attention to issues? What are the interactive relationships and causal effects between media and public agendas? How do the issues receiving media and public attention change over time during the course of an event? Through analyzing these questions, the study seeks to reveal the mechanisms of information dissemination between media and the public, understand the role of media in public opinion guidance, and provide a basis for public sentiment management and media strategies. Using the "Hebei Zhuozhou Heavy Rain" incident as a case study, the research will explore public opinion guidance strategies and their dissemination patterns during sudden events.

The hypotheses of this study are as follows:

H1: At different stages of sudden events, traditional media, social media, and the public exhibit distinct leadership and followership relationships in the temporal dimension of agenda setting.

H2: Throughout the event lifecycle, agenda setting by traditional media, social media, and the public displays different temporal characteristics.

H3: In the trend of public opinion shifts, specific trend characteristics emerge among traditional media, social media, and the public.

H4: Does a causal relationship exist among the agendas of traditional media, social media, and the public in the trajectory of public opinion?

### 3.3 Research Methodology

This study employs ARIMA and VAR models from time series analysis to examine and forecast the temporal evolution of media and public agendas during sudden events. First, relevant concepts and model developments are reviewed. Subsequently, these models are applied to analyze the "Hebei Zhuozhou Heavy Rainfall" incident through collecting and organizing related report data. Time-series dynamic data of the event is obtained via observation, investigation, and statistical methods. Based on this data, correlation analyses are conducted, and appropriate random models are selected for curve fitting. This reveals the underlying patterns of change in media and public agendas and forecasts their future trends. The research not only examines surface-level developmental patterns but also delves into the intrinsic mechanisms driving these changes. Ultimately, through model analysis, predictive conclusions regarding the evolution of media and public agendas are drawn, providing scientific grounds for public opinion management and strategic adjustments.

## 4. Data Analysis Results

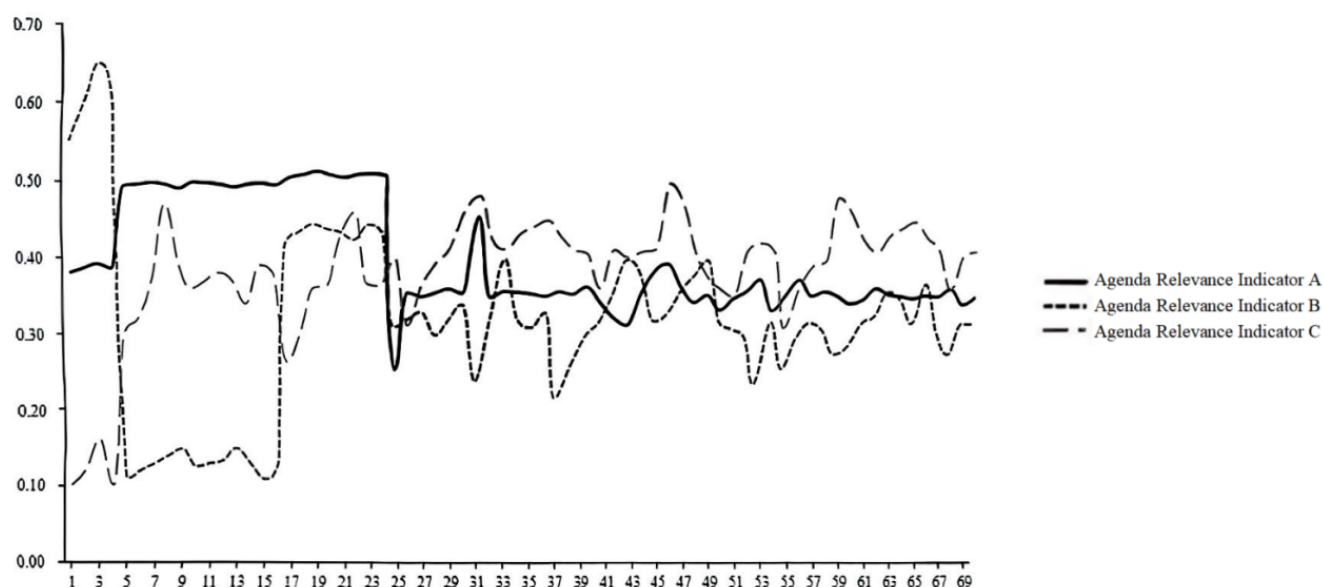
### 4.1 QAP Index of Agenda Relevance



The QAP index serves as a crucial tool for testing hypotheses and predicting future trend shifts in target subjects. This study constructs daily-count time series data using three primary subjects: public agenda, traditional media agenda, and social media agenda. By modeling the time series data through the ARIMA model and analyzing it via Granger causality tests, we delve into the interrelationships among these three subjects across different stages of public opinion surrounding sudden events.

The findings reveal significant differences in the QAP correlation indices between public and media agendas across distinct public opinion phases. As illustrated in Figure 1, the evolving trends of these indices across phases reflect the interactive dynamics and temporal characteristics among the three agenda-setting entities. These analyses enhance our understanding of the dynamic mechanisms of agenda setting, providing quantitative foundations for forecasting public opinion trends. Among these, Agenda Correlation Index A represents the QAP index between traditional media and the public, Agenda Correlation Index B represents the QAP index between social media and the public, and Agenda Correlation Index C represents the QAP index between traditional media and social media.

Figure 1: Agenda Correlation Index of Traditional Media, Social Media, and the Public as Public Opinion Develops



## 4.2 Stationarity Analysis and Determination of Lag Order

In time series analysis, stationarity is a crucial prerequisite for model establishment. One commonly used stationarity test is the Augmented Dickey-Fuller (ADF) test, also known as the unit root test. This method assesses whether a time series is stationary by testing the null hypothesis that the series is non-stationary. ADF test results typically include critical values, t-statistics, and p-values. If the p-value is less than the significance level (e.g., 0.1 or 0.05), the null hypothesis can be rejected, indicating the series is stationary. In research, if a time series is non-stationary, first- or second-order differencing is applied until stationarity is achieved. If the series remains non-stationary after second-order differencing, the second-order difference is adopted as the final differencing order.

For the time series data of the agenda relevance index, the initial ADF test yielded a t-statistic of -1.796 and a p-value of 0.383, exceeding the 0.1 significance level. The critical values at 1%, 5%, and 10% significance levels were -3.532, -2.906, and -2.590, respectively. Since the null hypothesis could not be rejected, the sequence was determined to be non-stationary. After applying first-order differencing to the data and re-running the ADF test, the p-value was 0.000, less than 0.01. At a 99% confidence level, the null hypothesis can be rejected, confirming the series is now stationary. Consequently, the ARIMA model parameters were determined as follows: autoregressive order (3), differencing order (0), and moving average order (1).

## 4.3 Autoregressive Integrated Moving Average Model

The Autoregressive Integrated Moving Average (ARIMA) model, also known as the Box-Jenkins model, is a widely used method for analyzing and modeling various time series data. It accommodates the combined effects of trend variations,



seasonal fluctuations, and random disturbances within the sequence. (Li Na, Li Yong, Feng Jiacheng, 2021.) The ARIMA model parameters were determined as follows: autoregressive order (3), differencing order (1), and moving average order (1).

#### 4.3.1 Future Trends in the Relationship Between Traditional Media and the Public Agenda

Table 1: ARIMA (3,1,1) Model Parameters for the Relationship Between Traditional Media and the Public Agenda

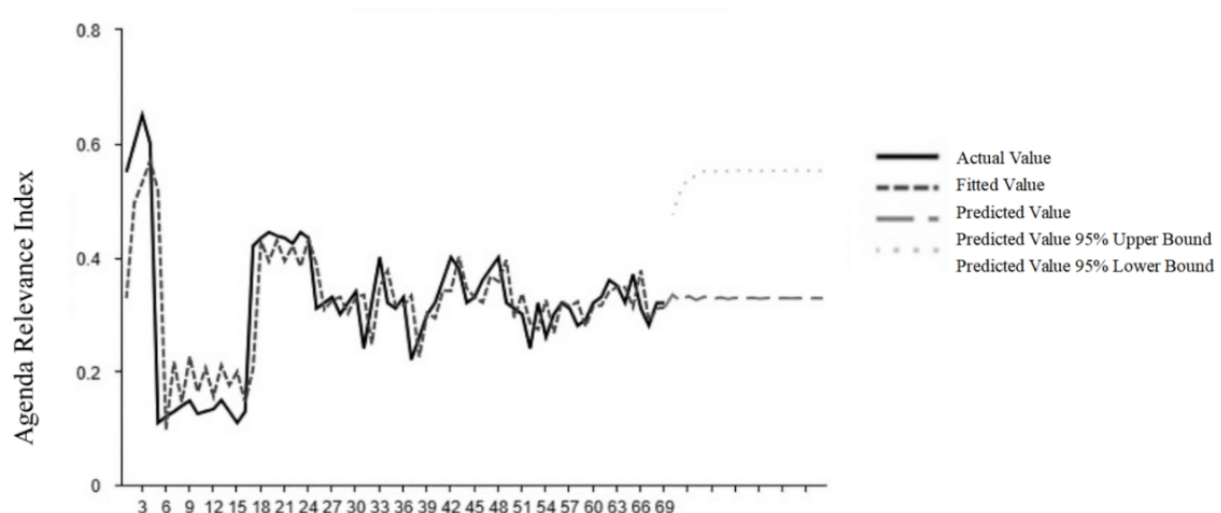
Term	Symbol	Symbol	Standard Error	z-value	p-value	95% CI
Constant term	c	-0.000	0.001	-0.362	0.717	-0.002 ~ 0.001
AR parameter	$\alpha_1$	0.610	0.209	2.922	0.003	0.201 ~ 1.020
	$\alpha_2$	0.160	0.395	0.404	0.686	-0.615 ~ 0.935
	$\alpha_3$	0.037	0.408	0.090	0.928	-0.762 ~ 0.836
MA Parameters	$\beta_1$	-0.980	0.297	-3.295	0.001	-1.562 ~ -0.397
AIC Value: -238.322 BIC Value: -225.005						

Researchers conducted a time-series analysis of the agenda relevance index over 17 days and forecasted trends for the subsequent four days. Results indicated that during the initial phase of the event, the public agenda exerted minimal influence on traditional media agendas, reflecting traditional media's lagging agenda-setting and failure to respond promptly to public opinion. Over time, the public agenda's influence on media fluctuated slightly: rising from Day 17 to Day 18, dipping slightly from Day 18 to Day 19, declining continuously from Day 19 to Day 20, and then rising again marginally from Day 20 to Day 21. This indicates that the public agenda exerts a certain degree of persistence on traditional media. Traditional media's delayed response to public feedback may lead to the spread of irrational opinions, potentially causing social unrest. With the proliferation of social media, the public has emerged as agenda-setters capable of influencing traditional media's reporting priorities.

#### 4.3.2 Future Trends in the Relationship Between Social Media and the Public Agenda

Researchers analyzed the agenda correlation index over 17 days using time series analysis and projected trends for the subsequent four days. Results indicate that during the event's early stages, the public agenda exerted significant influence on social media agendas, with this impact gradually diminishing later on. Specifically, the influence surged significantly on Day 18, rose slightly from Days 19 to 20, and then declined slightly from Days 20 to 21. Reverse agenda analysis indicates that public influence on social media exhibits fluctuating growth, reflecting social media's rapid responsiveness and attention to public opinion. During the early stages of public sentiment, the public swiftly generates attention through social platforms, turning issues into hot topics. Later on, as information updates rapidly, the influence of the public agenda diminishes.

Figure 2: Time Series and Forecast Chart of Social Media and Public Agenda QAP Index



### 4.3.3 Future Trend Changes in the Relationship Between Traditional Media and Social Media Agendas

Researchers conducted time series modeling on the 17-day agenda correlation index and forecasted trends for the subsequent four days. Results indicate that during the early stages of public discourse, traditional media exerted relatively weak influence on social media agendas. This reflects traditional media's limitations in guidance and discourse authority, as well as their lag in agenda setting. However, from days 18 to 22, traditional media's agenda-setting efficacy over social media showed a significant upward trend. This indicates its strengthened dominance in the mid-to-late stages of the public opinion event, while the public's voice through social media gradually weakened. Traditional media's values progressively took center stage. This phenomenon stems from the fact that during the early stages, traditional media failed to promptly set the agenda due to time lags, and social media was more influenced by the public agenda, focusing on event information and sentiments. However, in the middle and later stages, faced with vast and complex information, the public and social media tended to rely on authoritative traditional media reports. Leveraging priority access to interviews, rigorous review systems, and credibility and authenticity, traditional media gradually increased their influence on social media agendas.

### 4.4 Granger Causality Test Analysis

As a statistical method, the Granger causality test is typically used to predict the stationarity of time series data and assess causal relationships between variables within the data. However, it is only applicable to variable prediction in econometrics. Before conducting a Granger causality test, unit root tests must be performed on the stationarity of each indicator's time series. Results indicate that during the early stages of public opinion, traditional media exerted limited agenda-setting influence, while social media agendas were significantly shaped by public sentiment. As public discourse evolved, traditional media progressively strengthened their influence over social media agendas, whereas social media's impact on public agendas diminished, revealing pronounced time lags and causal relationships.

Table 2: Granger Causality Test Results

Null Hypothesis H0
'Agenda Relevance Index A' is not a Granger cause of 'Agenda Relevance Index B'
'Agenda Relevance Index A' is not a Granger cause of 'Agenda Relevance Index C'
'Agenda Relevance Index B' is not a Granger cause of 'Agenda Relevance Index A'
'Agenda Relevance Index B' is not a Granger cause of 'Agenda Relevance Index C'
'Agenda Relevance Index C' is not a Granger cause of 'Agenda Relevance Index A'
'Agenda Relevance Index C' is not a Granger cause of 'Agenda Relevance Index B'

\*  $p < 0.05$  \*\*  $p < 0.01$

## 5. Conclusions and Discussion

### 5.1 The temporal agenda exhibits dynamic, complex, and multifaceted characteristics

The shift from agenda lag to instantaneous agendas: "Agenda lag" refers to the time delay between public attention and decision-making. Early research indicated that media agendas required several months to translate into public agendas (Stone G & McCombs M, 1981). The proliferation of new media and social platforms has significantly shortened this lag time. Accelerated information dissemination enables public issues to spread rapidly and influence policy agendas. This shift promotes more democratic, scientific, and transparent policymaking while enhancing governmental responsiveness. However, it also increases policy-making complexity and may lead to short-term decisions dominated by public sentiment. Transition from Static to Dynamic Agendas: With the rise of digital media and social platforms, agenda-setting has shifted from unidirectional dissemination to multidirectional interaction, exhibiting dynamic changes. Research indicates that media agendas demonstrate varying focuses and directions at different times, particularly during emergencies where issues emerge and fade more rapidly. Dynamic agendas accelerate policy responses but also bring challenges like information overload and unfocused public discourse, requiring governments to pay greater attention to public feedback and enhance communication

and collaboration. Iteration from Linear to Networked Agendas: Traditional linear agenda-setting featured one-way information flow, with the public passively receiving content. With advancements in information technology, communication has shifted to interactive, multi-directional networked structures, enabling freer and more flexible interactions between the public and media. This shift offers new avenues for policy-making and social governance but may also lead to issues like information fragmentation and opinion polarization. Governments and platforms must strengthen information oversight to ensure a healthy online environment. From Traditional to Online Public Spheres: The rise of online public spheres has transformed information dissemination, with traditional social spheres gradually transitioning to digital ones. Individuals gain equal voice in cyberspace, and expression becomes more diverse. This shift impacts social structures and cultural forms while also bringing challenges like information overload and privacy breaches, requiring society to navigate new challenges alongside the conveniences of the internet.

## **5.2 Public Opinion Governance Should Shift from Agenda Lag to Agenda Leadership**

This study examines the dynamic relationship among traditional media agendas, social media agendas, and public agendas in agenda-setting, based on time-series data from the flood incident in Zhuozhou, Hebei. Findings indicate that within the reverse agenda-setting framework, the public agenda significantly influenced both traditional media and social media agendas, while traditional media agendas also impacted social media agendas. Specifically, the public agenda exerted strong influence on social media agendas during the early stages of the incident, but its effectiveness gradually diminished as the situation evolved. Conversely, the contribution of public agendas to traditional media agendas steadily increases over time, while the influence of traditional media agendas on social media agendas also grows (Peng B, 2019). This indicates that traditional media retains a dominant position in the middle and late stages of public discourse and plays a crucial role in shaping social media agendas. During the initial phase of sudden events, traditional media agendas exhibit noticeable lag, whereas social media rapidly reflects public sentiment and drives the formation of public opinion. Thus, social media and public agendas dominate this phase. As public sentiment evolves, traditional media gradually becomes the primary force guiding discourse, particularly in steering and controlling public opinion. Moreover, the rise of social media and public agendas highlights the mechanism of media empowerment, enabling the public to engage in free discussion anytime and anywhere, transforming the one-way nature of information dissemination. Current agenda-setting exhibits characteristics of diversity, interactivity, and fluidity. The intertwined influence of traditional media, social media, and the public on agendas has formed a more complex networked agenda. This phenomenon indicates that agenda-setting is no longer a singular linear process but rather the result of multi-party interaction. Overall, the interplay among diverse agenda-setting actors necessitates a time-based approach to guide public sentiment more scientifically. This shift offers fresh perspectives and methodologies for media to navigate public opinion during emergencies.

## **5.3 Establishing Agenda Dominance Through Multi-Dimensional Stakeholder Participation**

In today's highly developed information society, media agenda-setting plays a crucial role in shaping public perception and opinion trends. However, challenges persist due to the lag in media agendas, the influence of emotional media, and the guiding role of dominant agendas (Dong X & Gong H, 2024). To address these issues, media outlets, governments, and the public must collaborate to optimize agenda-setting. First, mitigating the negative effects of media agenda lag is paramount. Such lag often results in delayed, inaccurate information dissemination, potentially misleading the public. To enhance timeliness, media outlets should strengthen collaboration, share information resources, and improve the promptness and accuracy of reporting. Concurrently, elevating public media literacy can bolster information discernment capabilities, reducing misinformation. Furthermore, media outlets should establish effective feedback mechanisms and public opinion guidance systems to adjust reporting content promptly based on public feedback, thereby enhancing public trust and satisfaction. Secondly, emotional media's agenda intervention plays a vital role during socially sensitive periods. At specific times—such as holidays, major events, or sudden crises—emotional media should intervene promptly according to public emotional needs to reduce panic and misunderstanding. The topics selected by emotional media should focus on content that resonates with the public, and appropriate communication methods should be employed to enhance the effectiveness of the intervention. However, media must adhere to principles of truthfulness and fairness during interventions to avoid

misleading the public. Government oversight of media should be strengthened to ensure the legitimacy and effectiveness of such interventions. Finally, the future trajectory of the agenda will depend on the guiding role of dominant agendas. Against the backdrop of networked information dissemination, the diversity of information sources and channels complicates agenda-setting. Technological empowerment and media convergence have made information more diverse and globalized, increasing public access points while heightening the difficulty of discernment. Consequently, the guiding role of dominant agendas becomes particularly crucial. Media must foster interactivity in information dissemination, build credible and impartial communication platforms, and adjust agenda-setting in response to societal needs and evolving times to adapt to changing social environments. Optimizing media agenda-setting requires attention to information timeliness, interactive dissemination, and diversity. By enhancing public media literacy and government oversight, transparency, fairness, and effectiveness in information dissemination can be ensured. This will support the sustainable development of the media industry and foster a healthy public opinion environment.

## 6. Conclusion

This study employs time-series analysis to explore the interactive relationship between media and public agendas during the Zhuozhou flood incident. While the study reveals mechanisms of agenda-setting during emergencies, certain limitations exist. First, data quality is constrained, particularly in the later stages of the event, where data incompleteness affects the accuracy of findings. Second, the treatment of multiple variables is insufficient, and time-series methods struggle to fully capture complex interactive relationships. Future research could integrate qualitative analysis, big data technology, and dynamic models to enhance depth and breadth. Furthermore, the scarcity of relevant domestic and international literature, coupled with translation and comprehension challenges, has hindered in-depth theoretical exploration. Finally, limitations exist in model selection and parameter settings, suggesting the potential adoption of more flexible analytical approaches. Nevertheless, this study offers a fresh perspective on understanding agenda-setting during emergencies. Future research holds promise in further elucidating the interactive mechanisms between media and the public, thereby providing more reliable theoretical support for public opinion guidance and policy formulation.

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## Conflict of Interests

The authors declare that there is no conflict of interest regarding the publication of this paper.

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# Research on Experimental Teaching Reform of Vue.js Course Based on CDIO and Knowledge Graphs

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**Abstract:** With the rapid advancement of information technology and the increasing emphasis on engineering education certification, traditional experimental teaching models exhibit significant limitations in fostering students' abilities to address complex engineering problems. Using the Vue.js front-end development course as a case study, this paper proposes an experimental teaching reform model based on the integration of CDIO and knowledge graphs. The proposed model first constructs a structured, visualized, and interconnected Vue.js knowledge graph to organize course content. Guided by the CDIO (Conceive, Design, Implement, Operate) engineering education framework, the model then restructures the experimental teaching process around authentic projects, dividing it into four stages aligned with six experimental modules. This approach achieves a deeper integration of theoretical instruction and engineering practice. Teaching practice demonstrates that the reform model significantly enhances students' systematic knowledge construction, practical engineering skills, and capacity for innovation and collaboration, thereby offering an effective pathway for preparing learners to meet the evolving demands of the front-end technology ecosystem and the software industry.

**Keywords:** CDIO; Knowledge Graph; Experimental Teaching Reform; Vue.js; Engineering Education

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## 1. Introduction

In the era of the digital economy and intelligent industrial transformation, web front-end development technology has emerged as an essential core competency in the field of software engineering. As a progressive JavaScript framework renowned for its accessibility, Vue.js has achieved widespread industrial adoption due to its strengths in reactive data binding and component-based architecture, rendering it a critical skill for front-end engineers<sup>[1]</sup>. Nevertheless, contemporary university-level Vue.js experimental teaching often suffers from challenges such as fragmented content delivery, insufficient realism in project simulations, and a misalignment between skill development and industry needs. These issues hinder compliance with engineering education standards, such as those outlined in the Chinese Engineering Education Professional Accreditation, particularly in fostering students' ability to address complex engineering problems.

The CDIO (Conceive-Design-Implement-Operate) engineering education model advocates a project-based learning framework that cultivates students' integrated competencies across the complete project lifecycle. This pedagogical approach has achieved widespread adoption and demonstrated significant efficacy in global engineering education<sup>[2]</sup>. Meanwhile,



knowledge graph technology provides sophisticated capabilities for knowledge organization, semantic reasoning, and visualization, thereby addressing the pervasive challenge of "knowledge silos" and facilitating the construction of cohesive knowledge systems<sup>[3]</sup>. Drawing on these foundations, this paper examines the pedagogical application of the prevailing front-end framework Vue.js by integrating the CDIO engineering education philosophy with knowledge graph technology. It introduces an integrated experimental teaching framework that combines the CDIO engineering philosophy with knowledge graph technology. This dual-driven approach, which integrates CDIO with Knowledge Graphs, is designed to synergistically enhance both knowledge acquisition and engineering competency. The proposed framework aims to provide a replicable and scalable model for the reform of front-end development curricula.

## 2. Research Background and Current Situation Analysis

### 2.1 Challenges in Vue.js Experimental Teaching

Current experimental instruction in Vue.js predominantly encounters the following issues: (1) Fragmented knowledge points with weak correlations: Teaching is often linearly structured around isolated modules (e.g., syntax, directives, components), hindering students' ability to comprehend the integrated application logic of these elements in real-world projects. (2) Insufficient project authenticity: Experimental cases are frequently oversimplified or fragmented, lacking complete business workflows and authentic application scenarios, which creates a disconnect from industry practices. (3) Narrow focus in skill cultivation: An overemphasis on syntax and tool usage often sidelines the development of essential engineering competencies such as system design, team collaboration, and innovative iteration. (4) Outdated assessment methods: Evaluation remains predominantly based on final code output and experimental reports, failing to effectively measure process-oriented abilities and comprehensive engineering skills.

### 2.2 Current Applications of CDIO and Knowledge Graph in Education

The CDIO (Conceive-Design-Implement-Operate) engineering education model has been successfully implemented across multiple engineering disciplines. Its "learning by doing" and project-driven philosophy have been proven effective in enhancing students' practical engineering capabilities. For instance, a review of CDIO reforms in Chinese universities noted that this model addresses the classic disconnect between theoretical knowledge and practical application by integrating knowledge acquisition with competency development, yielding significant outcomes in fields like mechanical and electronic engineering<sup>[2]</sup>. Extending this approach, recent studies have applied the OBE-CDIO framework to programming courses to cultivate comprehensive practical skills through project-driven methods<sup>[4]</sup>, and integrated C language programming into automated system projects to provide an "early engineering experience"<sup>[5]</sup>. Notably, graph theory has been employed to optimize the structure of CDIO computing courses, ensuring coherent knowledge point coverage<sup>[6]</sup>. While these studies underscore the broad applicability of CDIO in engineering education, most focus on traditional disciplines, with limited in-depth exploration of its adaptation to modern technology stacks like Vue.js.

Concurrently, knowledge graph technology, representing a deep integration of artificial intelligence and education, demonstrates significant potential for structuring curricular knowledge systems, recommending personalized learning paths, and organizing teaching resources intelligently. Its educational applications are diverse: for example, clustering combined with knowledge graphs has been used to identify at-risk students in online environments by modeling entity relationships<sup>[7]</sup>; cosine similarity-based knowledge graphs enhanced with contextual signals have improved the precision of personalized content recommendations<sup>[8]</sup>; and multi-level knowledge graph generation methods have been shown to boost learning outcomes in online settings<sup>[9]</sup>. Furthermore, knowledge graphs facilitate interdisciplinary learning by linking formal education with resources from platforms like social media<sup>[10]</sup>. Despite these advancements, most applications remain confined to specific scenarios such as risk prediction or content recommendation, with a notable lack of systematic integration with established engineering pedagogical frameworks like CDIO.

Given the demonstrated pedagogical strengths of the CDIO framework and the structural advantages of knowledge graphs, significant potential exists for their integration in technical course design. A key research gap lies in tailoring this integration for specific technology stacks, such as Vue.js. Specifically, it remains unclear how to seamlessly embed knowledge graphs to dynamically interact with the distinct stages of the CDIO cycle (Conceive, Design, Implement, Operate), thereby achieving

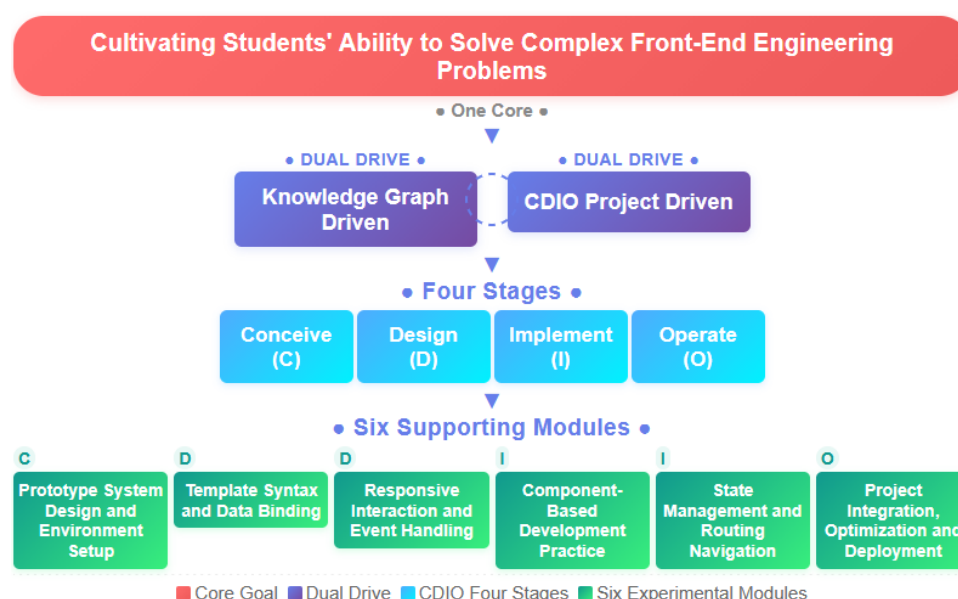
a synergistic enhancement of both knowledge assimilation and engineering skill development. To address this gap, this paper proposes an integrated instructional model that combines CDIO with knowledge graphs. This model aims to leverage the structured representation of knowledge graphs to systematically support and enhance the entire project-driven CDIO process.

### 3. Teaching Reform Model Design

#### 3.1 Overall Framework Design

This paper proposes an integrated teaching model structured around a core objective, dual drivers, a four-stage process, and six supporting modules (as illustrated in Figure 1). The core objective is to cultivate students' ability to solve complex front-end engineering problems. The model is dual-driven by a knowledge graph, which structures the knowledge system, and by CDIO projects, which anchor engineering practice. The four-stage process integrates the complete CDIO cycle—Conceive, Design, Implement, and Operate—throughout the experimental teaching. This process is enacted through six progressive experimental modules, each constituting a micro-cycle of the CDIO stages and designed to incrementally build competency with Vue.js core knowledge points.

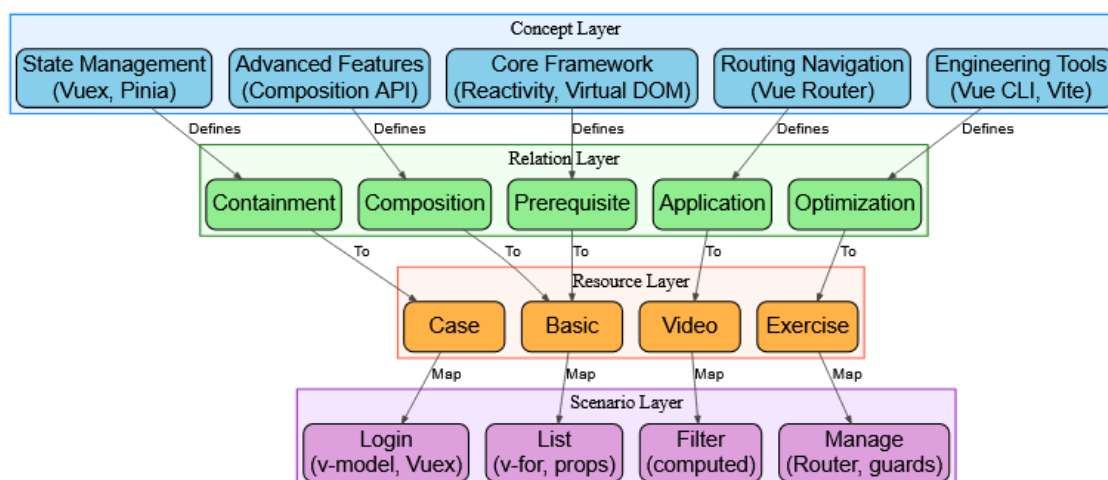
Figure 1: Overall Framework of the CDIO and Knowledge Graph Integrated Teaching Model



#### 3.2 Construction of the Vue.js Course Knowledge Graph

The Vue.js course knowledge graph is constructed with a four-layer architecture—Concept, Relationship, Resource, and Project Scenario (Figure 2)—to achieve semantic association and visual presentation of knowledge points while ensuring deep integration with engineering practice.

Figure2: Four-Layer Architecture of the Vue.js Knowledge Graph



**Concept Layer:** This core layer defines the domain concept entities for the Vue.js course, categorized into Core Framework, State Management, Routing Navigation, Engineering Tools, and Advanced Features, encompassing 86 core entities.

**Relationship Layer:** This layer defines semantic associations between concepts through five formal relationship types: Prerequisite (isPrerequisiteOf), Containment (contains), Application (appliesTo), Optimization (optimizesFor), and Composition (composesTo).

**Resource Layer:** This layer attaches multimodal teaching resources (Basic, Case, Video, Exercise) to each concept node via semantic matching, supporting dynamic updates.

**Project Scenario Layer:** To bridge theory and practice, this layer maps abstract concepts to concrete functional modules within a core project case—the “Book Query and Borrowing System.”

### 3.3 CDIO-Based Experimental System Design

Centered on the “Book Query and Borrowing System,” the experimental curriculum is decomposed into six progressive modules, each aligning with a primary CDIO stage to form a complete project iteration cycle (see Table 1).

No.	Experimental Project	Core Knowledge Points & Tasks	Primary CDIO Stage
1	Prototype Design & Environment Setup	Requirement analysis, tech stack selection, Vue CLI setup, prototype design.	Conceive (C)
2	Template Syntax & Data Binding	Interpolation, directives (v-bind, v-if, v-for), MVVM pattern, static data binding.	Design (D)
3	Reactive Interaction & Event Handling	Methods, computed, watch, v-model for forms, event modifiers.	Design (D)
4	Component-Based Development Practice	Parent-child communication (props/events), slots, reusable components, lifecycle hooks.	Implement (I)
5	State Management & Routing Navigation	Vuex (state, mutations, modules), Vue Router (routes, guards), state-route coordination.	Implement (I)
6	Integration, Optimization & Deployment	API integration (Axios), UI library, performance optimization, build & deployment, documentation.	Operate (O)

**Module 1: Conceive.** This initial module focuses on the Conceive (C) stage, aiming to cultivate students’ analytical understanding of complex engineering problems. Tasks include: (1) analyzing the core functional requirements of the book system (e.g., user authentication, book browsing, borrowing management); (2) selecting a technology stack (Vue.js, Vue Router, Vuex) informed by comparative analysis within the knowledge graph; (3) setting up the development environment using Vue CLI; and (4) designing interactive prototypes with tools like Figma. The goal is to establish a systematic pre-coding understanding of the project, adhering to the software engineering tenet that early design prevents later defects.

**Module 2: Design (Foundations).** Corresponding to the Design (D) stage, this module centers on Vue.js’s template syntax and reactive data binding. Students learn to: (1) use interpolation and core directives (v-bind, v-if, v-for); (2) comprehend the Model-View-ViewModel (MVVM) architecture to drive view updates via data changes; (3) implement dynamic data binding, such as rendering book lists from API-fetched JSON; and (4) apply dynamic CSS binding (:class, :style). A key pedagogical challenge is facilitating the transition from imperative DOM manipulation to a reactive, data-driven paradigm, a process supported by the semantic concept associations in the knowledge graph.

**Module 3: Design (Advanced).** This module deepens the Design (D) focus by exploring Vue.js’s reactive system and event handling. Students: (1) define and invoke component methods; (2) utilize computed properties for derived data and watch for side effects; (3) implement form handling with v-model; and (4) apply event modifiers (.stop, .prevent). A comparative exercise highlights the performance advantage of computed properties over methods, a rationale underpinned by the optimizesFor relationship in the knowledge graph.

**Module 4: Implement (Components).** Entering the Implement (I) stage, this module emphasizes Vue.js’s component-based architecture. Key activities include: (1) creating reusable functional components (e.g., book cards); (2) mastering communication patterns (props/events, event bus/Vuex, provide/inject); (3) applying slots for content distribution; and (4)

understanding component lifecycle hooks. Assessment focuses on reusability and maintainability, guided by principles like the Single Responsibility Principle (SRP) and Open-Closed Principle (OCP). The knowledge graph's composition relationship illustrates how simple components integrate into complex systems.

**Module 5: Implement (Architecture).** Continuing the Implement (I) stage, this module addresses architecture for larger applications. Students: (1) implement centralized state management with Vuex (state, mutations, actions, getters); (2) organize state using namespaced modules; (3) configure routing with Vue Router; (4) set up navigation guards for access control; and (5) manage state preservation across routes. The knowledge graph clarifies the applicability of Vuex (e.g., via `appliesTo` relationships) to navigate the inherent complexity of state management.

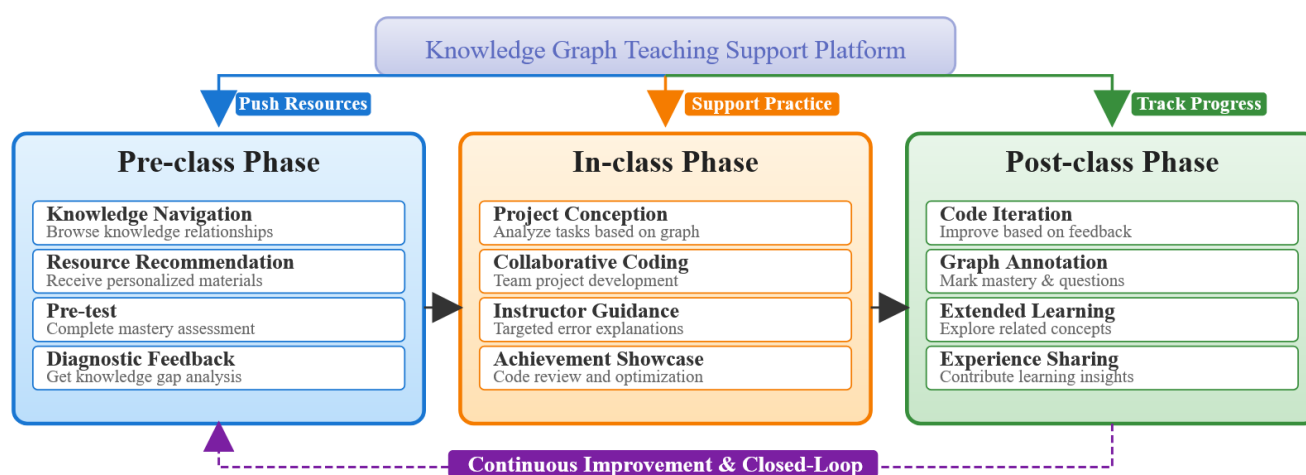
**Module 6: Operate.** The final module aligns with the Operate (O) stage, cultivating project delivery capabilities. It covers: (1) integrating third-party UI libraries (e.g., Element UI); (2) connecting to backend RESTful APIs using Axios with error handling; (3) applying performance optimizations (e.g., lazy loading); (4) building and deploying the project with Vite/Webpack; and (5) writing project documentation. This module embodies DevOps practices, and the project scenario layer of the knowledge graph provides authentic context for these operational tasks.

## 4. Teaching Reform Implementation Process

### 4.1 Teaching Implementation Process

The implementation follows an integrated “pre-class – in-class – post-class” design, supported throughout by the knowledge graph and the CDIO framework, thereby forming a closed-loop instructional process (as illustrated in Figure 3).

Figure 3: Teaching Implementation Process Flowchart



The primary objective of the pre-class stage is to equip students with the foundational knowledge required for the experimental tasks. The specific procedures include:

- (1) Knowledge Graph Navigation: Students access the Vue.js knowledge graph via an online learning platform (e.g., Learning Pass) to browse knowledge points relevant to the experiment and their interrelationships. Starting from core concepts, students can explore associated knowledge domains.
- (2) Personalized Resource Recommendation: Based on students' historical learning data—such as knowledge mastery, learning styles, and error records—the system recommends appropriate learning resources.
- (3) Pre-knowledge Testing: Students complete micro-tests (5–10 multiple-choice questions) drawn from the resource-layer question bank. The system automatically evaluates knowledge mastery, employing adaptive testing technology to dynamically adjust question difficulty according to student responses.

During the in-class stage, CDIO engineering practice serves as the main thread, with instructors guiding students to apply acquired knowledge in authentic projects. This phase comprises:

- (1) Conceive Stage: Instructors assign module tasks, requiring students to analyze the relationship between the tasks and prior knowledge using the knowledge graph. By querying the graph to identify key concepts, students engage in solution conception, thereby cultivating systematic thinking.

(2) Design & Implement Stage: Students undertake programming practice in small groups (4–6 members).

(3) Operate Stage: The final 20 minutes of each session are dedicated to outcome presentation and review. Each group demonstrates the iterative results of the module, while other groups conduct code reviews, highlighting strengths and suggesting improvements.

The post-class stage focuses on knowledge consolidation and expansion, closing the loop of continuous learning. Activities include:

(1) Code Iteration: Students revise their code based on feedback from in-class reviews and submit updates to Git repositories.

(2) Knowledge Graph Annotation: Students mark mastered knowledge points (green) and points requiring further clarification (red) on the knowledge graph. The system then generates personalized knowledge maps based on these annotations, visually representing mastery levels and helping students identify knowledge gaps.

(3) Extended Learning: Students with additional capacity may pursue in-depth study through extended resources linked to the knowledge graph, such as analyzing open-source projects, reading technical blogs, examining source code, and undertaking innovative practice.

## 4.2 Construction of Diversified Evaluation System

A diversified evaluation system aligned with CDIO capability objectives and the knowledge-graph-enhanced learning process was established (Table 2). This system emphasizes process-oriented, value-added, and comprehensive assessment, shifting away from a traditional score-centric approach.

*Table 2 Diversified Evaluation System Based on CDIO Philosophy*

Evaluation Dimension	Evaluation Content	Evaluation Method	Proportion
Process Evaluation (50%)	Pre-class knowledge tests, in-class participation, code submission quality/frequency, group collaboration, problem-solving trajectory	Platform auto-recording (30%), teacher observation (15%), peer evaluation (5%)	50%
Summative Evaluation (40%)	Final project completeness, code standardization, system functionality/performance, project defense and report	Teacher evaluation (30%), cross-review (10%)	40%
Value-Added Evaluation (10%)	Improvement in knowledge graph mastery; completion of extended tasks (e.g., open-source contributions, technical blogs)	Knowledge graph system analysis (8%), teacher assessment (2%)	10%

Process Evaluation focuses on students' learning progress and trajectory rather than solely on final outcomes. It encompasses pre-class tests, in-class engagement, code submission quality and frequency, group collaboration, and problem-solving processes. Data are automatically captured via the learning platform, ensuring objectivity and traceability.

Summative Evaluation assesses students' comprehensive abilities at the course conclusion, including final project delivery, code standardization, system functionality and performance, and the quality of project defense and reporting. A multi-round cross-review mechanism involving different instructors and groups helps mitigate subjective bias.

Value-Added Evaluation emphasizes student growth and extended learning, encouraging efforts beyond basic course requirements. This includes measuring progress in knowledge graph mastery and recognizing accomplishments such as contributing to open-source projects on GitHub, publishing Vue.js-related technical articles, participating in community discussions, and mastering advanced Vue.js features not covered in the core syllabus. The underlying philosophy is to promote continuous learning and self-improvement rather than mere compliance with course minima.

## 5. Analysis and Discussion of Teaching Effects

### 5.1 Experimental Design and Data Collection

A comparative teaching experiment was conducted during the 2024–2025 academic year at the School of Computer and Software Engineering, University of Science and Technology Liaoning. The experimental group ( $n \approx 500$  students across 14 classes; comprising 6 undergraduate classes with approximately 200 students and 8 top-up program classes with approximately 300 students) was instructed using the CDIO-knowledge graph integrated teaching model. The control group

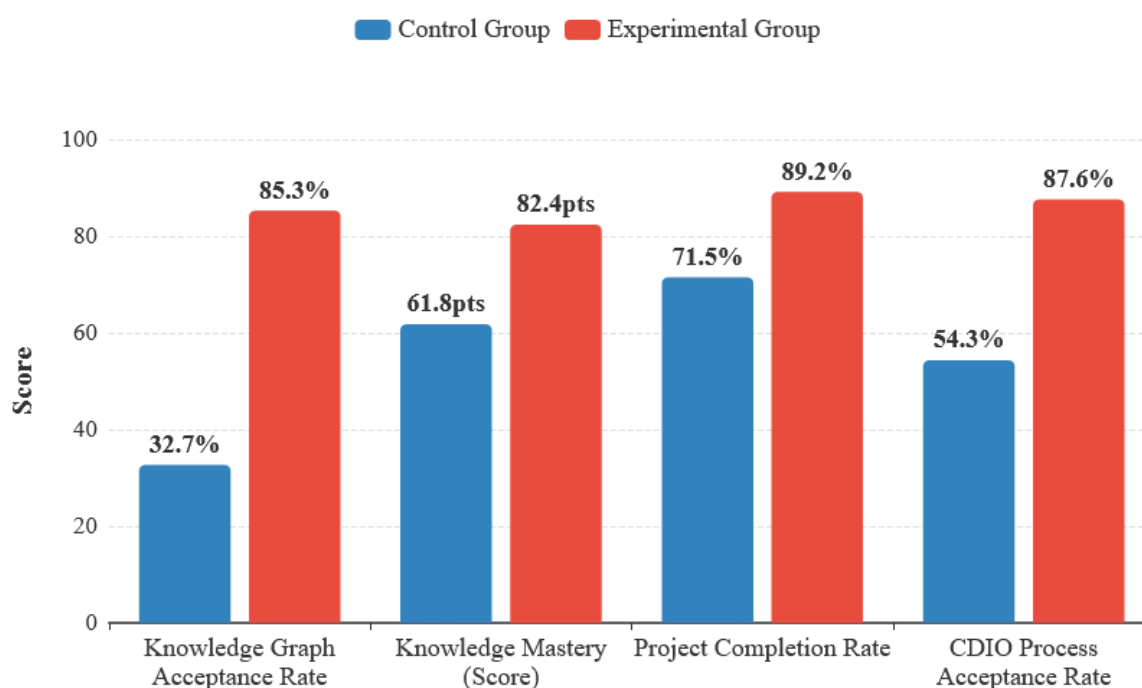


( $n \approx 500$  students across 14 classes) was selected from the same major during the preceding 2023–2024 academic year and received instruction via traditional experimental teaching methods. To ensure internal validity, key teaching conditions—including textbooks, total class hours, and assessment criteria—were held consistent between the two groups. Data collected for analysis included academic performance metrics (experiment scores, final examination scores, and project scores) and post-course questionnaire responses.

## 5.2 Teaching Effect Analysis

Questionnaire results indicate a pronounced positive perception of knowledge-graph-assisted learning among the experimental group. Specifically, 85.3% of these students acknowledged that the knowledge graph aided in understanding interconnections between knowledge points and in constructing a systematic cognitive framework—a proportion significantly higher than the 32.7% reported in the control group. Academic performance data further substantiate the model's effectiveness: the experimental group achieved an average score of 82.4 points, markedly surpassing the control group's average of 61.8 points. In terms of engineering practice capability, the experimental group demonstrated exceptional outcomes, with average project completeness reaching 89.2%, far exceeding the 71.5% observed in the control group. Notably, 87.6% of students in the experimental group reported that project-based practice substantially deepened their theoretical understanding, compared to 54.3% in the control group. These findings collectively underscore the synergistic benefits of integrating theoretical knowledge with practical application, contributing significantly to the cultivation of comprehensive student competencies.

Figure 4: Comparison of Learning Outcomes between the Experimental and Control Groups



## 6. Conclusion

This study addresses the prevalent issues of knowledge fragmentation and inadequate development of engineering practice skills in Vue.js experimental instruction by proposing an integrated instructional model based on CDIO and knowledge graphs. The construction of a dynamic Vue.js knowledge graph provides students with a systematic and visually structured navigation tool for knowledge acquisition. Concurrently, the design of a six-module, iterative experimental project—deeply embedded with the CDIO philosophy—enables students to undergo comprehensive training across the complete Conceive–Design–Implement–Operate cycle within an authentic engineering context. Teaching practices and effect evaluation demonstrate that this integrated model yields significant positive outcomes. It aligns effectively with the talent development objectives of emerging engineering disciplines and the standards of engineering education accreditation. Future work will focus on validating and refining this model across a broader range of institutions and academic majors.



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## Conflict of Interests

The authors declare that there is no conflict of interest regarding the publication of this paper.

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# General Education Reform in Foreign Studies Universities under Globalization: A Comparative Perspective from China and South Korea

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**Abstract:** Against the backdrop of higher education internationalisation, general education reform has become a crucial pathway for enhancing students' comprehensive competencies and global employability. This study focuses on Beijing Foreign Studies University (BFSU) and Hankuk University of Foreign Studies (HUFS), examining their general education reform from a comparative education perspective. Drawing on literature analysis and case comparison, the research systematically investigates the institutional context, curriculum structure, and implementation approaches of both universities' general education programs. It analyses similarities and differences across dimensions such as course offerings, interdisciplinary integration, teaching and assessment mechanisms, and international orientation. Findings indicate that BFSU emphasises the foundational role of general education within the undergraduate curriculum, fostering both language proficiency and broader competencies, whereas HUFS highlights practical engagement and international projects to cultivate global leadership and intercultural skills. Despite their differing emphases, both reform pathways reflect a shared trend of shifting general education from a knowledge-supplement model to a competency-oriented approach. The results provide comparative insights and practical implications for advancing the internationalisation of general education in foreign language universities.

**Keywords:** General Education; Internationalisation Reform; Beijing Foreign Studies University; Hankuk University of Foreign Studies; Comparative Education; Intercultural Competence

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## 1. Introduction

In the context of higher education internationalisation, general education reform has become a critical pathway for foreign language universities to enhance students' comprehensive competencies and global competence. In such institutions, general education serves as an essential means for cultivating students' intercultural communication skills and global perspectives, increasingly emerging as a key component of education systems worldwide <sup>[1]</sup>. According to UNESCO <sup>[2]</sup>, the objectives of modern foreign language education have shifted from mere language proficiency to fostering students' intercultural adaptability and global citizenship. This shift is manifested in three primary aspects: (1) linguistic diversity: globalization demands multilingual talents to meet the needs of multinational corporations, international organizations, and other multilateral contexts <sup>[3]</sup>; (2) intercultural communication skills: international engagement requires not only language

proficiency but also an understanding of different cultural norms, values, and communication patterns<sup>[4]</sup>; and (3) technology-supported language learning: modern language instruction increasingly integrates digital technologies, such as online courses and AI-assisted language tools, to enhance teaching efficiency<sup>[5]</sup>. These developments indicate that general education extends beyond disciplinary knowledge expansion to emphasise critical thinking, interdisciplinary integration, and the cultivation of global citizenship<sup>[6]</sup>. As education systems worldwide increasingly converge, the implementation of general education reflects distinctive characteristics shaped by local cultural and educational traditions<sup>[7]</sup>.

Within this context, China and Korea, as representative countries in Asia, offer valuable comparative insights into general education reform in foreign language universities. Since their establishment, Beijing Foreign Studies University (BFSU) and Hankuk University of Foreign Studies (HUFS) have continuously advanced reform practices regarding the positioning and function of general education in undergraduate talent development, aiming to cultivate high-quality graduates with international perspectives and intercultural understanding. Although both universities have made notable progress in promoting internationalisation of education and developing general education, they exhibit different orientations in reform pathways, institutional arrangements, and curriculum implementation, reflecting the distinct educational systems and cultural contexts in which they operate. Existing research remains limited: on one hand, discussions often remain at the level of course descriptions and theoretical analysis, lacking systematic cross-national comparison; on the other hand, the intrinsic relationship between intercultural competence and internationalised literacy, as well as the mechanisms by which general education promotes students' global competence, remains underexplored.

Against this backdrop, this study examines BFSU and HUFS as cases to systematically analyse how general education curricula and practices influence students' intercultural competence and internationalised literacy, aiming to enrich comparative research on general education and provide insights for higher education reform. From a comparative education perspective, this research systematically compares the institutional context, curriculum structure, and implementation approaches of general education reform at the two universities, with a focus on differences and similarities in internationalised orientation and competency development goals. Employing cross-cultural comparison and case analysis, the study integrates longitudinal historical review with horizontal institutional comparison, addressing key dimensions such as curriculum design and content, interdisciplinary integration, teaching and assessment mechanisms, and the role of general education in cultivating students' global perspectives and intercultural competence. Through comparison of representative reform initiatives and practical cases, the study aims to reveal common trends and differentiated pathways in general education reform under different institutional and cultural contexts, providing a reference for advancing the internationalisation of general education in foreign language universities.

## 2. Literature Review

### 2.1 Theoretical Foundations of General Education

General education constitutes a fundamental component of higher education, aiming to foster students' holistic development, including critical thinking, interdisciplinary competence, and global perspectives. Boyer<sup>[8]</sup> was among the first to systematically argue that general education should occupy a central position in university education, with its fundamental task being to equip students with the ability to solve complex problems while understanding diverse cultural contexts. Taylor<sup>[9]</sup> further proposed that, with the deepening of globalisation, the objectives of general education have gradually shifted toward cultivating global citizens, emphasising not only the expansion of knowledge but also students' ability to communicate effectively and collaborate across cultural boundaries. More recently, Nussbaum<sup>[10,11]</sup> highlighted the significance of general education in fostering global citizenship, arguing that students require not only academic knowledge but also social responsibility and moral imagination. Barnett<sup>[12]</sup> introduced the concept of the "Ecological University," emphasising the role of general education in nurturing social and environmental responsibility. Circles<sup>[13]</sup> further suggested that intercultural competence constitutes a key outcome of general education, particularly in an era of accelerated globalisation, where such skills are essential for students' future engagement in international work environments.

### 2.2 Theoretical Framework of Education Internationalisation

The theoretical framework of education internationalisation examines the transformation and development of education

systems in the context of globalisation. Globalisation is a primary driver of internationalisation of education, aligning educational content, teaching methods, and learning environments with global demands to cultivate students with intercultural understanding and international competitiveness <sup>[14]</sup>. Within this framework, intercultural education theory emphasises the multicultural dimension of education, advocating for fostering students' understanding and recognition of different cultures to enhance their intercultural communication skills <sup>[15]</sup>. Curriculum reform plays a pivotal role in internationalising education, requiring the integration of global perspectives into course content and the design of interdisciplinary learning modules that address global issues <sup>[16]</sup>. Moreover, the advancement of internationalisation depends on international cooperation and policy interactions, such as transnational study programs and academic collaborations, which facilitate global knowledge sharing <sup>[16]</sup>. Global citizenship education further emphasises students' sense of global responsibility, suggesting that education should cultivate not only knowledge but also social responsibility and ethical awareness <sup>[17,18]</sup>. Technological development, particularly in information technology, has provided new platforms for international education; online learning and virtual classrooms have overcome traditional geographical and temporal constraints, enabling global sharing of educational resources <sup>[19]</sup>. The theory of cultural adaptability in education posits that internationalisation efforts should respect national cultural differences, adjusting content and methods to better meet local needs <sup>[20]</sup>. Overall, the theoretical framework of education internationalisation emphasises connectivity and resource sharing under globalisation while integrating intercultural understanding, curriculum reform, international collaboration, and technology application to cultivate globally competent citizens.

### 2.3 Comparative Analysis of Educational Reform in Chinese and Korean Foreign Language Universities

From a longitudinal perspective, Beijing Foreign Studies University (BFSU), as a leading foreign language university in China, has undergone a transition in general education from a focus on single-language instruction to a diversified and internationalised approach. Recent reforms have emphasised interdisciplinary integration in curriculum design, cultivated cultural literacy and critical thinking, and actively incorporated international course resources, promoting bilingual education and international collaborative programs <sup>[21-23]</sup>. In contrast, Hankuk University of Foreign Studies (HUFS) in Korea places greater emphasis on integrating language learning with cultural knowledge. By combining language instruction with Korean culture, social sciences, and natural sciences, HUFS seeks to enhance students' linguistic proficiency and cultural understanding <sup>[24]</sup>.

From a horizontal comparative perspective, notable differences exist between Chinese and Korean models of general education. Chinese universities' reforms are more influenced by Western educational philosophies, emphasising curriculum openness and diversity and focusing on cultivating students' comprehensive competencies and innovation capacity <sup>[25,26]</sup>. Korean universities, on the other hand, tend to promote general education through the "college system" reform, yet this approach faces practical challenges, such as insufficient credits for general education courses and uneven resource allocation <sup>[27,28]</sup>. Moreover, Korean institutions face challenges related to cultural identity and academic recognition in the internationalisation process, necessitating further development of students' intercultural communication abilities <sup>[29]</sup>.

In terms of practical implementation, BFSU has advanced curriculum internationalisation and pedagogical innovation through cooperative programs with overseas universities and the integration of high-quality international educational resources. HUFS, in contrast, has promoted internationalisation by strengthening both global and regional partnerships <sup>[30]</sup>. BFSU emphasises internationalised course content and interdisciplinary integration, whereas HUFS prioritises the combination of language and culture. Both institutions, however, face challenges regarding resource allocation, faculty development, and cultural identity, underscoring the need for further optimisation to enhance the quality and effectiveness of general education <sup>[31]</sup>.

## 3. Research Methods

This study primarily adopts literature review and case analysis methods, aiming to systematically synthesise relevant research while examining practical reform cases at Beijing Foreign Studies University (BFSU) and Hankuk University of Foreign Studies (HUFS) to analyse the pathways, strategies, and outcomes of general education reform at both institutions.

First, an extensive literature review was conducted to identify recent research on general education, internationalisation of

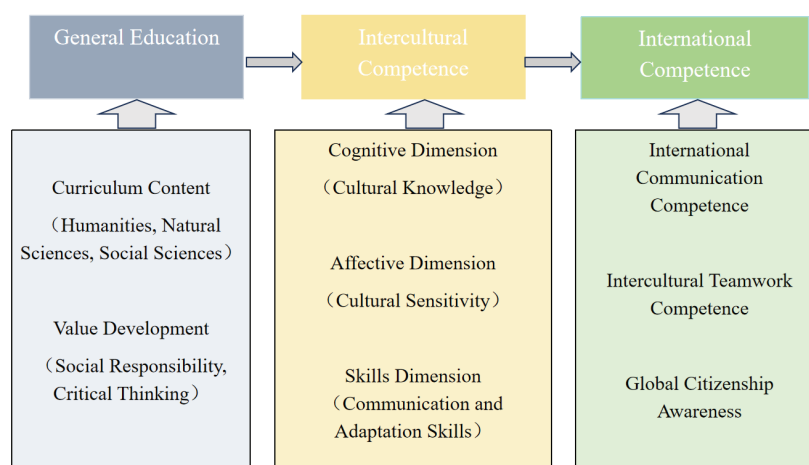
education, and comparative education. The review focused on three key areas: (1) the internationalization and development trends of general education, exploring its implementation pathways within the context of globalized higher education; (2) the impact and implementation of education internationalization, particularly regarding curriculum design, teaching methods, and intercultural communication practices; and (3) general education reform at Chinese and Korean foreign language universities, summarizing successes and challenges in promoting general education reform, with particular attention to innovative initiatives integrating internationalization and general education.

The study then concentrates on the reform practices of BFSU and HUFS, particularly the specific measures related to general education. This analysis was conducted through three main approaches: (1) education policy and document analysis, examining reform policies and related documents issued by the two universities to identify core principles, objectives, and implementation strategies; (2) curriculum analysis, comparing general education curricula at both universities to explore course content, teaching methods, and integration of international elements, with particular attention to how courses foster global perspectives, interdisciplinary integration, and critical thinking; and (3) teaching case analysis, using specific instructional cases to evaluate how the universities implement interdisciplinary teaching and globalized courses, assessing the effectiveness of these reforms in enhancing students' global awareness and intercultural competence.

The study primarily employs qualitative analysis, using comparative methods to conduct an in-depth comparison of the two universities' educational reforms. Analysis of curriculum design, policy documents, and teaching cases reveals similarities and differences in general education reform, evaluates reform outcomes, and explores their influence on students' comprehensive competencies and global perspectives. This provides a concrete reference for cross-national comparisons of general education models and helps illuminate the potential contribution of general education to students' internationalised literacy.

As illustrated in Figure 1, the framework presents the logical relationship between general education, intercultural competence, and internationalised literacy. In this framework, general education serves as the core focus, and differences in curriculum design, educational philosophy, and instructional practice may influence the development of students' intercultural competence. Intercultural competence, in turn, reflects students' ability to understand, communicate, and adapt within multicultural contexts, which constitutes a key component of internationalised literacy.

Figure 1. Theoretical Framework



## 4. Historical Development and Policy Evolution of Educational Reform at the Two Universities

### 4.1 Longitudinal and Cross-National Comparison of Reforms

General education in both China and Korea started relatively late. In China, higher education was historically influenced by the Soviet specialised talent training model, with professional education dominating the system for a long time<sup>[32]</sup>. In recent years, driven by globalisation and the development of the knowledge economy, Chinese universities have gradually emphasised general education, drawing on international experiences to progressively establish and reform general education



curricula<sup>[25,33]</sup>. However, due to its late development, general education in China remains in an exploratory stage, with challenges such as unreasonable curriculum design and an overly instrumental focus.

In contrast, Korea's development followed a trajectory from emphasising professional education to gradually recognising the importance of general education<sup>[34]</sup>. Between 1945 and 2009, Korean universities generally adopted a "professional-oriented, general education-light" model, resulting in the relatively low status of general education<sup>[27]</sup>. Around 2010, both the Korean government and universities began to pay greater attention to general education, establishing multiple organisations to promote its development. Although some progress has been made, challenges such as insufficient resources and unstable faculty remain<sup>[27]</sup>.

The historical development of general education at the two universities is summarised in Tables 1 and 2:

*Table 1. Development of General Education at Beijing Foreign Studies University (BFSU)*

Year	Stage	Main Content
1940s – early 1980s	Initial Stage	BFSU initially focused on language instruction, with limited comprehensive general education. At this stage, foreign language education primarily emphasized language skills and translation practice.
1980s – late 1990s	Transition Stage	With the advancement of globalization, BFSU gradually introduced more systematic general education concepts, attempting to expand students' cultural literacy and interdisciplinary knowledge. During this period, the university began offering non-language courses such as literature, history, and philosophy.
Early 21st century – present	Deepening Stage	In the early 21st century, general education became a key component of BFSU's educational reform. The university implemented holistic education, focusing on cultivating well-rounded talents with a global perspective. Emphasizing intercultural understanding and critical thinking, BFSU introduced more interdisciplinary and cross-cultural courses to address the challenges of internationalization and diversity.

Source: Beijing Foreign Studies University official website: <https://www.bfsu.edu.cn>

*Table 2. Development of General Education at Hankuk University of Foreign Studies (HUFS)*

Year	Stage	Main Content
1950s – late 1980s	Initial Stage	In its early years, HUFS primarily focused on foreign language instruction. Particularly during post-war reconstruction and Korea's modernization process, foreign language education was considered a national strategic priority. Early attention to general education was limited, with an emphasis on language and cultural instruction.
Late 1990s – early 21st century	Transition Stage	In the late 1990s, with the rise of education globalization and information technology, HUFS increasingly recognized the need to cultivate students' comprehensive competencies and began incorporating general education courses. Reforms during this period introduced courses in literature, sociology, economics, and other fields, expanding interdisciplinary learning opportunities.
Early 21st century – present	Deepening Stage	In the 21st century, HUFS strengthened its internationalized orientation and gradually developed a general education system centered on "global perspectives" and "intercultural competence." This system emphasizes the cultivation of students' critical thinking, innovation, and cross-cultural understanding.

Source: Hankuk University of Foreign Studies official website: <https://www.hufs.ac.kr/hufs/index.do#section1>

Although the development of general education at Beijing Foreign Studies University (BFSU) and Hankuk University of Foreign Studies (HUFS) exhibits similar staged characteristics, each institution demonstrates distinct emphases and internationalisation pathways. BFSU initially focused on language skill training during the early stage, gradually integrating courses on cultural literacy in the transitional stage, and, in the deepening stage, prioritised globalisation and holistic education, highlighting the cultivation of critical thinking and intercultural competence. HUFS, starting from post-war language education, reinforced students' multidisciplinary knowledge through reforms to the general education curriculum. In the deepening stage, it developed an education system oriented toward "global perspectives" and "intercultural competence," further aligning with internationalisation demands. The evolution of both universities illustrates the progression of general



education from foundational language instruction to the cultivation of global competence.

This study examines the reform measures and main outcomes of general education at the two universities across five dimensions: curriculum design and structural adjustments, introduction of core general education courses, innovations in teaching methods, reforms in assessment systems, and the cultivation of international perspectives, as summarised in Tables 3 and 4.

*Table 4. Reform Measures and Main Outcomes of General Education at Hankuk University of Foreign Studies (HUFS)*

No.	Key Measures	Main Outcomes
1	Curriculum Design and Structural Adjustment	HUFS optimized and adjusted its general education curriculum to meet the diverse needs of students. By integrating general education with professional programs, the university constructed a coherent undergraduate curriculum system and added interdisciplinary courses to enhance students' comprehensive competencies <sup>[35]</sup> . In addition, HUFS emphasized the richness and diversity of course content to cater to varied student learning needs <sup>[36]</sup> .
2	Introduction of Core General Education Courses	To improve students' overall competencies, HUFS introduced core general education courses. These courses include not only language learning but also multidisciplinary knowledge covering Korean culture, humanities, social sciences, and natural sciences, aiming to enhance student engagement and interactivity <sup>[37]</sup> . Through this interdisciplinary teaching model, students can better understand and apply knowledge, thereby enhancing their overall abilities.
3	Innovation in Teaching Methods	HUFS innovated its teaching methods by adopting diverse approaches to stimulate student interest and initiative. For example, the university implemented flipped classrooms, "deep-dish" courses, and co-teaching models <sup>[38]</sup> . These approaches encourage active participation in discussions and practical activities, improving learning outcomes. Additionally, the university emphasized the transformation of teachers' roles, encouraging more flexible and varied instructional methods <sup>[39]</sup> .
4	Reform of Assessment System	HUFS conducted comprehensive reforms of its assessment system. A scientific and rational evaluation framework was established to assess students' overall competencies <sup>[40]</sup> . This system not only considers academic performance but also evaluates innovation, critical thinking, and ethical leadership <sup>[41]</sup> . This approach allows the university to gain a comprehensive understanding of student development and provide personalized guidance and support.
5	Cultivation of International Perspectives	HUFS places strong emphasis on developing students' international outlook. The university provides abundant international learning opportunities through study abroad programs and recruitment of foreign faculty <sup>[21]</sup> . Students are also encouraged to participate in international internships and volunteer activities, enhancing their intercultural communication skills and global competitiveness <sup>[42]</sup> .

Source: Beijing Foreign Studies University official website and other scholarly research

*Table 3. Reform Measures and Main Outcomes of General Education at Beijing Foreign Studies University (BFSU)*

No.	Key Measures	Main Outcomes
1	Curriculum Design and Structural Adjustment	HUFS optimized and adjusted its general education curriculum to meet the diverse needs of students. By integrating general education with professional programs, the university constructed a coherent undergraduate curriculum system and added interdisciplinary courses to enhance students' comprehensive competencies <sup>[24]</sup> . In addition, HUFS emphasized the richness and diversity of course content to cater to varied student learning needs <sup>[36]</sup> .
2	Introduction of Core General Education Courses	To enhance students' overall competencies, HUFS introduced core general education courses. These courses include not only language learning but also multidisciplinary knowledge covering Korean culture, humanities, social sciences, and natural sciences, aiming to increase student engagement and interactivity <sup>[37]</sup> . Through this interdisciplinary teaching model, students can better understand and apply knowledge, thereby improving their comprehensive skills.
3	Innovation in Teaching Methods	HUFS innovated its teaching methods by adopting multiple instructional approaches to stimulate student interest and initiative. For instance, the university implemented flipped classrooms, "deep-dish" courses, and co-teaching models <sup>[38]</sup> . These methods encourage active participation in discussions and practical activities, thereby improving learning outcomes. The university also emphasizes the transformation of teachers' roles, encouraging more flexible and diversified teaching strategies <sup>[39]</sup> .

No.	Key Measures	Main Outcomes
4	Reform of Assessment System	HUFS carried out comprehensive reforms of its assessment system. A scientific and rational evaluation framework was established to assess students' overall competencies <sup>[40]</sup> . This system evaluates not only academic performance but also innovation, critical thinking, and ethical leadership <sup>[41]</sup> . This approach allows the university to gain a comprehensive understanding of student development and provide personalized guidance and support.
5	Cultivation of International Perspectives	HUFS places strong emphasis on developing students' international perspectives. The university offers abundant international learning opportunities through study abroad programs and the recruitment of foreign faculty <sup>[22]</sup> . Students are also encouraged to participate in international internships and volunteer activities, enhancing their intercultural communication skills and global competitiveness <sup>[42]</sup> .

Source: Hankuk University of Foreign Studies official website and other scholarly research

The practices of Beijing Foreign Studies University (BFSU) and Hankuk University of Foreign Studies (HUFS) in general education reform reflect the differences between their respective cultural and educational models. BFSU, guided by the philosophy of holistic education, has gradually expanded from language skill development to interdisciplinary and globalised courses. By introducing core courses and strengthening international programs, the university seeks to enhance students' global competencies. In contrast, HUFS, originating from post-war language education, emphasises curriculum diversity and instructional innovation, including flipped classrooms, interdisciplinary integration, and international exchange programs, gradually forming a general education model centred on global perspectives and intercultural competence. Both universities share a focus on responding to globalisation and fostering critical thinking; however, their implementation pathways and policy designs differ significantly, reflecting their respective educational traditions and national strategic priorities. In recent years, both institutions have introduced new initiatives to deepen general education reform and internationalisation practices. BFSU has organised a series of general education cultural festivals and expanded course offerings through resource-sharing mechanisms with leading domestic universities, further stimulating student engagement and the development of global perspectives. Meanwhile, HUFS has implemented a flexible "post-major selection" system in undergraduate admissions to strengthen interdisciplinary learning and global competitiveness, representing an institutional adjustment that allows its general education system to better respond to internationalisation challenges.

## 4.2 Influence of Western Educational Philosophies on General Education at Chinese and Korean Foreign Studies Universities

Beijing Foreign Studies University (BFSU), as one of China's leading foreign language universities, has conducted extensive exploration and practice in general education, including curriculum design, teaching methodologies, and faculty development<sup>[43]</sup>. In recent years, the university has incorporated instructional theories such as outcome-based education to enhance students' comprehensive competencies and innovative abilities<sup>[44]</sup>. Moreover, BFSU has emphasised both the preservation and innovation of its foreign language teaching, using practical teaching systems and volunteer service initiatives to improve educational quality<sup>[42]</sup>.

In South Korea, higher education has also actively pursued internationalisation reforms in recent years to enhance competitiveness in the global education market. Reforms in general education at Korean universities have primarily focused on curriculum design and the cultivation of intercultural communication skills<sup>[29]</sup>. Research by the Korea Foundation for the Study of Development (KFSD) indicates that top Korean universities emphasise fostering students' global perspectives and intercultural competence within their general education programs<sup>[44]</sup>. However, challenges remain, such as insufficient attention within academic departments to social and cultural discussions<sup>[29]</sup>.

In general, the influence of Western educational philosophies on general education reforms at Chinese and Korean foreign studies universities can be summarised in several key areas, as presented in Table 5.

Table 5. Influence of Western Educational Philosophies on General Education at Chinese and Korean Foreign Studies Universities

No.	Key Aspects	Main Content
1	Curriculum Design and Optimization	Western general education emphasizes interdisciplinary knowledge integration and the cultivation of humanistic literacy. In the reforms of general education, Chinese and Korean universities have increasingly focused on constructing coherent curriculum systems, introducing more interdisciplinary courses, and integrating humanities, social sciences, and natural sciences <sup>[46,47]</sup> .
2	Innovation in Teaching Methods	Western educational philosophies highlight student-centered teaching and active learning. Chinese and Korean universities have attempted to adopt more diversified teaching approaches, such as project-based learning and collaborative learning, to foster critical thinking, problem-solving skills, and student engagement <sup>[48]</sup> .
3	Reform of Assessment Methods	Western education emphasizes formative assessment and self-reflection. Chinese and Korean universities have introduced diversified assessment methods, including project assessments and peer evaluations, to more comprehensively reflect students' learning outcomes and competence development <sup>[49]</sup> .
4	Campus Culture Development	Western general education values campus diversity and inclusiveness. In response, Chinese and Korean universities have sought to create an open and inclusive campus culture, encouraging student participation in multicultural activities and promoting interaction and understanding among students from diverse backgrounds <sup>[49]</sup> .
5	Transformation of Educational Goals	Western general education emphasizes cultivating talents with global perspectives and lifelong learning abilities. Chinese and Korean universities have increasingly prioritized the development of students' international outlook, intercultural communication skills, and lifelong learning attitudes and capabilities.

Under the influence of globalisation and Western educational philosophies, the general education reforms at Beijing Foreign Studies University (BFSU) and Hankuk University of Foreign Studies (HUFS) exhibit both commonalities and differences. Both universities emphasise curriculum optimisation, interdisciplinary integration, and the cultivation of students' global competencies. However, BFSU, building on its language education tradition, highlights experiential learning and volunteer service to strengthen students' intercultural communication skills. In contrast, HUFS focuses more on multicultural exchange, emphasising interdisciplinary course offerings and internationalised educational pathways. These reform initiatives demonstrate how both universities implement localised practices and innovative strategies in the internationalisation of general education.

## 5. Comparison and Analysis of General Education Models at the Two Universities

### 5.1 Comparison of General Education Models

Beijing Foreign Studies University (BFSU) and Hankuk University of Foreign Studies (HUFS) each demonstrate distinctive features in their general education models. This study compares the two universities in terms of curriculum design, educational philosophy, and adaptation to globalisation, highlighting the different priorities and strategies they employ in implementing general education, as summarised in Table 6.

Table 6. Comparison of General Education Models at Beijing Foreign Studies University and Hankuk University of Foreign Studies

Dimension	Beijing Foreign Studies University (BFSU)	Hankuk University of Foreign Studies (HUFS)
Curriculum Design	BFSU's general education curriculum emphasizes the humanities and skill development for foreign language students. In recent years, the university has gradually strengthened the implementation of general education courses, though challenges remain, such as unclear course objectives and suboptimal course arrangements <sup>[59]</sup> . The curriculum includes a wide range of humanities and social sciences courses aimed at enhancing students' overall competence and intercultural communication skills. Additionally, BFSU has optimized the curriculum structure by introducing core general education courses <sup>[37]</sup> .	HUFS's general education curriculum is organized into three tiers: core general education (including critical thinking, analytical reasoning, and problem-solving skills), professional skills, and contextual skills <sup>[52]</sup> . This tiered structure emphasizes the cultivation of critical thinking and practical application, integrates Korea-specific cultural and social contexts, and highlights global perspectives and intercultural communication abilities.

Dimension	Beijing Foreign Studies University (BFSU)	Hankuk University of Foreign Studies (HUFS)
Educational Philosophy	BFSU's general education philosophy emphasizes the integration of general and specialized education ("general-special integration"), aiming to broaden students' knowledge, enhance their humanistic literacy, and cultivate social responsibility <sup>[42]</sup> . However, due to historical and cultural factors, challenges such as unclear course objectives and limited teaching methods remain <sup>[51]</sup> .	HUFS places stronger emphasis on fostering "global citizenship." Its philosophy not only focuses on academic competence but also prioritizes students' global perspectives and social responsibility <sup>[47]</sup> . The curriculum is designed to cultivate critical thinking and intercultural communication skills to meet the demands of globalization <sup>[52]</sup> .
Adaptation to Globalization	In the context of globalization, both BFSU and HUFS recognize the importance of general education. BFSU attempts to enhance students' global perspectives and intercultural communication skills by expanding foreign language-related elective courses <sup>[51]</sup> . However, limitations in course design and teaching methods mean that its adaptability to globalization still requires improvement.	HUFS better addresses globalization through its distinctive curriculum design and teaching approaches. The curriculum integrates critical thinking, problem-solving, global awareness, and self-management skills <sup>[52]</sup> . This comprehensive design equips students to respond more effectively to the challenges posed by globalization.

Beijing Foreign Studies University (BFSU) and Hankuk University of Foreign Studies (HUFS) each demonstrate strengths in their general education models. BFSU emphasises broadening students' knowledge and enhancing their humanistic literacy through general education, though further optimisation of curriculum design and teaching methods is needed. HUFS, on the other hand, leverages a tiered curriculum structure and the cultivation of global citizenship to more effectively meet the demands of globalisation. The experiences of both universities indicate that the successful implementation of general education requires alignment with the institution's cultural context and educational objectives, as well as continuous refinement of curriculum design and pedagogical approaches to cultivate students with global perspectives and well-rounded competencies.

## 5.2 Analysis of the General Education Models at BFSU and HUFS

In recent years, Beijing Foreign Studies University (BFSU) has implemented a series of innovative reforms in general education, demonstrating both systematic planning and forward-looking practices. The establishment of the BFSU College provided an experimental platform for undergraduate education reform, positioning itself as a "special zone for undergraduate education reform," which breaks down departmental and disciplinary barriers and integrates general education, foreign language instruction, and professional education to cultivate multidisciplinary, internationalised talents<sup>[53]</sup>. Moreover, through a general education course-sharing mechanism with Tsinghua University and Peking University, students can select courses across institutions, thereby enriching academic resources, strengthening inter-university cooperation, and enhancing the quality of undergraduate teaching<sup>[54]</sup>. In 2022, BFSU established a General Education Expert Committee to ensure scientific and sustainable curriculum development, promoting innovation in undergraduate training and enhancing students' comprehensive competencies<sup>[55]</sup>. Additionally, the inaugural General Education Cultural Festival further deepened students' experiential learning, cultivating cross-cultural understanding and social responsibility<sup>[56]</sup>. These measures incorporate the essence of Western educational philosophies, including holistic education and multicultural integration, combining language learning, interdisciplinary courses, and practical projects to strengthen cross-cultural understanding, problem-solving, and civic engagement, reflecting the goal of cultivating global competence.

Hankuk University of Foreign Studies (HUFS) demonstrates a combination of diversity and practicality in its general education reforms. The College of Chinese Studies integrates language teaching with general education, emphasising cross-cultural communication and embedding language learning within cultural understanding<sup>[29]</sup>. HUFS has also introduced Global Leadership courses, such as "Global Perspectives and Leadership" and "Cross-cultural Communication and Leadership," combining theoretical instruction with practical projects to develop students' global awareness and leadership skills<sup>[57]</sup>. Interdisciplinary research projects further integrate knowledge from economics, culture, and other fields, enhancing students' capacity to analyse complex international issues innovatively<sup>[57]</sup>. Collaboration with international organisations and

multinational enterprises through internships and volunteer programs provides authentic cross-cultural practice opportunities, reinforcing social responsibility and global competitiveness<sup>[57]</sup>. By integrating general education with language instruction, interdisciplinary research, and international practice, HUFS has constructed a practice-oriented, multicultural general education model. These initiatives create authentic cross-cultural learning contexts that enhance language proficiency while systematically developing problem-solving skills, cultural reflection, and social responsibility, effectively supporting the university's internationalisation goals in general education.

Both BFSU and HUFS have implemented measures such as multilingual education, interdisciplinary courses, core general education courses, and international exchange and internship programs. These reforms not only enhance students' language proficiency and professional competence but also strengthen global awareness, cross-cultural communication skills, and critical thinking, providing robust support for the internationalised development of general education at both universities.

## **6. Discussion and Recommendations**

### **6.1 Discussion**

This study finds that Beijing Foreign Studies University (BFSU) and Hankuk University of Foreign Studies (HUFS) share commonalities in their general education reforms, particularly in their adoption of globalised educational concepts and localisation of implementation practices. Both universities prioritise cultivating students' cross-cultural competencies and global perspectives, aligning with current trends in internationalised higher education. However, the specific reform pathways reflect their distinct educational contexts and societal needs. BFSU emphasises interdisciplinary integration and domestic resource sharing, whereas HUFS places greater focus on international collaboration and practical skill development. These differences provide diverse case examples for internationalisation in higher education reform.

The study has several limitations. It primarily focuses on institutional policies and reform practices, without in-depth investigation of the long-term outcomes. Additionally, the student perspective is underexplored, leaving the impact of general education on learning experiences and career development only partially assessed. Nevertheless, the comparative analysis of general education reforms at BFSU and HUFS offers theoretical insights and practical guidance for universities seeking to enhance internationalisation and talent development, while calling for policymakers and scholars to further examine reform effectiveness and multiple pathways in global higher education development.

### **6.2 Recommendations**

Based on the findings, the following policy recommendations aim to further advance general education reform, enhance internationalisation, and cultivate high-level, multidisciplinary talents aligned with national strategic needs:

#### **6.2.1 Strengthen Interdisciplinary Integration in Curriculum**

Universities should continue to optimise general education curriculum structures, promoting deep integration of humanities, social sciences, and natural sciences. Introducing diverse interdisciplinary courses can foster students' analytical skills and innovative thinking. Collaboration with other disciplines and the inclusion of courses addressing social responsibility and sustainable development are encouraged.

#### **6.2.2 Promote International Collaboration and Resource Sharing**

Universities should actively pursue international cooperation and establish exchange and collaborative programs with leading domestic and foreign institutions. Sharing and mutual selection of general education courses, as exemplified by BFSU's course-sharing projects with Tsinghua University and Peking University, provides a model to expand access to international courses and improve educational quality.

#### **6.2.3 Optimise Teaching Methods and Assessment Systems**

Innovative teaching approaches, such as project-based learning (PBL), case studies, and flipped classrooms, should be promoted to enhance students' practical abilities and critical thinking. Assessment systems should adopt diversified indicators, evaluating not only academic performance but also participation, collaboration, and innovation outcomes. HUFS's Global Leadership courses and interdisciplinary research projects provide valuable examples in this regard.

#### **6.2.4 Strengthen Faculty Development**

Universities should emphasise professional development for general education faculty through training programs,



international exchanges, and collaborative research to enhance interdisciplinary teaching skills and global perspectives. The establishment of BFSU's General Education Expert Committee and HUFS's teaching innovation projects demonstrates the importance of faculty development in sustaining reform.

### **6.2.5 Foster a Diverse and Inclusive Campus Culture**

Universities should cultivate an open and inclusive campus environment, encouraging participation in multicultural activities and international exchange programs to promote interaction and understanding among students from diverse cultural backgrounds. BFSU's General Education Cultural Festival and HUFS's international internships and volunteer programs effectively enhance students' cross-cultural literacy and social responsibility.

### **6.2.6 Policy Support and Continuous Improvement**

Government agencies and universities should formulate clear policies for general education development, providing necessary resources and policy guarantees to ensure sustainable reform. Establishing feedback mechanisms to periodically evaluate reform outcomes and adjust strategies is crucial to aligning general education practices with international standards. By further deepening general education reforms, BFSU and HUFS can enhance educational internationalisation and cultivate high-quality talents with global competitiveness and cross-cultural competencies. These initiatives not only benefit the universities themselves but also provide valuable experiences and references for higher education reform in China, South Korea, and globally.

## **7. Conclusion**

This study conducted an in-depth comparative analysis of general education reforms at Beijing Foreign Studies University (BFSU) and Hankuk University of Foreign Studies (HUFS), revealing both commonalities and differences in how the two universities respond to globalisation, enhance internationalisation, and cultivate multidisciplinary talents. The findings indicate that both institutions actively incorporate Western educational concepts, emphasising interdisciplinary knowledge integration, global perspective development, and cross-cultural communication skills. However, significant differences exist in their specific implementation pathways and priority areas, reflecting each university's unique educational traditions and national strategic priorities.

BFSU's general education reforms focus on integrating language instruction with general education courses. Through the establishment of BFSU College, the course-sharing mechanism with top domestic universities, the creation of a General Education Expert Committee, and the organisation of a General Education Cultural Festival, the university has systematically advanced its general education agenda. These initiatives not only optimise curriculum structures and enhance students' overall competencies but also expand their knowledge horizons through international cooperation, strengthening cross-cultural understanding and critical thinking abilities.

In contrast, HUFS places greater emphasis on practice-oriented learning and multicultural integration. Its reforms, including the general education initiatives within the Chinese Language Institute, the establishment of Global Leadership courses, interdisciplinary research projects, and international internships and volunteer programs, have effectively cultivated students' global perspectives and leadership capacities. These measures not only enhance cross-cultural communication and innovative thinking but also foster social responsibility and global competitiveness through hands-on experiences.

Despite differences in specific measures, both universities demonstrate effective integration and localisation of Western holistic education principles, contributing to comprehensive improvements in students' competencies. The experiences of BFSU and HUFS highlight the significant role of general education reform in enhancing higher education quality and fostering internationally competent graduates, providing valuable insights for other foreign language universities seeking to advance their own general education programs.

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## **Conflict of Interests**



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# **Research on the Psychological Path of Mindfulness Leadership and Job Burnout among College Teachers: Verification of the Impact Effects of Self-Efficacy and Emotional Regulation Ability Based on Artificial Intelligence**

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**Abstract:** Job burnout among university teachers poses a growing challenge to faculty well-being and sustainable development in higher education. Drawing on Conservation of Resources theory, this study examines how mindful leadership influences teacher burnout through the mediating roles of self-efficacy and emotional regulation ability. Survey data were collected from 658 full-time teachers across multiple universities in China and analyzed using structural equation modeling. In addition, artificial intelligence–assisted methods, including K-means clustering and sentiment analysis of open-ended responses, were employed to explore group heterogeneity and provide complementary evidence. The results show that mindful leadership is significantly and negatively associated with teacher burnout. Both self-efficacy and emotional regulation ability partially mediate this relationship, indicating that mindful leadership alleviates burnout by enhancing teachers’ psychological resources. AI-based clustering further identifies distinct teacher subgroups with different burnout risk profiles, underscoring the importance of differentiated intervention strategies. This study extends mindful leadership research to the higher education context and offers practical implications for leadership development and faculty support.

**Keywords:** Mindfulness-Based Leadership; Burnout; Self-Efficacy; Emotional Regulation Ability; Artificial Intelligence Assisted Analysis

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## **1. Introduction**

Higher education, as an important convergence point of the primary productive force of science and technology, the primary resource of talent and the primary driving force of innovation, its development quality is directly Relation to the overall situation of the country’s modernization drive. University teachers are the core force in higher education, shouldering the sacred mission of cultivating high-level talents, promoting scientific and technological innovation, and serving social development. However, with the in-depth advancement of the “Double First-Class” initiative, the assessment pressure from the fifth Epoch of discipline evaluation, and the continuous increase in the requirements for teaching, research and social services, university teachers are facing unprecedented professional pressure. The interweaving of factors such as role overload, work-family conflict, career development bottleneck and performance assessment pressure has made burnout

increasingly prominent among university teachers<sup>[1]</sup>. Job burnout not only harms the physical and mental health of teachers, leading to the depletion of work enthusiasm and the decline in teaching and research efficiency, but also may cause talent loss, ultimately affecting the improvement and sustainable development of higher education quality. Therefore, delving deeply into the formation mechanism of job burnout among college teachers and seeking Valid intervention Path have become an urgent and highly practical issue.

In the Domain of organizational management, leadership is regarded as a key situational factor influencing employees' attitudes and behaviors<sup>[2]</sup>. Mindfulness leadership, as a leadership paradigm that emphasizes focusing on the present, accepting insights, and non-judgmental awareness, has been initially confirmed to play a role in alleviating employee stress and promoting positive organizational behavior. However, the existing research on mindful leadership and teacher burnout mostly focuses on grassroots teachers in the basic education stage, and the exploration of the specific organizational context of colleges and universities is still insufficient. The loosely coupled organizational structure of colleges and universities, the high autonomy and professionalism of teachers' work, and the complexity of the performance evaluation system all make the mechanism of mindfulness-based leadership potentially unique<sup>[3]</sup>. Furthermore, most existing studies start from a single psychological mechanism and lack an integrated investigation of multiple mediating Path. Based on this, the core issue of this study lies in: In the context of university management, can and how can mindfulness leadership alleviate teachers' job burnout by stimulating their self-efficacy and enhancing their emotional regulation ability through two internal psychological Path? Meanwhile, traditional quantitative research has limitations in revealing group heterogeneity and complex Pattern Recognition. This study attempts to introduce Artificial Intelligence Data analysis methods as an auxiliary means, aiming to Exploration how Artificial Intelligence methods can provide new and richer Evidence and insights for this research, thereby deepening the understanding of relationships between variables.

This study is of great theoretical value and practical significance. At the theoretical level, first of all, it extends the research on mindful leadership to the organizational field of colleges and universities, tests its applicability and effectiveness, and enriches the theory of educational organizational leadership. Secondly, by introducing the dual mediating variables of self-efficacy and emotional regulation ability in parallel, a more integrated psychological mechanism Model was constructed and verified, deepening the understanding of the internal process black box of how mindfulness leadership affects employees' occupational health and transcending the explanatory limitations of a single mediating Model. Finally, the exploratory combination of artificial intelligence-assisted analysis and traditional quantitative research provides a new methodological approach for the study of educational organizational behavior. At the practical level, the research conclusions can provide university administrators with intervention ideas based on empirical Evidence. By cultivating mindful leadership and specifically enhancing teachers' psychological capital (such as self-efficacy) and emotional management skills, it can effectively prevent and alleviate teachers' job burnout, and build a high-quality teaching staff that is physically and mentally healthy, energetic, and highly productive. Serve the strategic Objective of building a strong educational country.

## **2. Theoretical Basis, Core Concepts and Research Hypothesis**

### **2.1 Definition of Core Concepts and Theoretical Perspectives**

#### **2.1.1 Mindful Leadership**

Mindful leadership originated from the intersection of positive psychology and organizational behavior in the Domain. It refers to the ability that leaders cultivate through continuous mindfulness practice (such as meditation, focused breathing, etc.) to remain acutely aware of their inner experiences (thoughts, emotions, feelings) and the external Environment, without judgment, and to focus on the present moment, and organically integrate this ability into leadership behavior. So as to make decisions, communicate and manage teams more Valid<sup>[4]</sup>. Its core Features include: Depth awareness, being able to keenly perceive subtle changes in oneself, subordinates and the organizational Environment; Emotional balance, remaining calm and rational in the face of stress and challenges; Accept and be inclusive, with an open mind towards different opinions and failures; Empathy, the ability to deeply understand the situation and feelings of subordinates; Valid response, rather than inertial reaction<sup>[10]</sup>. In the context of higher education institutions, a mindful leader is characterized by the ability to truly listen to the voices of teachers, understand their pressures and needs in research and teaching, provide timely and Valid



support, and create a safe and supportive organizational atmosphere.

### **2.1.2 Burnout among university teachers**

Job burnout among college teachers refers to a comprehensive psychological exhaustion State that they exhibit under long-term and continuous work pressure, especially in the work Features of high intellectual input, high emotional consumption and high achievement Expectation. Drawing on Maslach's three-dimensional Dimension Model, it is specifically manifested as: emotional exhaustion, feeling that emotional resources have been overdrawn, extreme fatigue, and loss of enthusiasm for work; De-individualize personality, treat students, colleagues and work with indifference, negativity and estrangement, and view the objects of work as objects rather than people; A low sense of personal achievement, a tendency to negatively evaluate the meaning and value of one's work, and a sense of incompetence and failure <sup>[5]</sup>. The job burnout of college teachers not only affects their personal physical and mental health and career development, but also has a profound negative impact on the quality of higher education through the decline in teaching quality, the deterioration of the Relation between teachers and students, and the lack of scientific research and innovation.

### **2.1.3 Self-efficacy**

Self-efficacy was proposed by Bandura and refers to an individual's confidence judgment on whether they have the ability to organize and carry out behavioral tasks in a specific Domain to achieve the set results. The self-efficacy of college teachers is the strength of their belief in their ability to successfully complete various professional tasks such as teaching, research, and social service, and to deal with related challenges. Teachers with high self-efficacy usually set challenging Objective, show greater resilience and perseverance when facing difficulties <sup>[6]</sup>, and tend to view challenges as growth opportunities rather than threats, thus experiencing less helplessness and stress.

### **2.1.4 Ability to regulate emotions**

Emotional regulation ability is the psychological process by which an individual monitors, assesses and adjusts their own emotional responses to adapt to Environment requirements and achieve personal Objective. For college teachers, the ability to regulate emotions is of vital importance. It involves how to Valid manage possible negative emotions such as anxiety, depression and anger when facing heavy workloads, strict assessment requirements and complex interpersonal interactions, maintain emotional stability and mobilize positive emotions to engage in work. Gross's process Model classifies emotion regulation Policy into cognitive reevaluation (altering the understanding of emotional events to adjust emotional responses) and expressive inhibition (suppressing the behavioral expression of emotions), among which cognitive reevaluation is generally regarded as a more adaptive and constructive regulation Policy.

### **2.1.5 Artificial Intelligence assisted analysis and Feedback**

In this study, Artificial Intelligence -assisted analysis does not replace traditional statistical Hypothesis Test, but serves as a research tool and a supplementary means of Evidence to deepen, Cross Validation and enrich the understanding of core variables and their Relation. Its role positioning is specifically reflected in: conducting exploratory analysis of multivariate Data through Unsupervised Learning Algorithm (such as K-means Clustering), identifying subgroups of teachers with different Risk Features of burnout and psychological resource levels, revealing the heterogeneity within the groups, and compensating for the possible masking of the subdivision patterns by traditional mean analysis. Through techniques such as association rule Mining, Non-Linearity and complex interaction Relation among variables are discovered, providing additional evidence for theoretical Model. By conducting Sentiment Analysis and topic modeling on text Data (such as answers to open-ended questions), quantitative research findings are supplemented from a qualitative perspective, providing richer contextualized explanations.

## **2.2 Research Hypothesis and theoretical Model-Construction**

Based on the resource conservation theory, individuals always strive to acquire, retain and protect the resources they cherish. Stress and burnout occur when resources are threatened with loss or actually lost, and the investment fails to yield sufficient returns. Mindful leadership can be seen as an important organizational context resource. Mindfulness leaders, through their traits of awareness, balance, inclusiveness and empathy, can provide teachers with clearer Objective guidance, more timely social support, fairer performance Feedback and a safer emotional atmosphere, which helps teachers accumulate and maintain



their psychological resources.

H1: Mindful leadership has a significant negative impact on burnout among college teachers<sup>[1]</sup>. That is, the higher the level of mindfulness of college leaders, the lower the degree of burnout among their subordinate teachers.

Mindfulness leadership can enhance teachers' confidence in their own abilities by providing a supportive Environment and successful Experience and Feedback. When leaders can accurately identify teachers' contributions and provide constructive Feedback, teachers are more likely to form the belief that they are competent. At the same time, mindful leaders encourage an attitude of focusing on the present and accepting challenges, which helps teachers concentrate their Attention on problem-solving rather than the difficulties themselves, thereby enhancing their sense of self-efficacy. Teachers with high self-efficacy, who are confident in completing tasks, put in more effort and are more resilient in the face of setbacks, which directly buffers the emotional exhaustion and reduced sense of achievement caused by work pressure.

H2: Self-efficacy plays a mediating role between mindful leadership and burnout among college teachers. That is, mindfulness-based leadership reduces burnout by enhancing teachers' self-efficacy.

Mindfulness leaders themselves are demonstrators of emotional management, and their calm and rational behavioral patterns provide Learning models for teachers. The inclusivity atmosphere they create allows teachers to express their true emotions without worrying about negative evaluations, which creates a safe space for teachers to practice emotional regulation. Through mindful communication, leaders can help teachers reevaluate their cognition of stressful events and change their negative interpretation methods. The improvement of teachers' emotional regulation ability enables them to manage negative emotions generated at work more Valid, reduce the unnecessary consumption of emotional resources, prevent emotional exhaustion, maintain good interpersonal interaction, avoid personality, and at the same time, positive emotional experiences also help enhance personal achievement.

H3: Emotional regulation plays a mediating role between mindful leadership and burnout among college teachers. That is, mindfulness-based leadership reduces burnout by enhancing teachers' ability to regulate emotions.

### **3. Research Design: A Mixing approach integrating traditional quantification with Artificial Intelligence assistance**

#### **3.1 Research Sample and Data Collection**

This study adopted an online anonymous questionnaire survey method. Through channels such as professional Network communities of university teachers and assistance from the personnel departments of cooperating universities, a sample was conducted among full-time teachers from different types of universities in the eastern, central and western regions of the country. The questionnaire distribution lasted for about two months, and a total of 725 questionnaires were retrieved. After Data Cleaning, invalid questionnaires with overly short answering times, obvious regularity in answers, and inconsistent responses to lie detector questions were eliminated. Ultimately, 658 Valid questionnaires were obtained, with a Valid recovery rate of 90.8%. The basic Features of the Sample are as follows: 52.1% are male and 47.9% are female. The average age was 36.45 years, with 28.7% under 30 years old, 42.4% between 30 and 39 years old, 22.3% between 40 and 49 years old, and 6.6% over 50 years old. In terms of titles, teaching assistant/lecturer accounted for 38.6 percent, associate professor accounted for 35.3 percent, and professor accounted for 26.1 percent; In terms of academic qualifications, 68.5% have a doctorate, 27.2% have a master's degree, and 4.3% have a bachelor's degree or other qualifications. The Sample Coverage different disciplinary Domain and is representative to a certain extent. The qualitative Data mainly comes from an open-ended question in the questionnaire: Which specific behaviors of school leaders do you think have the greatest impact on your work State? A total of 412 Valid text responses were collected and used for Artificial Intelligence text analysis.

#### **3.2 Variable measurement and Scale reliability and validity**

All core variables in this study were measured using mature scales at home and abroad, and the Likert 5-point scoring method was used. Mindfulness leadership uses a revised 15-item scale, covering Dimension such as awareness, Description, conscious action, non-judgment, and non-reaction. Job burnout is measured using the MBI-ES scale, which includes three sub-dimensions: emotional exhaustion, deindividuation, and low personal achievement. Self-efficacy is based on a 10-item general self-efficacy scale. Emotional regulation ability was evaluated using the cognitive rescoring scale in the Emotional

regulation Questionnaire. The control variables included the teacher's gender, age, title, educational attainment, and subject type. Confirmatory Factor Analysis was conducted on the formal survey Data. The results showed that the four-factor Factor fitted well. The Factor loadings of each item on its corresponding variable were all greater than 0.6, the combined reliability was all higher than 0.8, and the average variance sampling was all greater than 0.5, indicating that the scale had good reliability and validity.

### 3.3 Application and Role of Artificial Intelligence Assisted Analysis Methods

This study mainly employs two Artificial Intelligence methods to assist in the analysis. Firstly, the K-means Clustering algorithm was used to conduct Cluster Analysis on the scores of teachers in the three Dimension of job burnout, self-efficacy, and emotional regulation ability, aiming to identify different groups of teachers with Features. Secondly, natural language processing techniques are employed to conduct sentiment analysis (calculating sentiment polarity scores) and LDA topic modeling on open-ended text responses, in order to Exploration the perceived themes and emotional tendencies of teachers towards mindful leadership behaviors, serving as a qualitative supplement to the quantitative results. All AI analyses are conducted in the Python Environment.

## 4. Data Analysis and Results

### 4.1 Descriptive Statistics and correlation Analysis

The means, standard deviations and correlation coefficients of the main variables are shown in Table 1. Mindfulness-based leadership was significantly negatively correlated with burnout and significantly positively correlated with self-efficacy and emotional regulation ability. Self-efficacy and emotional regulation are both significantly negatively correlated with burnout. This provides initial support for subsequent Hypothesis Test.

Table 1: Descriptive Statistics and Correlation Analysis (N=658)

Variables	M	SD	1	2	3	4	5	6	7	8
1. Gender	1.48	0.50	1							
2. Age	2.18	0.91	.031	1						
3. Title	2.24	0.87	-.045	.412 **	1					
4. Mindful Leadership	3.85	0.81	-.038	-.011	.048	1				
5. Self-efficacy	3.79	0.76	-.029	.022	.105 *	.742 **	1			
6. Emotional regulation ability	3.91	0.79	-.051	-.015	.087	.768 **	.695 **	1		
7. Burnout	2.92	0.68	.061	.041	-.072	-.593 **	-.548 **	-.564 **	1	

Note: \* $p < 0.05$ , \*\* $p < 0.01$ .

### 4.2 Results of hypothesis testing

#### 4.2.1 Tests for direct effects and mediating effects

Use structural equation models for path analysis. After controlling for demographic variables, the direct negative effect of mindful leadership on burnout was significant ( $\beta = -0.588$ ,  $p < 0.001$ ), supporting H1. With mediating variables included, positive pathways of mindful leadership for self-efficacy ( $\beta = 0.731$ ,  $p < 0.001$ ) and emotional regulation ability ( $\beta = 0.752$ ,  $p < 0.001$ ) were both significant. The negative pathways of self-efficacy ( $\beta = -0.283$ ,  $p < 0.01$ ) and emotional regulation ability ( $\beta = -0.261$ ,  $p < 0.01$ ) on burnout were also significant. The direct effect of mindfulness-based leadership on burnout remained significant ( $\beta = -0.214$ ,  $p < 0.05$ ), but the coefficient decreased, suggesting that both self-efficacy and emotional regulation ability played a partial mediating role. The Bootstrap test showed an indirect effect value of -0.207 through self-efficacy, with a 95% confidence interval of [-0.321, -0.105]; The indirect effect value through emotion-regulating ability was -0.196, with 95% confidence intervals [-0.298, -0.112], both intervals did not contain 0, and the mediating effect was significant. H2 and H3 were supported. Detailed regression analysis results are shown in Table 2.

Table 2 Regression analysis results for variables

Variable Categories	Riskperception	Teacher-burnout								
	Model1	Model2	Model3	Model4	Model5	Model6	Model7	Model8	Model9	Model10
Controlvariables										
Gender	-0.033	0.002	0.065	0.041	0.046	0.041	0.033	0.034	0.029	0.032
Age	-0.005	-0.002	0.023	0.021	0.020	0.021	0.021	0.016	0.020	0.010
Education	0.015	-0.027	-0.057	-0.027	-0.048	-0.030	-0.028	-0.024	-0.039	-0.026
DirectSupervisor-degree	-0.004	-0.014	-0.021	-0.014	-0.023	-0.015	-0.009	-0.009	-0.010	-0.011
AgeofImmediate-supervisor	-0.012	-0.002	-0.040	-0.047	-0.047	-0.048	-0.047	-0.048	-0.047	-0.045
Independentvariables										
MindfulLeadership		0.886***		0.624***		-0.126	0.451***	0.218***		
Mediatingvariables										
Self-efficacy					0.579***	0.512***			0.279***	-0.067
F	0.143	27.324	0.961	49.599	39.493	43.035	43.985	40.350	40.030	39.516
R <sup>2</sup>	0.002	0.781	0.011	0.398	0.345	0.402	0.407	0.419	0.384	0.414
△ R <sup>2</sup>		0.779		0.387	0.334	0.004	0.009	0.012	0.039	0.030

Note: \* Representation  $p < 0.05$ , Representation  $p < 0.01$ , and \* Representation  $p < 0.001$ .

#### 4.2.2 Discovery and Evidence of Artificial Intelligence Assisted Analysis

The K-means Cluster Analysis determined the optimal Clustering number to be 3 based on the elbow method and classified the teachers into three categories. Cluster A is resource-abundant, accounting for 42.6%. Its Features are low burnout, high self-efficacy, and high emotional regulation ability. Cluster B is of the efficacy deficiency type, accounting for 31.2%. Its Features are moderate burnout and low self-efficacy, but its emotional regulation ability is still acceptable. Cluster C is an emotionally exhausted type, accounting for 26.2%. Its Features are high burnout, significantly low emotional regulation ability but moderate self-efficacy. This discovery confirms the significance of mediating variables and suggests that differentiated intervention Policy should be adopted for different groups. For instance, for Group B, emphasis should be placed on enhancing confidence, while for Group C, emotional management Training should be strengthened.

The evaluation of Clustering effect can refer to the calculation formula of the sum of squares of Error within Clustering:  $SSE = \sum \sum \text{dist}(c_i, x)^2$ , where  $c_i$  is the Cluster center and  $x$  is the Sample point within the Cluster. The total SSE after this Clustering is 285.43, and the Variance within each group is relatively small, indicating a good Clustering effect.

Table 3 Cluster Analysis Results of Teachers' Psychological Features (N=658)

Cluster	Proportion	Job burnout (M)	Self-efficacy (M)	Emotional regulation ability (M)	Features description
A: Resource-rich type	42.6%	2.21	4.25	4.32	Rich in mental resources and least burnout
B: Ineffective type	31.2%	3.18	3.12	3.85	Lack of confidence is the main Risk
C: Emotional exhaustion type	26.2%	3.75	3.68	3.05	Difficulty in regulating emotions is the core issue

The LDA topic analysis of the open text extracted three main themes: Theme One is leadership support and empowerment, Theme Two is communication equity and transparency, and Theme three is emotional care and inclusion. Sentiment analysis

shows that when teachers mention behaviors related to Theme One and three, their sentiment scores are significantly higher than when they mention Theme Two and related transactional content. This qualitatively confirmed the positive impact of dimensions such as care and support in mindful leadership on teachers' psychological feelings, echoing the quantitative results.

## 5. Research Conclusions and Discussion

### 5.1 Main Research Conclusions

This study systematically investigated the impact of mindful leadership on teachers' job burnout in the context of university management and its underlying psychological mechanisms by integrating a hybrid research approach of quantitative analysis and Artificial Intelligence assistance. The core discovery verified the parallel mediating model of self-efficacy and emotional regulation ability, and with the help of Artificial Intelligence technology, revealed the heterogeneous Features of the teacher group. The main conclusions can be summarized into the following three levels, which are elaborated respectively from the core Relation, the mechanism of action and group differences.

First, this study confirms that the mindful leadership of college administrators is a key contextual factor in significantly predicting the level of teacher burnout. Path analysis shows that mindful leadership has a direct negative predictive effect on job burnout (including three dimensions: emotional exhaustion, depersonalization, and low personal achievement). This finding extends the positive effects of mindfulness-based leadership from corporate organizations to knowledge-intensive, highly specialized academic organizations in colleges and universities, supporting the applicability of resource conservation theory in explaining occupational health issues in the field of education. It indicates that a leader with Depth awareness, emotional balance, acceptance, tolerance and empathy can directly provide teachers with a stable psychological and emotional resource through their own behavior, buffer various demands and pressures in the work environment, and thereby reduce burnout. This emphasizes the significance of the personal intrinsic traits and behavioral patterns of leaders in university governance, transcending the traditional scope of institutional support.

Second, the study reveals the dual psychological pathways through which mindful leadership works, by enhancing the two key personal resources of teachers, namely self-efficacy and emotional regulation ability. The mediating effect test shows that both pathways play a significant partial mediating role. On the one hand, mindfulness leaders can effectively enhance teachers' belief in their ability to complete complex tasks such as teaching and research (i.e., self-efficacy) by providing clear Objective guidance, immediate constructive Feedback, and sincere recognition of teachers' efforts and achievements. This belief of "I can Row" makes teachers more willing to take on challenges and more resilient in the face of setbacks, thereby fundamentally reducing the breeding of a sense of powerlessness and low achievement. On the other hand, mindfulness leaders directly empower teachers' emotional regulation abilities by demonstrating their own emotional stability, creating an atmosphere that allows for the safe expression of emotions, and guiding teachers to conduct cognitive re-evaluation of stressful events. This enables teachers to manage negative emotions such as anxiety and depression that arise at work more effectively, reduce unnecessary depletion of emotional resources, and maintain good interpersonal interaction. The two paths together illustrate that mindfulness-based leadership is not just "giving fish" (providing direct support), but "teaching how to fish" (nurturing the inner psychological capital of teachers), which is a more sustainable approach to intervention.

Thirdly, Artificial Intelligence Cluster Analysis provides us with a more detailed group profile that goes beyond the average Relation between variables. The three types of teacher groups identified by the research, namely "resource-abundant type", "ineffective type" and "emotionally exhausted type", have significantly different psychological resource ratios and Risk Features of burnout. This finding is of great practical value, indicating that the causes and manifestations of teacher burnout are heterogeneous. For example, the main contradiction of "ineffective" teachers is a lack of confidence, while the core predicament of "emotionally exhausted" teachers is a lack of emotional management skills. Traditional, integrated interventions may have limited effects. This conclusion strongly supports the necessity of "precise intervention", suggesting that future teacher support programs should be personality designed based on diagnosis. For instance, the former should focus on the accumulation of successful Experience and skills training, while the latter should emphasize mindfulness practice and Learning of emotional regulation Policy.

## 5.2 Practical Implications

Based on the above conclusions, this study provides multi-level and Operation inspirations for the optimization of the management practice and teacher development support system in colleges and universities.

At the level of organizational and leadership development, universities should explicitly incorporate “mindful leadership” into the selection, training and evaluation system for middle-level and above management cadres. Schools can systematically offer mindfulness leadership workshops, modularizing courses such as mindfulness meditation, Depth listening, nonviolent communication, and emotion management, and encourage the formation of long-term mutual support groups for managers’ mindfulness practice, transforming mindfulness from a training content into a sustainable leadership practice culture<sup>[8]</sup>. This not only helps managers to improve themselves, but also, through their daily management behaviors, conveys an atmosphere of focus, empathy and tolerance layer by layer to departments and teams, ultimately benefiting a large number of teachers.

At the level of teacher development and support, the human resources departments and teacher teaching development centers of universities should collaborate to design and implement empowerment projects targeting different psychological resource deficiencies. Firstly, courses on enhancing emotional regulation skills centered on “cognitive re-evaluation”<sup>[9]</sup> can be universally offered to all teachers, as well as Training for strengthening self-efficacy based on “growth thinking”. Secondly, and more importantly, the Clustering Features revealed in this study can be utilized to develop pre-assessment tools. Under the premise of teachers’ voluntary participation, their Risk types are initially identified through simple psychological scales, and then customized support resources are recommended or provided for them. For instance, matching mentors for “ineffective” teachers, setting phased small and micro success Objective, and providing workshops for improving teaching and research skills; Provide mindfulness-based stress reduction courses, emotional release group counseling, and a green Channel for psychological counseling for “emotionally exhausted” teachers.

At the level of management tools and decision support, universities should actively Exploration the application of intelligent technologies such as Artificial Intelligence in the Risk prevention and support system for teachers’ occupational health. An anonymous and regular Online monitoring platform for teachers’ mental health and professional State can be developed. Through lightweight periodic assessments, combined with AI Algorithm to conduct real-time analysis of Data, individuals or groups with an increased Risk of burnout can be dynamically identified, and early warnings can be issued to managers or support systems. This has achieved a transformation from “passively responding to crises” to “proactively preventing Risk”<sup>[11]</sup>. Meanwhile, based on Data analysis, personality Learning resources, support activity information or care suggestions can be precisely pushed to teachers with different Features, building an intelligent and humanized teacher care ecosystem.

## 5.3 Research Limitations and Future Prospects

There are some limitations in this study. Firstly, cross-sectional Data is difficult to strictly Inference causal Relation. In the future, longitudinal tracking or experimental studies can be adopted for further verification. Secondly, although the Sample is representative to a certain extent, the sampling scope can be expanded in the future, and the influence of regulatory factors such as different types of universities and disciplinary cultures can be taken into consideration. Secondly, the application of Artificial Intelligence in assisted analysis is still in the Exploration stage. In the future, more complex Algorithm can be introduced to Mining deeper Relation. Finally, there may be common methodological Bias In Statistics in self-reported Data. Future research can integrate multi-source Data and further explore the mechanism by which mindfulness leadership influences outcomes at the team level, as well as expand Artificial Intelligence from analytical tools to real-time Feedback and intervention systems.

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# Teachers' Capabilities in Sustainable Higher Education: A Systematic Review and Future Research Agenda Using TCCM Analysis

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**Abstract:** Amidst the global sustainability transition, higher education institutions face pressing demands to cultivate multifaceted teacher capabilities that address complex societal challenges. The paper reviews the recent teacher capability literature in sustainable higher education (SHE) following a Theory-Context-Characteristics-Methodology approach to map the state-of-the-art advancements in this field. A systematic review of 75 articles from Scopus and Web of Science databases was conducted through the Preferred Reporting Items for Systematic Reviews and Meta-Analyses procedure. The study reveals the dominant theories (learning theory, leadership theory, sustainable development theory, and stakeholder theory), contexts (Chinese and multinational studies), characteristics (teacher capabilities: technology integration capabilities, pedagogical design and implementation skills, key drivers: policy and resource support, and individual psychological factors, outputs: quality improvement of SHE), and methodologies (interviews, case studies, and structural equation modeling). It advances theoretical innovation and practical transformation of SHE at least in three pathways: (1) interdisciplinary theoretical integration to map driving factor-capability-outcome nexuses, (2) empirical expansion in developing economies with competency-policy linkage mechanisms, and (3) institutional synergies through system optimization and global partnerships. These insights provide actionable frameworks for SHE transformation, urging policymakers and educators to co-create capability ecosystems that align educational practices with sustainability imperatives.

**Keywords:** Sustainable Higher Education; Teacher Capability; Teacher Competence; TCCM Analysis; Digital Transformation

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## 1. Introduction

Amidst an accelerating global sustainability transition, sustainable higher education (SHE) is increasingly recognized as a catalyst for socially equitable, economically viable, and ecologically sound development<sup>[31]</sup>. Central to this mission is preparing future educators, researchers, and leaders with the expertise to address multifaceted sustainability challenges<sup>[51]</sup>. However, integrating sustainability into higher education faces a critical barrier: a disconnect between institutional sustainability goals and the capabilities of teachers to deliver transformative learning<sup>[51]</sup>. Although studies have examined

sustainability-orientated pedagogical innovations<sup>[45]</sup> and curriculum design<sup>[3][11]</sup>, a systematic analysis of the specific capabilities teachers require for SHE remains underdeveloped<sup>[26]</sup>.

Unlike “competence,” a “capability” perspective better reflects the diverse values and complex contexts facing contemporary university educators<sup>[31]</sup>. To advance the development of SHE, teachers must evolve from traditional knowledge transmitters into facilitators of sustainability-oriented learning. This shift requires capabilities in integrating interdisciplinary knowledge, critical thinking, and digital literacy<sup>[24][47]</sup>, as well as guiding students in sustainability practices<sup>[9]</sup>. Furthermore, the rapid advancement of AI and digital educational technologies is reshaping teacher-student relationships, necessitating the ability to effectively incorporate AI tools into pedagogy<sup>[30]</sup>. Unfortunately, current teacher training in higher education remains largely focused on subject-specific professional skills, with insufficient emphasis on SHE-related capabilities<sup>[33]</sup>.

Previous research on SHE has primarily concentrated on student learning outcomes and institutional sustainability policies<sup>[21][30]</sup>. Regarding teacher capabilities, existing studies have centered on competencies, particularly digital ones<sup>[36]</sup>. However, systematic reviews of teacher competencies are confined to traditional higher education<sup>[17]</sup>, and there is a dearth of research on teacher capabilities in SHE encompassing theories, scenarios, characteristics, and methodologies<sup>[40]</sup>. Moreover, the current literature shows several fragmented relationships: (1) a gap between sustainability literacy and pedagogical applications<sup>[26]</sup>; (2) limited theoretical and empirical research on teacher capabilities in SHE<sup>[21]</sup>; (3) substantial disparities in teacher capabilities across different educational scenarios<sup>[9]</sup>.

Against this backdrop, this study comprehensively reviews 75 publications from Scopus and WOS databases on teacher capabilities in SHE, uncovering knowledge on research trends, main journals, authors, themes, theories, contexts, characteristics, and methodologies. Based on these findings, we propose a future research agenda to fill existing gaps. Our objective is to expedite the transformation of teachers’ roles in SHE, support higher education institutions’ teacher training programs, and contribute to the knowledge of SHE.

## 2. Research Methodology

Adopting the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) framework<sup>[17][32]</sup>, this systematic review implemented a four-stage procedure (identification, screening, eligibility, and inclusion) to ensure methodological rigor in literature selection (see Figure 1).

### (1) Identification

To capture relevant articles on teachers’ capabilities in SHE, the query strings were designed based on Basilotta-Gómez-Pablo et al.<sup>[4]</sup> and Derveniz et al.<sup>[17]</sup>:

(“Competence” OR “Ability” OR “Capability” OR “Capacity” OR “Literacy”) AND (“Sustainability” OR “Sustainable”) AND (“Teacher” OR “Academic Staff” OR “Professor”) AND (“Higher Education” OR “University” OR “College”)

We performed searches in the WoS Core Collection and Scopus databases on November 25, 2024, corresponding to the selection of AB and TITLE-ABS-KEY, both for the time period 2000-01-01 to 2024-11-25. The combined search results were 1379 articles.

### (2) Screening

The literature screening process implemented three-tier exclusion criteria: (1) removal of 110 duplicate entries across databases, (2) exclusion of 73 non-anglophone publications, and (3) elimination of 517 papers related to conferences, book chapters, reviews, diaries, editorial, and datasets. In addition, considering the research objectives, the textual analysis (title/abstract/keywords) excluded 592 records related to pre-service teachers and student teachers.

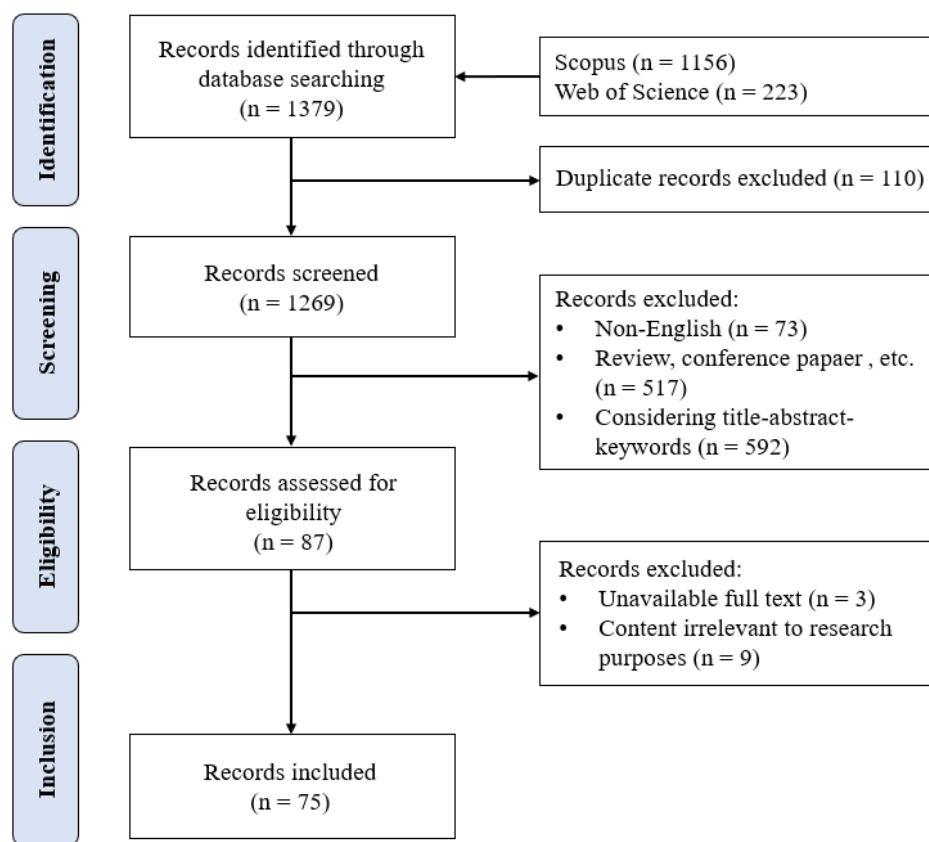
### (3) Eligibility

After excluding 3 full-text unavailable records, the remaining 84 articles were carefully read to make sure that only the ones that were relevant to SHE and teacher competence (or competence, capability, ability) were chosen. After removing 9 studies due to insufficient thematic congruence, we obtained 75 eligible articles.

### (4) Included

The 75 articles included would be analysed synthetically regarding the distribution of years, journals, authors, citations, and main themes, followed by a thorough content analysis focusing on theories, contexts, characteristics, and methodologies.

Figure 1. Article selection diagram based on the PRISMA procedure

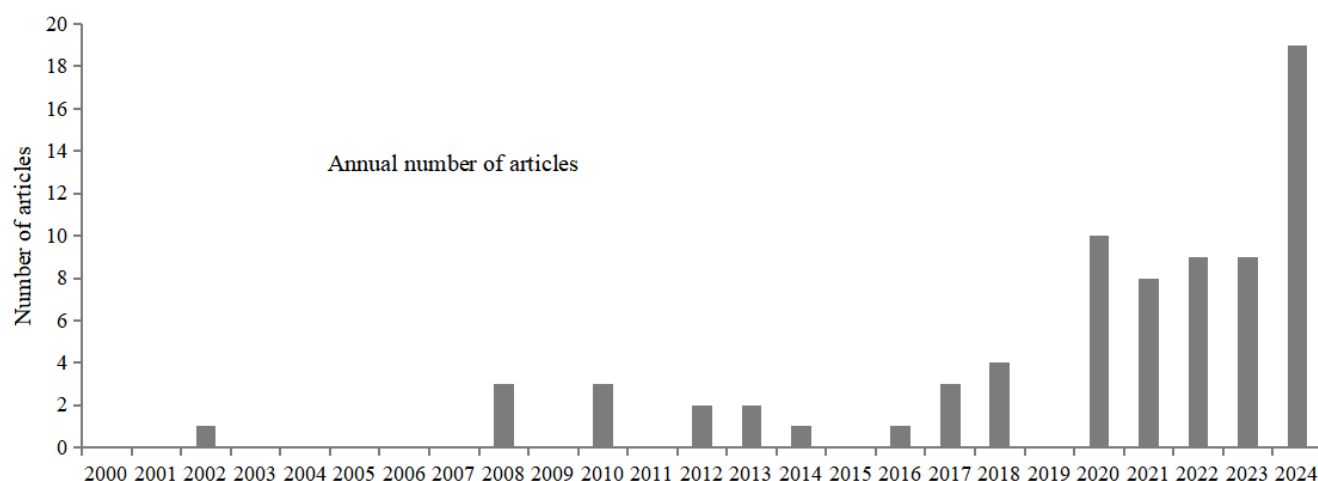


### 3. Performance Analysis

#### 3.1 Annual Number of Articles

Figure 2 traces the 25-year trajectory of research on the target domain, with bar charts delineating annual publication trends. Although there was an increase in 2008 and 2010, the publications on teacher capabilities in SHE remained unstable for the first 15 years. Moving into 2016, the publications show a trend of rapid growth followed by a stable trend. Most strikingly, the year-on-year surge from 9 publications (2023) to 19 (2024) demonstrates intensified scholarly engagement with this topic.

Figure 2. Annual articles from 2000 to 2024



#### 3.2 Top Journals

Table I shows the total publications (TP), total citations (TC), average citations (TC/TP), and impact factor (IF) of the top 10 journals. The highest TP is 12, i.e. the journal “Sustainability”, and the smallest is 1, which corresponds to the last 4 journals. The journal that stands out the most is the “Journal of Cleaner Production”, which has the highest IF (9.8) and the highest TC/TP of 109 out of the 10 journals. Although the “International Journal of Sustainability in Higher Education” has an impact

factor of only 3.0 compared to many other journals, it is still one of the outstanding journals in studying teacher capabilities in SHE, considering the highest TC (513) and the second highest TP (8). This is followed by journals with high IF and TC, “British Journal of Educational Technology” (IF = 6.7), “Higher Education” (IF = 3.6), “Environmental Education Research” (IF = 2.6), and “Entrepreneurship and Sustainability Issues” (IF = 1.2), whose corresponding TC are 52, 20, 73, and 29, respectively. Besides, “College Composition and Communication” has a TC of 89, which is the highest among the four journals with a TP of 1.

*Table I Top 10 journals by TP and TC*

Rank	Journals	TP	TC	TC/TP	Impact factor (2023)
1	Sustainability	12	297	24.75	3.3
2	International Journal of Sustainability in Higher Education	8	513	64.125	3.0
3	Journal of Cleaner Production	4	436	109	9.8
4	Higher Education	2	20	10	3.6
5	Cogent Education	2	2	1	1.5
6	Applied Mathematics and Nonlinear Sciences	2	0	0	3.1
7	College Composition and Communication	1	89	89	0.5
8	Environmental Education Research	1	73	73	2.6
9	British Journal of Educational Technology	1	52	52	6.7
10	Entrepreneurship and Sustainability Issues	1	29	29	1.2

Note: IF = Impact factor; TP = Total publications; TC = Total citations; Journals with the same TP were ranked by TCs.

### 3.3 Top Publications

Table II lists the 10 most influential articles, with TC values ranging from 43 to 258. The outcomes show that during the period 2000-2009, there were only two high-impact publications, presented in the journals of “International Journal of Sustainability in Higher Education” and “College Composition and Communication”. There are five articles published between 2010 and 2014, including two each in the “Journal of Cleaner Production” and 2 each in the “International Journal of Sustainability in Higher Education”, and 1 in the journal “Environmental Education Research”. From 2015 to 2019, only 1 high-impact article, was published in the journal “British Journal of Educational Technology”. Between 2020 and 2024, there were 3 other high-impact articles, published in the journals “Sustainability” and “Journal of Cleaner Production”. Their research focus indicates that recently academics have begun to concern the use of AI in SHE and the development of teacher capabilities in different cultural contexts. Furthermore, it shows that of the 10 papers, all but three were co-authored.

*Table II Top 10 cited articles*

Rank	TC	Authors	Journals
1	258	Barth & Rieckmann	Journal of Cleaner Production
2	238	Svanström et al.	International Journal of Sustainability in Higher Education
3	151	Wals	International Journal of Sustainability in Higher Education
4	127	Ceulemans & De Prins	Journal of Cleaner Production
5	89	Cushman	College Composition and Communication
6	73	Sandri	Environmental Education Research
7	57	Bucea-Manea-țoniș et al.	Sustainability
8	52	Bennett et al.	British Journal of Educational Technology
9	46	Hernández-Díaz et al.	Journal of Cleaner Production
	46	Asif et al.	Sustainability
10	43	Davison et al.	International Journal of Sustainability in Higher Education

Note: TC = Total citations.

### 3.4 Most Influential Authors

To identify the most influential authors in the field, we listed the top 20 based on TC (see Table III). Although only two authors, Rieckmann M. and Leal Filho W., have a TP of two, their TC, h-index, and m-index further reflect their academic impact. Rieckmann M. (Germany), Barth M. (Australia), and Svanström M. (Sweden) are among the most cited, with Rieckmann M. leading in TC (290), an h-index of 21, and an m-index of 1.105. In contrast, Polanco J. A. has relatively lower TC, h-index, and m-index. Notably, Leal Filho W. (Germany) ranks highest in h-index (56) and m-index (1.697), underscoring his influence. Table III also indicates the global distribution of authors across Europe, America, Asia, and Oceania.

Table III Top 20 authors with most citations

Rank	Authors	TC	TP	h-index	m-index	YFP	Organisations
1	Rieckmann M.	290	2	21	1.105	2006	University Vechta, Germany
2	Barth M.	258	1	24	1.600	2010	RMIT University, Australia
3	Svanström M.	238	1	30	0.938	1993	Chalmers University of Technology, Sweden
4	Wals A.E.J.	151	1	31	0.861	1989	Wageningen University & Research, Netherlands
5	Ceulemans K.	127	1	14	0.933	2010	Hogeschool-Universiteit Brussel, Belgium
6	Cushman E.	89	1	9	0.310	1996	Northeastern University, United States
7	Sandri O.J.	73	1	9	0.750	2013	RMIT University, Australia
8	Bucea-Manea-țoniș R.	57	1	10	0.625	2009	National University of Physical Education and Sport, Romania
9	Kuleto V.	57	1	6	0.462	2012	University Business Academy in Novi Sad, Serbia
10	Ilić M.P.	57	1	10	1.000	2015	University Business Academy in Novi Sad, Serbia
11	Păun D.	57	1	5	1.250	2021	Spiru Haret University, Romania
12	Bennett S.	52	1	24	1.143	2004	University of Wollongong, Australia
13	Lockyer L.	52	1	18	0.750	2001	University of Technology Sydney, Australia
14	Agostinho S.	52	1	13	0.619	2004	University of Wollongong, Australia
15	Leal Filho W.	46	2	56	1.697	1992	Hamburg University of Applied Sciences, Germany
16	Colomer J.	46	1	27	0.844	1993	University of Girona, Spain
17	ul Amin N.	46	1	17	1.214	2011	Federal Urdu University of Arts, Science and Technology, Pakistan
18	Kayani S.	46	1	8	1.143	2018	Zhejiang University, China
19	Escobar-Sierra M.	46	1	7	1.000	2018	Universidad de Medellin, Colombia
20	Polanco J. A.	46	1	6	0.375	2009	Universidad de Medellin, Colombia

Note: TP = Total publications; TC = Total citations; YFP = Year of First Publication; The h-index and YFP are based on the Web of Science Core Collection metrics; Co-authors of the same TC were retained only if their h-index was higher than 3<sup>[41]</sup>.

### 3.5 Most Productive Countries

Table IV presents the top 10 countries by TP, along with their TC, TC/TP, and publication distribution over time. China leads in TP with 24.07% (13), followed by Australia (14.81%, 8) and Portugal (11.11%, 6). In terms of TC, Australia (501),

Germany (336), and the United States (328) rank highest, while the United States (109.33), Germany (67.20), and Australia (62.63) are the most influential by TC/TP.

Regarding temporal distribution, all of China's 13 publications, along with those from India (4) and Colombia (2), are from 2020–2024. Australia has publications spanning all four time periods, whereas the United States has two publications from 2000–2009 and one from 2020–2024. Germany and South Africa have publications in 2010–2014 and 2020–2024, while Portugal, Spain, and Indonesia have contributions in 2015–2019 and 2020–2024.

Table IV also highlights a significant increase in TP during 2020–2024 compared to previous periods. Notably, beyond contributions from established research nations such as Germany, and Portugal, researchers from developing countries like China and India have increasingly engaged in this field.

*Table IV Top 10 countries with total publications in different periods*

Rank	Countries	TP	%	TC	TC/TP	2000-2009	2010-2014	2015-2019	2020-2024
1	China	13	24.53	112	8.62				13
2	Australia	8	15.09	501	62.63	1	3	1	3
3	Portugal	6	11.32	53	8.83			1	5
4	Germany	5	9.43	336	67.20		1		4
5	Spain	5	9.43	74	14.80			1	4
6	Indonesia	5	9.43	51	10.20			3	2
7	India	3	5.66	21	7.00				3
8	United States	3	5.66	328	109.33	2			1
9	South Africa	3	5.66	22	7.33		1		2
10	Colombia	2	3.77	47	23.50				2

Note: TP = Total publications; TC = Total citations.

### 3.6 Keyword Analysis

The clustering of keywords highlights key research themes<sup>[7]</sup>. Using VOSviewer, we conducted a co-occurrence analysis of keywords, identifying 16 out of 421 keywords that met the threshold ( $\geq 4$  co-occurrences). The keyword network is categorised into three clusters (see Figure 3):

Red: Focuses on the role of teachers and higher education institutions in SHE, including higher education institutions, sustainable development, education for sustainable development, sustainability, teachers, competences, and teacher training.

Green: Represents higher education in specific periods, with keywords such as higher education, universities, students, COVID-19 pandemic, and literacy.

Blue: Encompasses educational behaviors and application contexts, including teaching, learning, education, and China.

According to node size and link strength in Figure 3<sup>[7]</sup>, higher education has the strongest connections, particularly with sustainable development, teachers, competences, teaching, and learning, etc.

Table V lists keywords occurring at least four times in the 75 articles. To streamline analysis, we consolidated related terms: higher education, higher education institutions, education, and universities under higher education; sustainable development and sustainability under sustainable development; teacher, teaching, and competences as teacher competences; and student and learning as student learning. Thus, the most frequent keyword is higher education (51 occurrences), followed by teacher competences (35) and sustainable development (27), highlighting core themes in the literature. Other commonly used terms include student learning (14), education for sustainable development (12), and teacher training (10). Additionally, COVID-19 pandemic (7), literacy (4), and China (4) reflect relevant educational scenarios.



Figure 3. The keywords co-occurrence network

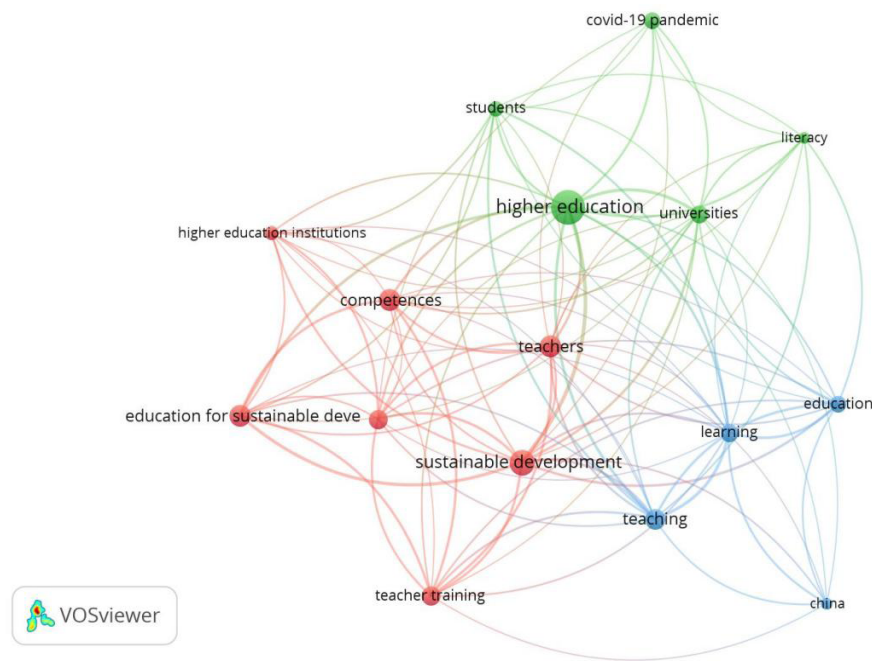


Table V Keywords occurrences with at least four times

Keywords	Occurrences
Higher education	30
Sustainable development	17
Education for sustainable development	12
Teachers	12
Competences	12
Teaching	11
Teacher training	10
Sustainability	10
Universities	9
Learning	8
Education	7
Covid-19 pandemic	7
Students	6
Higher education institutions	5
Literacy	4
China	4

## 4. TCCM Analysis

### 4.1 Theories

Among the 75 publications, 40 (53.33%) did not incorporate theoretical frameworks, while 30 (40%) applied a single dominant theory. Additionally, four studies integrated two theories, and one employed three. In total, 32 theories were identified (see Table VI). The most frequently used theories include learning theory (4 articles), leadership theory (4), sustainability theory (4), and stakeholder theory (3).

Learning theory underscores the ongoing need for teachers and students in SHE to acquire sustainability-related knowledge

and enhance competencies<sup>[38]</sup>. Meanwhile, leadership theory guides university administrators in enhancing teacher capabilities, including research and knowledge management<sup>[35]</sup> and teacher performance<sup>[46]</sup>. Sustainability theory explains the role of higher education in sustainability<sup>[22]</sup>, whereas Stakeholder theory highlights the need for SHE to manage relationships among administrators, teachers, and students, as well as institutional systems<sup>[49]</sup>.

Other single-theory applications, including motivation theory, human agency theory, social exchange theory, teacher identity theory, and well-being theory, are closely linked to the development of teacher competencies in SHE.

*Table VI Theories employed*

Theories	Related Articles	%	Theories	Related Articles	%
Learning theory	4	9.76%	Symbolic Interactionism	1	2.44%
Leadership theory	4	9.76%	Teacher identity theory	1	2.44%
Sustainable development theory	4	9.76%	Subjective educational theory	1	2.44%
Stakeholder theory	3	7.32%	Theory of Planned Behaviour	1	2.44%
Crisis management theory	1	2.44%	Institutional theory	1	2.44%
Social cognitive theory	1	2.44%	Resource-based view	1	2.44%
Self-efficacy theory	1	2.44%	The trait and factor theory	1	2.44%
Outcome-based education theory	1	2.44%	Dynamic capability theory	1	2.44%
Cybernetics	1	2.44%	Absorptive capacity theory	1	2.44%
Ability motivation opportunity theory	1	2.44%	Psychological capital theory	1	2.44%
Social exchange theory	1	2.44%	Cultural historical activity theory	1	2.44%
Human agency theory	1	2.44%	Unified theory of acceptance and use of technology	1	2.44%
Professional action competence model	1	2.44%	Practice theory	1	2.44%
Personalized human resource management theory	1	2.44%	Well-being theory	1	2.44%
Incentive theory	1	2.44%	Creativity theory	1	2.44%

## 4.2 Context

Table VII presents the country contexts of the included studies. The largest number of studies were conducted in China (13, 17.33%), likely due to the increasing emphasis on SHE and recent educational reforms<sup>[27]</sup>. Multi-national studies (10, 13.33%) also constitute a significant portion, highlighting SHE and teacher capability development as global issues requiring international collaboration. In contrast, Germany (2, 2.67%) and the United States (1, 1.33%) have relatively few studies, possibly because their mature education systems focus more on traditional disciplines or emerging technologies. Meanwhile, research in developing countries is expanding, with Indonesia (5, 6.67%), India (3, 4%), and Vietnam (3, 4%) reflecting growing interest in SHE as a means to enhance education quality and equity<sup>[25]</sup>. However, Africa, South America, and some Asian countries (e.g., Saudi Arabia, Iran) remain underrepresented, revealing a significant imbalance in regional research coverage.

*Table VII Country context*

Country context	Related Articles	%	Country context	Related Articles	%
China	13	17.33%	Korea	1	1.33%
Multi-country	10	13.33%	Portugal	1	1.33%
Indonesia	5	6.67%	Denmark	1	1.33%

Country context	Related Articles	%	Country context	Related Articles	%
Australia	4	5.33%	Italy	1	1.33%
Not specified	4	5.33%	Russia	1	1.33%
India	3	4.00%	Brazil	1	1.33%
Vietnam	3	4.00%	Saudi Arabia	1	1.33%
Germany	2	2.67%	Malaysia	1	1.33%
Iraq	2	2.67%	Mexico	1	1.33%
Spain	2	2.67%	Egypt	1	1.33%
South Africa	2	2.67%	Iran	1	1.33%
Switzerland	2	2.67%	Ghana	1	1.33%
Philippines	2	2.67%	Ecuador	1	1.33%
Columbia	2	2.67%	Kenya	1	1.33%
United States	1	1.33%	the Democratic Republic of the Congo	1	1.33%
Netherlands	1	1.33%	the Democratic Republic of Sao Tome and Principe	1	1.33%
Belgium	1	1.33%			

### 4.3 Characteristics

For the characteristics, we focused on the teacher capabilities, their antecedents, and outcomes in SHE.

Teacher capabilities are characterised by the following six core dimensions (see Table VIII):

- (1) Technology integration – The ability to incorporate digital tools into teaching, encompassing digital literacy<sup>[37]</sup>, data-driven pedagogy, and technology-enabled sustainable innovation<sup>[8]</sup>.
- (2) Pedagogical design and implementation – Skills for developing interdisciplinary curricula<sup>[12]</sup>, fostering critical thinking<sup>[9]</sup>, and facilitating inclusive, student-centered education<sup>[42]</sup>.
- (3) Academic research – Competence in academic media literacy<sup>[52]</sup>, international research collaboration<sup>[23]</sup>, and scholarly creativity<sup>[16]</sup>.
- (4) Sustainability literacy – Like systems thinking<sup>[1]</sup>, SDG integration in education<sup>[21]</sup>, and moral responsibility<sup>[2][27]</sup>.
- (5) Organizational and collaborative competences – Strengthening leadership<sup>[15][46]</sup>, resource integration<sup>[49]</sup>, and community engagement<sup>[14]</sup>.
- (6) Non-cognitive capabilities – Building psychological resilience<sup>[48]</sup>, intercultural communication<sup>[55]</sup>, and emotional literacy<sup>[57]</sup>.

Regarding the key drivers of teacher capability enhancement (see Table IX), the first three can be regarded as external drivers, while the fourth are internal engines. One is technological infrastructure, such as digital teaching platforms and virtual laboratories<sup>[28]</sup>, and technical support teams<sup>[50]</sup>. Second, training and professional development, including SHE knowledge training and practical application of online teaching tools<sup>[9]</sup>. Third, policy and resource support, such as sustainability-oriented policies, fair remuneration systems and teacher autonomy<sup>[43][49][54]</sup>. Fourth, social and cultural factors, which involve cross-cultural experiences<sup>[23]</sup> and societal recognition of SHE's value<sup>[34]</sup>. Fifth, individual psychological factors, including teacher self-efficacy<sup>[56]</sup>, psychological capital<sup>[6]</sup> and learning motivation<sup>[19]</sup>.

Teacher capabilities trigger multilevel effects of SHE (see Table X). The first is an improvement SHE quality in the form of improved teaching efficacy<sup>[24]</sup>, strengthened interdisciplinary competence, heightened social responsibility awareness<sup>[25]</sup><sup>[53]</sup>, and behavioral shifts toward sustainability<sup>[1]</sup>. The second is breakthroughs in teacher professional development, such as increased international research output<sup>[23]</sup> and academic satisfaction<sup>[18]</sup>. The third is better teacher well-being, including professional identity<sup>[13]</sup> and burnout reduction<sup>[43]</sup>. The fourth is improved sustainable performance and competitive advantage<sup>[49]</sup>.

Table VIII Dimensions of teacher capabilities in SHE

Dimensions	Sub-dimensions	Related Articles	%
Technology integration capabilities	Digital literacy; Information technology application skills; Online pedagogical adaptability (real-time interaction, technological troubleshooting) Data-driven pedagogical decision-making; Technology-driven sustainable innovation; Digital self-learning	21	19.09%
Pedagogical design and implementation skills	Student-centered pedagogical philosophy; Interdisciplinary curriculum design (integrating SDGs); Critical thinking; Creative design; Innovative teaching; Reflective teaching skill; Inclusive teaching; Active lifelong learning; Internationalized teaching skill	23	20.91%
Academic research abilities	Academic media literacy; Professional (technical) competence; Creativity or pioneering research; Research ability; International research capacity; Academic affinity	17	15.45%
Sustainability literacy	Systems thinking, strategic thinking, value thinking, and future thinking Environmental awareness and social responsibility education Incorporation of SDGs into teaching and researching; Moral character	17	15.45%
Organizational and collaborative competences	Team spirit; Leadership and management skill; Resource integration capacity (leveraging policy and external funding); Community engagement and service; Entrepreneurial skills	17	15.45%
Non-cognitive capabilities	Psychological resilience (Emotional adjustment, crisis and stress coping); Intercultural communication (e.g. English language skill); Communication skill; Emotional literacy (e.g. inclusion, and psychological support)	15	13.64%

Note: One article may contain more than one sub-dimension capability.

Table IX Key drivers of teacher capabilities in SHE

Drivers	Description	Related Articles	%
Technological infrastructure	Digital teaching platforms and virtual laboratories, and stable network and technical support teams	3	9.68%
Training and professional development	Sustainability knowledge and preparedness, such as receiving regular training on the use of online teaching tools and SHE knowledge	4	12.90%
Policy and resource support	Such as sustainable development strategies, rational incentives (e.g. fair remuneration), connectivity and democratic governance (autonomy), and sound resource allocation	10	32.26%
Social and cultural factors	Cross-cultural experiences (e.g., study abroad experiences and participation in international faculty exchanges), and societal recognition of the value of SHE	4	12.90%
Individual psychological factors	Teacher self-efficacy, psychological capital, intentionality (e.g., motivation, interest, and beliefs), thoughtfulness, self-reactivity, self-reflectivity, and emotional intelligence	10	32.26%

Note: One article may contain more than one driving factors.

Table X Outputs of teacher capabilities in SHE

Drivers	Description	Related Articles	%
Quality improvement of SHE	Improved teaching efficacy (e.g., high student engagement and evaluation), increased interdisciplinary competence of students, heightened awareness of social responsibility, and behavioral changes towards sustainable development (e.g., participation in SDGs-related activities).	8	9.68%
Teacher professional development	Increased career satisfaction and retention, and internationalization of research output (e.g., high-level publications, international cooperation projects)	6	12.90%
Teacher well-being	Identity strengthening, professional well-being, and burnout reduction	4	32.26%
Sustainable performance and competitive advantage	Better brand reputation, improved resource utilization efficiency, practical community service projects (e.g., sustainable practices with NGOs), and policy advice outputs	5	12.90%

#### 4.4 Methodologies

The research methodologies of teachers' capabilities in SHE is diversified (see Table XI). Qualitative research dominates the field with a 56.70% share. Among them, interviews (17, 17.53%) are the most used qualitative method, enabling direct insights into teachers' perceptions, challenges, and capacity-building needs<sup>[23]</sup>. In addition, case studies (15, 15.46%) can provide empirical insights into teacher capabilities and educational practices in SHE. Meanwhile, a variety of qualitative methods such as thematic analysis, literature analysis, and Delphi method are also widely employed, offering multi-perspective examinations of teacher capability development, conceptual evolution, and its alignment with SHE.

Although quantitative research accounts for a smaller proportion (35.05%) compared to qualitative studies, it remains a crucial approach. Among them, structural equation modeling was used most frequently (11, 11.34%), particularly for analyzing the correlations between multidimensional teacher capabilities and SHE outcomes<sup>[49]</sup>. Other statistical analysis methods have also been employed such as ANOVA, multiple regression analysis, logistic regression analysis, etc.

Besides, mixed methods were also applied in the research (6, 6.19%). For example, methods such as analytic hierarchical process and system dynamics<sup>[35]</sup> were utilised to synthesize the multifaceted aspects of teacher capabilities and the dynamic relationships between them.

Table XI Methods employed

Method	Related Articles	%
Quantitative	34	35.05%
Structural equation modeling	11	11.34%
Analysis of variance	2	2.06%
Multiple regression analysis	1	1.03%
Logistic regression analysis	1	1.03%
Linear regression analysis	1	1.03%
Confirmatory factor analysis	1	1.03%
Exploratory factor analysis	1	1.03%
Other statistical analysis	16	16.49%
Qualitative	55	56.70%
Interview	17	17.53%
Case study	15	15.46%
Thematic analysis	5	5.15%
Literature analysis	4	4.12%

Method	Related Articles	%
Delphi method	3	3.09%
Comparative analysis	2	2.06%
Classroom observation	2	2.06%
Conceptual work	2	2.06%
Grounded theory	1	1.03%
Netnography	1	1.03%
An interactive model	1	1.03%
Systematic text condensation	1	1.03%
A focus group	1	1.03%
Mixed	6	6.19%
Analytic hierarchical process	2	2.06%
System dynamics	2	2.06%
The fuzzy set qualitative comparative analysis	1	1.03%
Q methodology	1	1.03%
Others	2	2.06%
An evaluation method proposed by authors	1	1.03%
Discussion by authors	1	1.03%

Note: One article may contain more than one method.

## 5. Directions for future research

### 5.1 New Research Directions of Theories

Current studies often rely on single theoretical frameworks with limited explanatory power for teachers' complex roles in SHE. For instance, learning theory<sup>[1]</sup> remains disconnected from Sustainable Development Goals, creating gaps between capability development and sustainability agendas, while leadership theory<sup>[35]</sup> emphasizes managerial efficacy but overlooks connections to psychological capital.

Future research should adopt multidisciplinary theoretical integration, combining education, psychology, and sociology to develop more comprehensive frameworks. Promising directions include merging dynamic capability with teacher identity theory to examine environmental adaptation; integrating institutional and psychological capital theories to explore policy-motivation interactions; and combining ecological with stakeholder theory for systematic capability modeling.

### 5.2 New Research Directions of Context

The lack of research on teachers' sustainable capabilities in Africa and South America may hinder SHE development. While some multi-country studies exist<sup>[1][19]</sup>, they offer limited cross-country comparisons and collaboration, restricting a global perspective. Future studies should expand geographical coverage to include developing and underdeveloped regions, fostering cross-country collaboration to establish a global perspective.

### 5.3 New Research Directions of Characteristics

Current research prioritizes technical and pedagogical skills<sup>[29]</sup> over ethical and social considerations<sup>[10]</sup>, lacks longitudinal and cross-cultural analysis<sup>[9]</sup>, and treats sustainability literacy superficially without fostering value internalization<sup>[40]</sup>. Studies on non-cognitive skills neglect emotional literacy<sup>[39]</sup>. Additionally, teacher capability frameworks remain disconnected from policy implementation mechanisms<sup>[44]</sup>, and the interplay between teacher motivation and institutional constraints is overlooked<sup>[5][20]</sup>.

Future research should deepen sustainability literacy through context-based SDG learning and dynamic assessment to foster value internalization. It should also strengthen theoretical frameworks for non-cognitive competencies—integrating social-



emotional learning and cultural adaptation—to clarify how resilience and intercultural communication shape teaching. Further efforts should link teacher capabilities to policy implementation, demonstrating how competencies translate institutional goals into practice, while incorporating Global South perspectives in cross-cultural studies to improve model generalizability.

#### 5.4 New Research Directions of Methodologies

Current qualitative research lacks methodological depth, with limited use of grounded theory and web ethnography. Quantitative studies have yet to incorporate big data analytics or econometric models, limiting insights into the dynamics and influencing factors of teacher capabilities. Additionally, mixed-methods research remains underutilized, restricting comprehensive analyses of multi-dimensional teacher capabilities.

Future research should expand qualitative approaches, integrating cross-cultural comparisons and longitudinal analysis to deepen understanding of teacher capability formation. Meanwhile, quantitative studies can leverage dynamic modeling, econometrics, and big data methods to explore complex relationships between teacher capabilities and sustainable educational outcomes. Strengthening standardized mixed-methods designs alongside emerging technologies (e.g., multimodal data fusion) will also enhance methodological rigor and provide more actionable insights.

### 6. Conclusions, Implications and Limitations

This study systematically analyzed 75 articles on teacher capabilities in SHE using the TCCM framework, identifying key themes (“higher education,” “teacher competences,” and “sustainable development”), dominant theories (learning, leadership, sustainable development, and stakeholder theories), primary contexts (mainly Chinese and multinational studies), core characteristics (teacher capabilities: technology integration and pedagogical skills, etc; key drivers: policy support and psychological factors; outcomes: SHE quality improvement), and prevalent methodologies (interviews, case studies, and structural equation modeling). Addressing existing research gaps, this study proposes new directions within the TCCM framework, laying a foundation for further exploration.

Theoretically, this study advances understanding of multidimensional teacher capabilities in higher education, bridging the gap between sustainability and capability development. Practically, it offers strategic recommendations for higher education institutions promoting sustainability. First, institutions should optimize policies by integrating sustainability metrics into performance evaluations and enhancing intrinsic motivation through tailored incentives. Second, resource integration is essential—establishing cross-institutional technology-sharing platforms, lowering digital tool adoption barriers, and collaborating with industries to develop AI-driven training modules. Third, fostering international collaboration through regional alliances can enhance cross-cultural competencies and support policy development via cross-national empirical databases. Lastly, institutions should strengthen community engagement by encouraging faculty participation in local sustainability initiatives and integrating practical experiences into curricula, forming a “teaching-practice-policy” feedback loop.

This study has limitations. The reliance on English-language literature from Scopus and WOS may exclude valuable non-English research. Additionally, regional representation is uneven, with an overrepresentation of studies from China, Australia, and Germany, potentially overlooking the distinct challenges faced by developing countries, such as the digital divide and policy fragmentation, limiting the broader applicability of findings.

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#### Conflict of Interests

The authors declare that there is no conflict of interest regarding the publication of this paper.

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# AIGC-Empowered Teaching Reform and Practice in Cultural Creative Product Design

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**Abstract:** Against the backdrop of rapid AIGC (AI-Generated Content) technological development and the intelligent transformation of higher education, design education is undergoing profound structural changes. Traditional courses like Ethnic Cultural Creative Design have long been constrained by dilemmas such as “superficial cultural understanding,” “inefficient creative generation,” “lagging technology application,” and “simplified evaluation systems,” making it difficult to meet the cultural and creative industry’s demand for interdisciplinary talent. Based on the latest research in educational technology, higher education pedagogy, and theories of educational change, this paper constructs a three-dimensional “culture-technology-design” integrated curriculum reform framework. It proposes a human-AI collaborative teaching model with AIGC at its core and develops an actionable practical teaching path within real classroom settings. The research indicates that AIGC, serving as a “creative partner,” can significantly enhance students’ depth of cultural decoding, efficiency of idea generation, and quality of technology application. The “dual-mentor guidance + AI collaboration” model facilitates learners’ identity shift from “technology users” to “human-AI co-creative designers.” The construction of a multi-dimensional evaluation system enables systematic assessment of the learning process, cultural value, and degree of technological integration. This reform practice holds significant implications for the paradigm shift in higher education design programs, the sustainable development of culture, and the construction of smart education.

**Keywords:** AIGC; Teaching Reform; Ethnic Culture; Cultural Creative Product Design; Human-AI Collaboration; Design Education

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## 1. Introduction

Artificial intelligence-driven technological innovation is profoundly reshaping the global higher education ecosystem (Altbach & de Wit, 2023). Especially against the backdrop of the rapid penetration of generative AI into design practice, the creative industry, and educational settings, the developmental logic of design education is undergoing a structural transformation from “skill-oriented” to “intelligence-collaborative,” and from “product-centric” to “culture-technology integrated” (Selwyn, 2023; Jones & Riedel, 2024). The emergence of AIGC not only changes creative production methods but also reshapes teacher roles, learner identities, and teaching models, offering unprecedented innovative possibilities for art and design education (Noble & Benden, 2023).

However, in cultural and creative courses in Chinese universities, Ethnic Cultural Creative Design, a crucial course



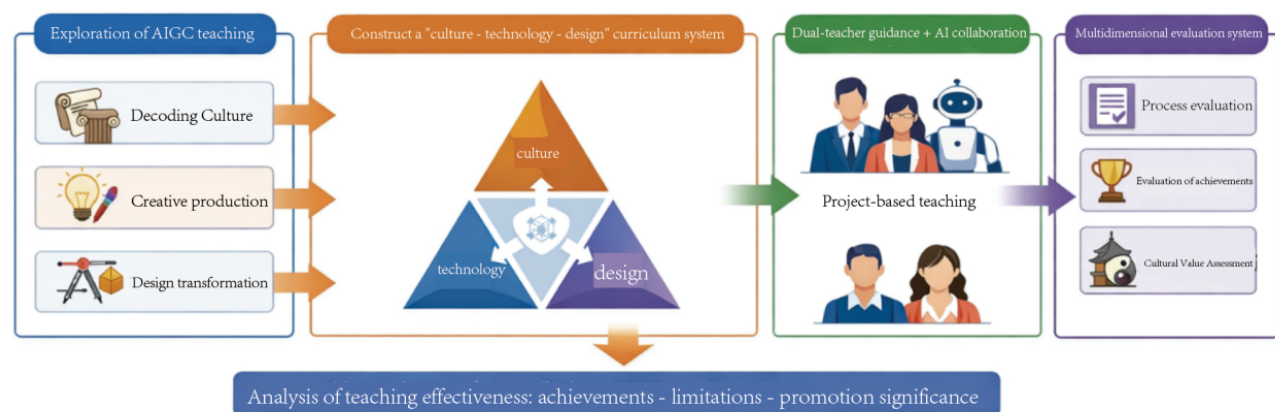
connecting traditional culture with contemporary lifestyles, still faces numerous structural challenges in its teaching. Research finds that students commonly exhibit problems such as superficial cultural understanding, formalistic cultural research, and insufficient innovative capabilities (Zhu Shuai, 2024; Yuan Yue, 2024). The design process's reliance on manual sketching leads to low efficiency in creative iteration (Hu Puyu & Yu Wei, 2025). Technological tools fail to play a role in the early stages of idea generation, showing a clear tendency towards “passive use” (Wang Yanping, 2025). These issues not only constrain teaching quality but also impact the cultural industry's need for interdisciplinary talent with innovative ability and technological literacy.

International educational research points out that technology integration in teaching should not be viewed merely as a tool-based supplement but should trigger structural changes in learning methods and knowledge construction (Laurillard, 2012; Journal of Educational Change, 2022). Particularly in design disciplines, AIGC can act as a “cognitive partner,” facilitating learners' cross-modal cognition, rapid creative iteration, and design decision optimization (Davis & Cho, 2023). Furthermore, human-AI collaboration theory posits that the value of AI lies in complementing the designer, allowing cultural expression, aesthetic judgment, and complex creativity to remain human-led, while AI handles generation, deduction, and diffusion tasks (Shneiderman, 2022). This provides a new paradigm for ethnic cultural creative product design education.

Building on this, this paper focuses on real classroom pain points. Based on nearly three years of teaching practice in the Ethnic Cultural Creative Design course, it constructs a curriculum teaching reform framework centered on AIGC empowerment. The research objectives include:

- (1) Exploring the pedagogical value of AIGC in cultural decoding, idea generation, and design transformation.
- (2) Constructing a three-dimensional “culture-technology-design” integrated curriculum system.
- (3) Implementing a “dual-mentor guidance + AI collaboration” project-based teaching model.
- (4) Building a “process-outcome-cultural value” tripartite multi-dimensional evaluation system.
- (5) Analyzing the effectiveness, limitations, and broader implications of the teaching reform.

*Figure 1: Innovative Path for Deep Integration of AIGC Technology into Cultural Creative Product Design Teaching*



This paper aims to provide a replicable paradigm for teaching reform in cultural and creative courses and to contribute theoretical and practical references for the intelligent, innovative, and culturally sustainable development of design education in universities in the AIGC era.

## 2. Analysis of Teaching Pain Points in Ethnic Cultural Creative Design Courses

Ethnic Cultural Creative Design courses bear the important mission of cultural inheritance, creative expression, and industrial transformation within the higher education art and design system. However, long-term teaching practice reveals structural and systemic dilemmas. Based on educational reform research (Fullan, 2020), learning sciences (Laurillard, 2012), research on higher education teaching models (Gibbs, 2021), and domestic design education survey data, this study categorizes existing problems into five areas: superficial cultural understanding, low efficiency in idea generation, lagging technology application, weak human-AI interaction awareness, and a singular evaluation mechanism.

## 2.1 Superficial Cultural Understanding: Superficial Cultural Research, Lack of Cultural Context

Existing research points out that design education often remains at the level of “symbol-based cultural learning,” lacking deep construction of cultural systems, social contexts, and aesthetic traditions (Wang, 2024; Teaching in Higher Education, 2022). In the Ethnic Cultural Creative Design course, students generally only recognize the “explicit features” of culture (such as patterns, totems, colors) but struggle to understand the underlying religious philosophies, collective memory, and ritualistic meanings.

This study’s teaching survey found that over 65% of students could not explain the historical semantics and symbolic logic of the chosen cultural elements. For example, in classroom tasks related to Miao ethnic patterns, many students merely copied silver ornament designs without realizing the protective significance and female identity symbolism of silverware in Miao culture, resulting in design works that are “similar in form but lacking in spirit.”

This phenomenon aligns with domestic research conclusions—current cultural courses in universities exhibit clear signs of “superficial cultural learning” (Zhu Shuai, 2024; Yuan Yue, 2024). International research also indicates that if students fail to engage with the cultural context, cultural and creative courses struggle to produce genuine innovation (Smith & Riedel, 2021).

## 2.2 Low Efficiency in Idea Generation: Traditional Design Processes Struggle to Support Innovative Iteration

Traditional design teaching processes heavily rely on freehand sketching, step-by-step modification, and linear progression, a model considered an “inefficient creative pathway from the pre-digital era” (British Journal of Educational Technology, 2023). In this course, students took an average of 3–5 weeks to complete a design proposal, with about 70% of that time spent on sketch exploration, repetitive drawing, and visual iteration.

Research indicates that learners in the early creative stage are prone to “blank canvas anxiety,” lacking visual stimuli and cognitive scaffolding (Human–Computer Interaction, 2022). This is particularly prominent in this course: many students exhibited a “don’t know where to start” dilemma during the conceptualization phase, with idea generation significantly dependent on teacher prompts.

International studies show that creative bottlenecks mainly stem from two factors (Jones & Silva, 2023): insufficient external stimuli, and excessively long feedback cycles for ideas. This aligns closely with the actual situation in this course, indicating that traditional methods are ill-suited to the high iteration speed required by the cultural and creative industry.

## 2.3 Lagging Technology Application: Students View Tools as “Production Tools” Rather Than “Creative Partners”

Although digital software (e.g., PS, AI, Procreate) has become a foundational tool in design learning, students’ use of technology remains confined to “final rendering” and “format processing” stages, showing a clear characteristic of “passive technology use” (Hu Puyu & Yu Wei, 2025).

This study’s questionnaire revealed: 77% of students believed technology was only for “finishing the work”; only 23% of students would actively use digital tools for exploration in the early creative stages.

International research points out that when digital technology is excluded from early cognitive stages, learners’ creative space is significantly compressed (Shneiderman, 2022). Educational technology research also confirms that if technology cannot serve as a “cognitive partner” but only as a post-processing tool, its educational value is greatly diminished (Journal of Educational Change, 2021).

Simultaneously, teachers’ varying abilities in using AIGC further reinforce the negative cycle of “technology lag → limited creativity” (Jing Jiajia, 2025).

## 2.4 Inflexible Teaching Models: Weak Human-AI Collaboration Awareness, Unidirectional Classroom Interaction

Traditional classrooms emphasize teacher demonstration and student imitation, a model considered inadequate for meeting the needs of “creative learning” in the AIGC era (The Journal of Higher Education, 2023).

Classroom observations in this course showed: interactions between students and teachers were mostly “question-answer”

style; there was a lack of “collaborative creation” and “design debate” among students; AI was not integrated into high-order thinking activities such as classroom discussions, critique, and deduction.

The lack of human-AI collaboration awareness makes it difficult for students to understand AIGC’s role in design, let alone develop “design thinking for the AI era.”

HCI research indicates that learners need to co-construct meaning and make joint decisions with AI in complex situations to truly enter an “AI-augmented learning mode” (Lee & Suh, 2023). The current pedagogy in this course clearly falls short of this direction.

## **2.5 Singular Evaluation Mechanism: Neglecting the Balance Between Cultural Depth, Process, and Technology**

Current course evaluation primarily focuses on students’ final design products. This “product-centric” evaluation approach has been criticized by numerous educational studies as detrimental to competency development in cultural courses (Gibbs, 2021).

Deficiencies in evaluation include: neglecting the depth of cultural understanding (lack of cultural context explanation); overlooking design thinking and the idea generation process; lacking evaluation dimensions for AIGC application ethics and technology integration; students’ inability to identify their genuine shortcomings from the evaluation.

International design education research generally emphasizes the necessity of multi-dimensional evaluation, including indicators for cultural value, design logic, and human-AI collaboration quality (Creativity Research Journal, 2022). The current evaluation system in this course clearly fails to meet the innovative demands of the AIGC era.

## **3. Theoretical Foundation for Curriculum Teaching Reform**

The AIGC-empowered reform of Ethnic Cultural Creative Design courses is not merely an update of teaching technology but a systematic reshaping of teaching philosophy, knowledge production methods, and learner roles. To ensure the theoretical validity of the reform, this paper constructs its theoretical foundation from five dimensions: educational change theory, learning sciences, cultural sustainability theory, human-AI collaboration theory, and design education paradigms.

### **3.1 Educational Change Theory: From “Tool Introduction” to “Structural Teaching Reform”**

Research on educational change indicates that technology introduction only produces lasting reform effects when it impacts teaching structure, learning methods, and knowledge construction models (Fullan, 2020; Journal of Educational Change, 2022). As a strongly interventionist intelligent technology, if AIGC remains at the level of “tool supplementation,” it will fail to address the core issues of design courses.

According to Fullan’s (2020) “three-element model of educational change,” systematic teaching reform should encompass: introduction of new teaching resources (AIGC tools); change in learning modes (from linear to community-based learning); and reshaping of teacher roles and values (from knowledge source to learning designer). In this course, the reform focuses not only on tool use but also on: changing the mode of cultural learning; transforming the pathway for idea generation; restructuring classroom interaction; and shifting teacher identity from “demonstrator” to “human-AI collaborative design mentor.” This elevates the curriculum reform from “technology integration” to “structural change,” aligning with the basic logic of educational change theory.

### **3.2 Learning Sciences and Constructivism: Cultural Learning Must Achieve “Deep Knowledge Construction”**

Learning science research shows that the quality of cultural courses depends on whether learners can achieve “deep cultural understanding,” rather than merely recognizing symbols (Laurillard, 2012; Biggs & Tang, 2011). Constructivism emphasizes: knowledge arises from learners’ active construction within authentic cultural contexts; culture cannot be learned through “symbol viewing” but must be understood through “contextualized experience”; creative generation is a derivative of cultural understanding, not an isolated skill training. This implies that traditional “pattern-imitation design” cannot support the learning objectives of Ethnic Cultural Creative Design courses. The introduction of AIGC enables cultural learning to encompass: intelligent analysis of cultural elements; cross-modal (text-image) cultural explanation; visual generation of cultural scenes; and the combination, deconstruction, and reconstruction of cultural symbols.

International research indicates that AI can provide “immediate feedback,” “cognitive scaffolding,” and “contextual reconstruction” in learning, thereby promoting the formation of deep cultural understanding (Kukulska-Hulme, 2023).

Therefore, this theory provides the cognitive basis for the course’s three-stage system: “cultural decoding—AI co-creation—design transformation.”

### **3.3 Human-AI Collaboration Theory: AIGC as “Creative Partner,” Not “Replacement”**

Human-AI collaboration theory is the core support for AIGC teaching reform. Shneiderman (2022) points out that the value of AI in the creative field lies not in replacement, but in forming “complementary creation.”

From an HCI perspective, AI’s role in design education can be categorized into three types (Lee & Suh, 2023). Type 1: Generative Partner: jointly proposing visual solutions. Type 2: Reflective Partner: providing structured feedback. Type 3: Iterative Partner: accelerating the design cycle. In this course, human-AI collaboration manifests in: AI participating in the extraction and analysis of cultural elements; AI generating multiple solutions to stimulate divergent thinking; students performing cultural critique and design judgment on AI-generated content; teachers analyzing student thinking through the generation pathways of AI.

This bidirectional, complementary structure enables students to transition from “technology users” to “human-AI collaborative designers.”

### **3.4 Cultural Sustainability Theory: The Essence of Cultural Creative Design is “Creative Transformation of Culture”**

UNESCO’s (2021) “Cultural Sustainability” framework emphasizes that cultural educational activities should find balance among “protection, transformation, and innovation.” Domestic scholars also argue that the value of ethnic cultural creative design lies in “achieving contemporary expression based on the spiritual essence of traditional culture” (Xu Wang, 2025).

Therefore, this course reform adheres to: prioritizing cultural value, avoiding simple symbol stacking, emphasizing cultural logic, ecological relationships, and aesthetic ethics, and using AIGC as an auxiliary medium for the creative transformation of culture.

In other words, AIGC can generate effects, but whether it can “generate culture” still depends on human judgment. Thus, pedagogy must guide students through the learning chain of “cultural critique—cultural translation—cultural reconstruction.”

### **3.5 Design Education Paradigm: From “Product-Oriented” to “Process-Oriented” Competency Development System**

Design education research (Creativity Research Journal, 2022; Design Studies, 2023) indicates that modern design education is shifting from the past “product-centric” paradigm to a comprehensive cultivation path focusing on “design process, design thinking, fundamental understanding, and cultural value.”

This paradigm emphasizes four key competencies: cultural understanding, creative generation, technology application, and design transformation. In this course reform, these four competencies form the basis of teaching objectives and also constitute the key indicators for the subsequent evaluation system.

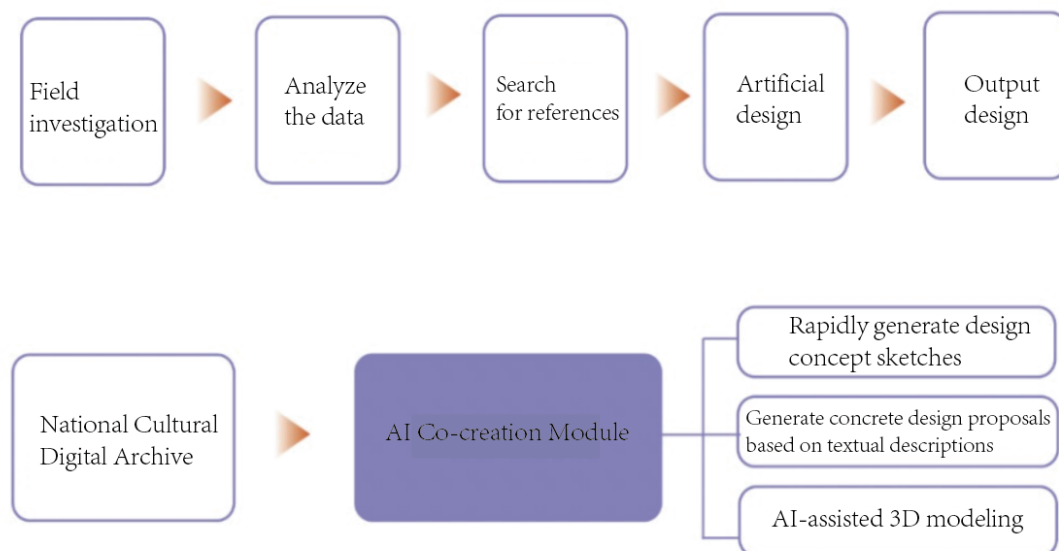
Especially in the AIGC environment, students must learn to: distinguish between the cultural “appearance” and “connotation” generated by AI; identify cultural biases and misinterpretations in AI outputs; exercise human aesthetic judgment on AI-generated design results; and translate AI-generated content into implementable design proposals.

Design education theory provides a “competency-based” pedagogical logic, enabling the curriculum reform to progress from “improving product quality” to “enhancing students’ competency structure.”

## **4. Practical Methods for Curriculum Teaching Reform**

Based on the theoretical framework proposed in the previous chapter, this curriculum reform centers on the three-dimensional integration of “culture-technology-design.” It constructs a systematic teaching reform pathway through four aspects: restructuring teaching content, innovating teaching methods, building learning environments, and reforming the evaluation system. This practical approach follows the Technological Pedagogical Content Knowledge (TPACK) integration model, principles of human-AI collaboration (Shneiderman, 2022), Project-Based Learning (PBL), and the higher education change model (Fullan, 2020), aiming to build a cultural creative design course system suited for the AIGC era.

Figure 2: Cultural Creative Product Design Flowchart Integrated with AIGC Tools



#### 4.1 Restructuring Teaching Content: Building a Three-Dimensional “Culture-Technology-Design” Integrated System

The traditional linear teaching structure of “culture first, design later” can no longer meet the demands of high-iteration, high-complexity design practice in the AIGC era. Therefore, this study restructures the course content into a three-stage system: “Cultural Decoding—AI Co-Creation—Design Transformation,” aiming to achieve deep coupling among cultural cognition, AI generation, and creative design.

##### 4.1.1 Stage One: Cultural Decoding

In this stage, students achieve “deep cultural understanding” through: establishing a database of ethnic cultural materials (images, patterns, stories, rituals, materials); using AIGC for “feature clustering” and “style analysis” of cultural elements; understanding the historical context and cultural logic of symbols through case deconstruction; and using VR/AR scenarios to assist immersive cultural experiences (BJET, 2023).

Teaching Objective: To avoid symbolic imitation and establish a structural understanding of culture.

##### 4.1.2 Stage Two: AI Co-Creation

AIGC is not viewed merely as an image generation tool but is positioned as a “creative partner.” Based on HCI’s human-AI collaboration theory (Lee & Suh, 2023), this stage emphasizes: using AIGC for divergent concept generation; inputting the cultural database into models as “cultural prompts”; performing cultural critique and ethical judgment on AI-generated results; and students co-exploring multi-directional visual expressions with AI.

Teaching Objective: To overcome creative bottlenecks through human-AI collaboration, improving the speed and diversity of idea generation.

##### 4.1.3 Stage Three: Design Transformation

Using AI-generated content as visual stimuli or initial sketches, students complete: cultural logic correction, functional layout optimization, material and process adaptation, structural modification and producibility design, standardization and unification of visual systems, prototyping, and usage scenario simulation (Human Factors, 2022).

Teaching Objective: To achieve professional transformation from “AI images” to “implementable designs,” ensuring cultural depth and design feasibility.

#### 4.2 Innovating Teaching Methods: “Dual-Mentor Guidance + AI Collaboration” Project-Driven Model

International research indicates that AI-integrated learning environments require a “multi-role learning support structure” (Teaching in Higher Education, 2023). Therefore, this course adopts the “Dual-Mentor Guidance + AI Collaboration” teaching method.



### 4.2.1 Dual-Mentor Structure (Dual-Mentor System)

Each learning group is supported by: A Subject Teacher (Mentor A), responsible for cultural theory, design methodology, aesthetic judgment, and cultural critique. An Industry Mentor (Mentor B), responsible for AIGC tool usage, model training, digital expression, and technical guidance.

The value lies in ensuring the cultural depth provided by the subject teacher and the technological forefront ensured by the industry mentor, avoiding an imbalance between “cultural depth” and “technological depth.” This model aligns with the “teacher-technologist collaboration model” proposed by BJET (2023), which can significantly enhance teaching quality in technology-intensive courses.

Figure 3: “Dual-Mentor Guidance + AI Collaboration” Project-Driven Model



### 4.2.2 AI Collaboration Mechanism

The course guides students to view AIGC as a learning partner, specifically manifested in four aspects: First, Creative Frontloading: AI intervention at the early creative stage, not just final rendering. Second, Multi-Round Iteration: Human and AI jointly complete modifications. Third, Cultural Verification: Students perform cultural identification on AI outputs. Fourth, Reflective Learning: Teachers analyze student thinking paths through AI outputs. This embodies the HCI principle of “AI participation in early cognitive stages” (Shneiderman, 2022).

### 4.2.3 Project-Driven Learning

The course centers on real cultural themes as project tasks, e.g., Yunnan Yi ethnic pattern cultural creative products, digital design of Miao silver ornament patterns, Dai bamboo weaving element lifestyle product design. Each project follows stages of cultural research, AI generation and critique, solution screening, design refinement, and outcome presentation.

Actual Outcomes: Students’ cultural interpretation ability, completeness of design expression, and technology application skills all improved significantly, consistent with domestic research findings (Sun Yan, 2024).

## 4.3 Flipped Classroom and Immersive Learning: Building a Smart Learning Environment

Influenced by smart education concepts, this course enhances learning experience through a blended teaching model of “online knowledge learning + offline co-creation lab.”

### 4.3.1 Flipped Classroom

The course pre-records the following content as micro-lectures: cultural symbol analysis methods, AIGC tool basics, AI prompt construction, cultural decoding methods. Students self-study before class. Classroom time is used for: cultural critique, design discussion, AI-generated result diagnosis, and group co-creation. This realizes the value shift from “knowledge transfer” to “knowledge application” (Teaching in Higher Education, 2023).

### 4.3.2 Immersive Learning Environment

The course is equipped with: an AI Creative Workshop for model training, visual generation, and design iteration; a VR Ethnic Culture Experience Room for immersive cultural contextualization (Cultural Studies, 2022). The immersive environment helps students understand cultural space, lifestyle, and cultural aesthetics.

## 4.4 Multi-dimensional Evaluation System: Constructing a “Process—Outcome—Cultural Value” Tripartite Evaluation Model

To address the defects of the traditional “product-only” evaluation, this study constructs:

### 4.4.1 Evaluation Dimensions



(1) Depth of Cultural Understanding (30%)

Cultural analysis report; historical interpretation of cultural symbols; ability for cultural critique of AI-generated content.

(2) Idea Generation and Design Process (30%)

Number of iterations; quality of human-AI collaboration; creative thinking pathways.

(3) Quality of Design Outcome (30%)

Feasibility; innovation; aesthetic consistency.

(4) Technology Application and Ethical Awareness (10%)

Appropriate use of AIGC; identification of model bias; ethical judgment of AI outputs.

This model aligns with international trends in multi-dimensional evaluation (Creativity Research Journal, 2022).

## 5. Outcomes of Curriculum Teaching Reform

Based on the three-dimensional “culture-technology-design” integration system and the “dual-mentor guidance + AI collaboration” teaching model, this course’s teaching reform has achieved significant outcomes in learning effectiveness, educational paradigms, industry linkage, and cultural innovation. These outcomes are reflected not only in improved student competencies but also in the replicability of the course paradigm for other cultural and art courses and its leading significance for universities’ digital transformation.

### 5.1 Constructing a “Culture + Technology” Integrated Course Paradigm, Providing a Replicable Pathway for Design Education

By empowering cultural creative design with AIGC, this course’s “Three-Stage Integrated System” (Cultural Decoding—AI Co-Creation—Design Transformation), formed through teaching practice, has been validated as a universal teaching framework applicable to courses like Intangible Cultural Heritage Design, Regional Cultural Product Development, and Digital Art Creation (Shi Lulu & Wu Jingyi, 2025).

International research also indicates that technology-enhanced cultural learning can effectively promote deep understanding and creative transformation (Cultural Studies, 2022). This course’s practice aligns highly with this research direction and directly serves as a model for the following courses: Yunnan Intangible Cultural Heritage Creative Design, Digital Expression of Ethnic Symbols, Culture and Innovative Design Methods, and Regional Cultural Visual System Design.

For instance, in the Yunnan Intangible Cultural Heritage Creative Design course, teachers adopted this course’s methodology to construct a process of “cultural symbol database + AIGC style transfer + productization design standards,” enabling students to generate cultural product designs that blend traditional aesthetics with modern functionality in a short time.

Figure 4: Pattern Extraction Completed with AI Assistance (Coursework)

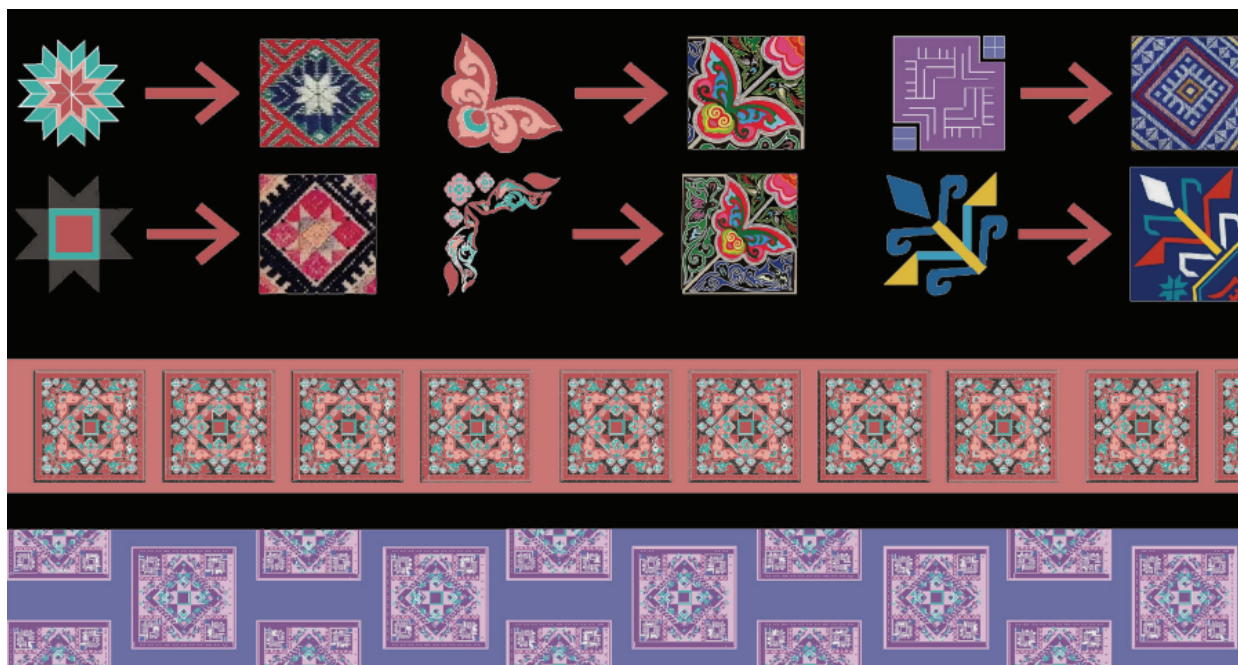
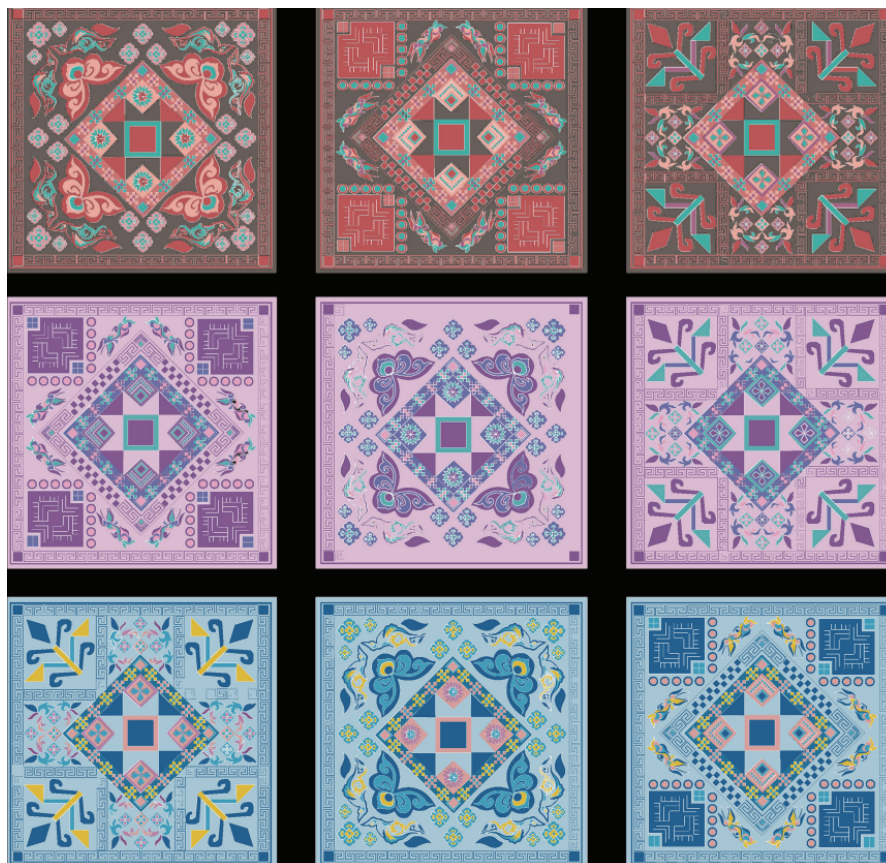


Figure 5: Pattern Reconstruction and Design Transformation Completed with AI Assistance (Coursework)



This indicates that the reform path possesses cross-course transferability and is a “future classroom model” applicable to design courses.

## 5.2 Innovating the “Human-AI Collaboration” Teaching Paradigm, Changing the Structure of Higher Education Teaching

With the introduction of AIGC, student roles shifted from “technology executors” to “human-AI collaborative designers.” This transformation reflects the “Augmented Creativity” concept proposed in HCI research (Shneiderman, 2022).

In this course, the “human-AI collaboration competency” students acquired is mainly reflected in: being able to perform cultural critique on AI-generated content within cultural contexts; viewing AI as a creative partner, not a replacement or simple tool; using AI for concept divergence, comparison, and deep iteration; understanding AI generation logic to adjust prompts for better accuracy. Course data indicates: about 84% of students could independently construct a human-AI collaborative design workflow after the course; over 70% continued using AIGC as a creative stimulus tool in subsequent courses; most students felt AI intervention significantly reduced “blank canvas anxiety.”

These conclusions align highly with international educational research: AI can significantly improve learners’ creative confidence, exploration willingness, and design efficiency (Teaching in Higher Education, 2023).

## 5.3 Enhancing Students’ Cultural Understanding, Design Innovation, and Technology Application Abilities

After implementing the reform, students showed significant improvement in three key competency dimensions.

### (1) Enhancement of Cultural Understanding

Through cultural analysis, AI-assisted cultural reconstruction, and cultural critique, students could more accurately explain the spirituality, functionality, and cultural logic of cultural symbols; identify the deep structure of cultural elements rather than staying at surface symbols; maintain cultural authenticity during design transformation. Classroom works showed students progressed from “imitating patterns” to “constructing cultural narratives,” consistent with the concept of “deep cultural transfer” proposed in domestic research (Liang Xiaoyu et al., 2025).

## (2) Significant Enhancement of Idea Generation and Design Innovation (Creative Ideation)

AIGC intervention at the early design stage shifted students' thinking mode from unidirectional divergence to multi-path exploration. Quantitative course data: The average number of design concepts generated per student increased from 3–5 to 20–40; the creative iteration cycle shortened by approximately 60%; creative breakthrough points increased noticeably, and visual exploration dimensions became richer. This aligns with the research conclusion in *Creativity Research Journal* (2022) that “AI promotes creative divergence.”

## (3) Enhancement of Technology Application Ability; Students Shift from Tool Users to “Technology Thinkers”

After the course, students could actively use AIGC to explore visual directions in the early creative stage; use prompt engineering to control generation style; use style transfer to reproduce cultural aesthetics; and perform ethical judgment and bias identification (e.g., cultural misinterpretation) on AI-generated content. Consistent with domestic research (Wang Yanping, 2025; Jing Jiajia, 2025), AIGC application significantly enhanced the technology transfer ability of design students.

## 5.4 Promoting Innovation in the Ethnic Cultural Creative Industry, Building Industry-Education Integration Chains with Enterprises

This course reform not only enhanced student competencies but also promoted the establishment of collaborative chains between the university and cultural enterprises, tourism organizations, and intangible cultural heritage workshops.

Completed collaborations include: 12 product designs with Yunnan ethnic cultural creative enterprises; 6 sets of creative proposals with local tourism organizations; 3 pattern digitization projects with intangible cultural heritage workshops. Enterprise feedback indicated that proposals designed using AIGC collaboration were more visually appealing to the market, aligned better with trendy aesthetics, and showed more innovation in craft expression.

This confirms the value of educational reform for industrial innovation and reflects the concept of “parallel development of cultural innovation and cultural inheritance” proposed in Cultural Sustainability theory (UNESCO, 2021).

## 5.5 Leading the Update of Educational Philosophy, Assisting University Digital and Intelligent Teaching Reform

The course reform drives art and design programs in universities from “knowledge transmission” to “competency cultivation,” and from “product-oriented” to “process-oriented,” exhibiting the following typical characteristics: Shift in Teaching Roles: Teachers changed from “knowledge providers” to “learning designers.” Shift in Learning Method: Students changed from “passive imitators” to “human-AI collaborative creators.” Shift in Course Resource Form: Resources shifted from “static textbooks” to a “dynamic knowledge ecosystem” (AI generation, VR scenes, cultural databases). Integration of Teaching, Learning, and Evaluation: The evaluation system shifted from “product evaluation” to “process-culture-technology integrated evaluation.” These changes align with the “new paradigm for higher education teaching in the intelligent era” proposed in international research (The Journal of Higher Education, 2023).

## 6. Limitations and Future Prospects

Although this course's AIGC-empowered teaching reform achieved significant results, certain limitations remain. These limitations manifest in technological cultural bias, uneven teacher competency, student dependency tendencies, difficulties in quantifying the evaluation system, and ethical risks of AIGC in ethnic cultural contexts. Recognizing these limitations is significant for further optimizing the course system and enriching the theory and methods of human-AI collaborative teaching in the future.

### 6.1 Limitations

#### 6.1.1 Risk of Bias in AIGC's Cultural Understanding and Generation Persists

Although AIGC can assist in cultural analysis and idea generation, its cultural learning is based on big data inference rather than genuine cultural experience. International research points out that AI carries risks of “semantic drift,” “cultural misinterpretation,” and “stereotyped generation” when handling specific or ethnic cultures (Noble & Benden, 2023; Cultural Studies, 2022).

Course practice also observed that some models simplified ethnic symbols into “pattern templates”; AI struggled to understand the ritualistic meanings of certain cultural symbols; students frequently needed to culturally correct AI outputs.

This indicates that AIGC must be used cautiously in the cultural domain, with teachers' cultural oversight and aesthetic judgment remaining necessary.

### **6.1.2 Differences in Teachers' AIGC Application Abilities Affect Teaching Uniformity**

Disparities in teachers' information literacy and AIGC technical skills impact the depth and stability of course dissemination. Teaching observations showed that some teachers could not design structured prompts; some could not identify cultural biases in AI-generated content; the technical depth of the course varied significantly depending on the teacher. This aligns with domestic and international research: teachers' competency development lags noticeably in the AI era (Teaching in Higher Education, 2023; Jing Jiajia, 2025).

### **6.1.3 Students Are Prone to Dependence on AIGC, Affecting Autonomy in Creative Thinking**

AIGC's high-speed generation capability can lead students to reduce independent thinking, adopting a passive "AI generates first, then I select" approach; dependency on rapid visual generation leads to insufficient logical reasoning; weakening of cultural analysis; being misled by visually appealing images in design judgment (Human Factors, 2022). Some students failed to develop critical AI use skills, resulting in "cognitive inertia" during the design process.

### **6.1.4 Quantitative Indicators in the Evaluation System Still Have Room for Improvement; Fully Measuring Student Competency Remains Challenging**

Although this study constructed a four-dimensional "Cultural Value—Creative Process—Design Outcome—Technology Ethics" evaluation system, challenges remain: depth of cultural understanding is difficult to fully quantify; quality of human-AI collaboration (quality of AI use) lacks unified standards; assessment of student creative iteration quality relies more on teacher experience. This aligns with international critiques of innovation education evaluation: innovative learning inevitably faces the structural dilemma of "insufficient quantification and over-reliance on qualitative judgment" (Creativity Research Journal, 2022).

### **6.1.5 Copyright and Cultural Ethical Issues Related to AIGC Are Not Fully Resolved**

Both domestic and international research point out numerous copyright disputes and cultural ethical risks associated with AIGC in the design field (Lee & Suh, 2023). These include: opacity in model training data sources; whether AI "infringes on cultural intellectual property" remains a gray area; minority cultures, as vulnerable cultures, need protection against misuse or commodification by AI tools. This implies the future need to further establish usage norms at the teaching level.

## **6.2 Future Prospects**

### **6.2.1 Deepening AIGC Application in Cultural Narrative Generation and Cultural Semantic Modeling**

Future research could explore: cross-modal (text-image) narrative generation; AI-based cultural symbol semantic modeling; constructing fine-tuned AIGC models specific to ethnic cultures (e.g., LoRA / DreamBooth modes). This would enable AI not only to "generate images" but also to generate stories, semantic chains, and cultural structures with cultural logic.

### **6.2.2 Optimizing "Human-AI Collaborative Design Processes," Establishing Replicable Teaching Models**

Based on this course's experience, future work could further construct: shared human-AI prompt libraries; AI style transfer libraries for cultural themes; human-AI iteration maps; AIGC-based course knowledge graphs. International research indicates that establishing "replicable, transferable" human-AI collaboration models is a core trend in design education (BJET, 2023).

### **6.2.3 Strengthening Teacher AIGC Literacy Training, Promoting University Digital Transformation**

Future teaching reform should focus on: teacher AI literacy certification systems; teacher technical workshops and interdisciplinary communities; development of AI teaching materials, case databases, and teaching templates. Teachers' digital competency is a key variable for the sustainability of teaching reform (Altbach & de Wit, 2023).

### **6.2.4 Establishing a More Scientific Learning Evaluation System, Enhancing Comprehensive Assessment of Culture, Technology, and Innovation**

Future research could investigate: quantitative analysis of learning trajectory data; transparency of AI process records; analysis of process evidence like student logs and prompt version iterations. This would optimize student competency diagnosis, making evaluation more objective and data-driven.



### 6.2.5 Expanding AIGC Application in Diverse Ethnic Cultures, Promoting Cultural Digital Asset Construction

Potential developments include: image databases for diverse ethnic cultures; intelligent recognition models for intangible cultural heritage patterns; digital assets for ethnic cultures; multi-modal teaching resource libraries for diverse ethnic cultures. Collaborating with domestic intangible cultural heritage enterprises, tourism enterprises, and cultural institutions could help enhance cultural digitization capabilities and support cultural industry innovation.

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# The Dilemma of Dual Identity: Conflict Between Cultural Capital and Identity Among Professional Undergraduate Students in Higher Education

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**Abstract:** Based on theories of cultural capital and identity, this paper explores the identity conflicts encountered by vocational undergraduate students within the college context. These students simultaneously possess the dual identity attributes of “undergraduate” and “vocational student,” which can easily lead to internal conflict. The study finds that such conflicts are mainly manifested in three aspects: first, insufficiently clear self-positioning; second, greater susceptibility to embarrassment and stress in interpersonal interactions; and third, a higher likelihood of encountering institutional recognition barriers and restricted access to opportunities. The primary reasons include three factors: an imbalance in cultural capital, the negative stigma associated with vocational education, and a lack of institutional-level recognition. To alleviate these problems, a multifaceted approach is necessary. This can involve improving teaching and training methods, refining social support systems, and guiding students to more actively enhance their capabilities and self-confidence. The ultimate goal is to foster a more supportive campus and institutional environment, thereby helping vocational undergraduate students establish a more stable sense of identity.

**Keywords:** Vocational Undergraduate Education; Dual Identity; Cultural Capital; Identity; Vocational Education

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## 1. Introduction

Since China launched the pilot program for undergraduate vocational education in 2019, vocational undergraduate education has developed rapidly and become an important part of the modern vocational education system. By 2025, there will be 87 vocational undergraduate colleges nationwide, and enrollment is also increasing, with the goal of cultivating high-level technical and skilled talents. However, in this round of reform, vocational undergraduate students have encountered a distinct “dual identity” dilemma: on the one hand, they are “undergraduates” in higher education; on the other hand, they are often perceived as “vocational students” with a vocational education background. The overlap of these two identities not only leads to differences in resources and competencies but may also trigger deeper issues of identity.

In the university environment, vocational undergraduate students often feel a sense of not belonging due to differences in their theoretical foundations, learning methods, and academic habits compared to their peers. Simultaneously, they must contend with external prejudice against vocational education. This combination of internal discomfort and external pressure leads to

difficulties in three key areas: self-perception, interpersonal relationships, and fair evaluation within institutional systems. Studies further indicate that some vocational undergraduate students experience self-doubt and competence anxiety in the face of educational digital transformation. They also report a blurring of career aspirations and a lack of adequate emotional support. Compounded by the reality of “stratification” within the education system, it becomes even more challenging for them to cross this invisible threshold.

From the perspectives of cultural capital theory and identity theory, this paper analyzes the manifestations, causes, and potential solutions to the dual-identity dilemma faced by vocational undergraduate students. Through this research, we aim to provide a foundation for more targeted psychological support and campus integration initiatives, thereby helping these students establish a more positive and stable professional identity and achieve better personal development.

## **2. Theoretical Framework: An Interwoven Perspective of Cultural Capital and Identity**

### **2.1 Cultural Capital Theory and Its Manifestation in the Educational Field**

Bourdieu conceptualized cultural capital as an individual's capacity to possess and utilize specific cultural resources, which are not equally accessible to everyone. Cultural capital primarily exists in three forms: embodied state (cultural competence), objectified state (cultural goods), and institutionalized state (academic qualifications). Within the educational field, cultural capital influences individuals' social positions and determines who holds greater symbolic authority or power to define legitimate knowledge.<sup>[1][2]</sup>

#### **1) Cultural ability:**

Embodied cultural capital (or cultural competence), which includes language expression, ways of thinking, and behavioral habits, refers to long-formed dispositions that individuals “carry with them.” Traditional higher education places greater emphasis on theoretical foundations, academic thinking, and scientific research capabilities—areas in which vocational undergraduate students are often less proficient, thus making them more prone to experiencing a sense of discomfort or inadequacy.

#### **2) Cultural products:**

Objectified cultural capital (or cultural goods), such as academic certificates, published theses, and competition awards, constitutes relatively “visible” forms of attainment. While vocational undergraduate students may accumulate considerable achievements in practical skills, these accomplishments are often accorded less value within a predominantly academic evaluation framework.

#### **3) Cultural system:**

Institutionalized cultural capital refers to the process through which cultural capital gains formal “legitimacy” and security via institutional arrangements, such as degree certifications and professional qualifications. As the academic credentials and social recognition associated with vocational undergraduate education are still being established, its institutionalized cultural capital remains relatively weak.

The theory of cultural capital helps reveal the implicit hierarchies and disparities present within the university environment. Differences in the cultural capital possessed by vocational undergraduate students can significantly affect their sense of integration in the academic community and the formation of their identity.<sup>[3]</sup>

### **2.2 Identity Theory and Its Explanatory Power for Vocational Undergraduate Students**

Identity theory focuses on how individuals define themselves through their relationships with social groups, encompassing dimensions such as personal identity, group identity, organizational identity, and social identity. For vocational undergraduate students, identity crises stem from the dilemma of defining “who I am”—whether to emphasize their identity as “undergraduate students” or their attribute as “vocational trainees.”<sup>[4]</sup>

Social Identity Theory further posits that individuals construct their identity through the processes of social categorization, social comparison, and positive distinctiveness.<sup>[5][6]</sup> In their academic environment, vocational undergraduate (or non-four-year) students often unconsciously compare themselves with their counterparts in traditional four-year programs. Prevailing societal stereotypes about vocational education may lead such comparisons to yield unfavorable results, thereby hindering

the formation of a positive self-concept.<sup>[7]</sup> When vocational undergraduate education is perceived as a product of the Matthew Effect, students' self-esteem and group identity face significant challenges.

### **2.3 An Interwoven Perspective: The Superimposed Effects of the Dual Dilemma**

Cultural capital and identity are not separate entities; they interact and mutually reinforce each other. Greater disparities in cultural capital increase the likelihood of identity confusion. The more unstable a student's identity, the harder it becomes for them to focus on their studies and engage fully, thereby hindering further accumulation of cultural capital. This superposition of issues places vocational undergraduate students in a more complex predicament within the university environment.

From the perspective of their "mutual influence," this paper analyzes the identity dilemma faced by vocational undergraduate students and seeks to propose more effective solutions.

## **3. The Multidimensional Manifestation of Dual-Identity Tension**

The dual-identity dilemma faced by vocational undergraduate students is not a one-dimensional phenomenon; rather, it permeates all aspects of their academic, personal, and social lives. Specifically, this tension manifests in three dimensions: self-perception, social interaction, and institutional recognition.

### **3.1 Ambiguity and Conflict in Self-Perception**

In terms of self-awareness, many vocational undergraduate students experience unclear identity and self-doubt regarding their value. As vocational undergraduate education is a relatively new development within higher education, these students often struggle to find a stable position between the identities of "undergraduate" and "vocational trainee."

Research indicates that some students in jointly-run vocational programs face several related issues: they do not fully identify with their student identity and lack a sense of belonging to the institution; they feel ambivalent about their intended role and have unclear personal ideals and goals; and they are uncertain about the future, resulting in confused career planning. Many students repeatedly ask themselves, "What kind of person do I want to become?"—whether someone following an academic path oriented toward theory, or someone pursuing a technical path focused on application. This internal conflict further complicates their learning objectives and career decision-making.<sup>[8]</sup>

### **3.2 Identity Embarrassment and Stigma Coping in Social Interactions**

Socially, vocational undergraduate students often face external doubts and prejudices. In important scenarios such as job hunting, postgraduate entrance examinations, and civil service exams, their identity as "vocational undergraduates" is easily called into question.

What is more common yet less obvious is the differential treatment they encounter in daily interactions. For example, they may feel uneasy when asked about their school during family gatherings, or perceive social stratification based on academic qualifications at alumni reunions. Although such incidents might seem insignificant in isolation, these accumulated experiences constantly remind students that they are "different from others." Consequently, some students choose to conceal their educational background, which further hinders the development of a positive self-identity.

### **3.3 Barriers in Institutional Accreditation and Social Evaluation Systems**

In terms of institutional accreditation, vocational undergraduate students face numerous systemic barriers. Although policies stipulate that vocational undergraduate degrees are equivalent to ordinary academic undergraduate degrees, implementation in practice often reveals many obstacles that hinder this parity.

1) Professional Codes in Public Examinations: The major titles and codes for many vocational undergraduate programs differ from those of ordinary academic programs. This discrepancy creates barriers for students applying for civil service positions or public institution recruitment exams. For instance, some students have encountered situations where their major, such as "Software Engineering Technology" — which includes the word "Technology" and carries a different code compared to the ordinary undergraduate "Software Engineering" — leads to repeated rejections during provincial civil service exam registration.

2) Degree Recognition and Thresholds for Further Education: The recognition of vocational undergraduate degrees remains unstable when students pursue further studies, such as postgraduate entrance exams or studying abroad. Some universities exercise greater caution in admitting vocational undergraduate students to master's programs, often due to concerns about

their academic preparedness.

3) Inertia in Social Perception: The societal bias of “valuing academic education over vocational training” remains deeply ingrained. Many still regard vocational education as a “second-choice” or less prestigious path. Such entrenched perceptions are difficult to change and place vocational undergraduate students at a disadvantage in the context of social stratification. Consequently, it becomes more challenging for them to build confidence in their educational identity.

*Table 1: Multidimensional Manifestations of Identity Dilemmas Among Vocational Undergraduate Students*

Dimension	Key Manifestations	Impacts
Self-Perception	Vague Identity Positioning, Self-Worth Doubt, Role Conflict	Lack of Learning Motivation, Career Planning Confusion
Social Interaction	Identity Embarrassment, Stigma Coping, Experience of Microaggressions	Social Avoidance, Identity Concealment
Institutional Accreditation	Barriers in Civil Service/Public Institution Exams, Uncertainty in Degree Recognition, Social Evaluation Bias	Limited Development Pathways, Legitimacy Crisis of Identity

These three levels of tension are intertwined, collectively shaping the complex dual-identity dilemma faced by vocational undergraduate students. Only by fully understanding these manifestations can we propose targeted solutions.

## 4. The Source of Conflict: Dual Pressure from Cultural Capital Disparities and External Labeling

The identity conflict among vocational undergraduate students is not an accidental phenomenon, but a product of multiple factors. It is rooted in the triple pressures of cultural capital disparity, external labeling, and inadequate institutional recognition.

### 4.1 Imbalance of Cultural Capital and Field Adaptation Dilemma

There exists a set of “game rules” and evaluation criteria in the educational environment, which are predominantly established by more advantaged groups. For vocational undergraduate students, the cultural capital imbalance they encounter primarily manifests in the following ways.

First, in terms of cultural competency:

Many vocational undergraduates come from a background that emphasizes practical learning. Their strengths lie in applied abilities and technical skills, rather than in traditional academic training. However, as higher education institutions have long prioritized academic culture, the prevailing evaluation system tends to be theory- and research-oriented. This makes it difficult for their practical strengths to be recognized. As one teacher noted, “Some students may not excel in lectures, but they have strong hands-on capabilities. If you let them do it, they can master the task quickly.” Yet, in an environment that values publishing papers and academic research, such practical competence often fails to become a “recognized advantage.”

Second, in terms of cultural products:

Vocational undergraduates tend to produce more practical outcomes—such as technical innovations and project portfolios—than traditional academic outputs like research papers and patents. Within the existing evaluation framework, these practical achievements are frequently overlooked. For instance, a highly skilled student may be disadvantaged in award evaluations simply due to a lack of published papers.

Third, in terms of the cultural-institutional dimension:

The credential recognition and qualification system for vocational undergraduate education is still under development, resulting in relatively weak institutional-level cultural capital. Although policies have legally affirmed the status of vocational undergraduates, invisible barriers and institutional gaps persist in practical scenarios such as corporate recruitment and civil service examinations. As one vocational undergraduate student remarked, “It has been six years since the first pilot programs were launched, but there is still a gap between policy enactment and its full implementation.”

The imbalance in these forms of cultural capital makes it easier for vocational undergraduates to feel marginalised within the academic environment and harder for them to find a clear position and developmental trajectory.

## 4.2 The Stigma of Vocational Education: Labeling and Social Comparison Pressure

The long-standing social perception of vocational education as an “inferior” alternative is another key source of the identity crisis among vocational undergraduate students. This stigma is further reinforced through social comparison.

Social identity theory suggests that individuals derive self-esteem from intergroup comparisons. When the group to which they belong is stigmatized, individuals experience identity threat. Vocational undergraduates often unconsciously compare themselves with their peers in traditional academic programs, typically using criteria such as academic performance and postgraduate admission rates—metrics that often place them at a disadvantage. Research indicates that a persistent social atmosphere, which glorifies elite education while disparaging vocational training, has eroded students’ willingness to even consider vocational undergraduate education as a viable option.<sup>[9]</sup>

More seriously, this stigma has been internalized, leading to self-denial among students. Some students bluntly state, “For jobs with high technical requirements, it seems to require tremendous effort to achieve anything. It’s better to avoid making a ‘wrong first step’.” Such negative self-perception reflects a utilitarian, confused, and helpless mindset among students. This trend raises concerns about the prospects of vocational undergraduate education, whose goal is to cultivate high-skilled, occupation-oriented professionals.

## 4.3 Insufficient Industry-Education Integration and Lack of Institutional Recognition

In theory, vocational undergraduate education should closely integrate theoretical coursework with practical training. In reality, however, many institutions suffer from insufficient integration between industry and education, which directly undermines students’ institutional identification.

On the one hand, the teaching staff at many vocational colleges face clear challenges. Some instructors come from traditional academic backgrounds and emphasize theory, yet lack familiarity with hands-on teaching. Others possess strong technical skills and practical experience, but struggle to systematize that experience into structured curricular content. As one student remarked, it is difficult for faculty at their school to deliver truly integrated “theory + training” instruction: “Many senior teachers are not familiar with simulation software or practical training modules,” while newly hired skilled masters find it hard to “explain theory while conducting training.”

On the other hand, school-enterprise cooperation often remains superficial and fails to achieve in-depth collaboration. Some students noted that the internships arranged by their schools merely involve tasks like “tightening screws” on factory assembly lines—work that anyone could do. They simply cannot see how the knowledge they have acquired applies to such positions. This kind of shallow practical experience makes it difficult for students to develop a sense of professional value. Instead, it may lead people to equate “vocation” with “low-end labor,” thereby reinforcing negative stereotypes.

*Table 2: Analysis of the Causes of Professional Undergraduate Students’ Identity Conflict*

Category of Causes	Manifestations	Identity Impact
Imbalance of Cultural Capital	Inadequate Academic Competence, Undervaluation of Cultural Products, Weak Institutional Accreditation	Sense of Field Incongruity, Self-Worth Doubt
Stigmatization of Vocational Education	Societal Devaluation of Vocational Education, Internalized Self-Denial, Unfavorable Social Comparison	Identity Threat, Impaired Self-Esteem
Inadequate Integration Between Industry and Education	Contradictions in Faculty Structure, Superficial School-Enterprise Cooperation, Shallow Practical Teaching	Reduced Professional Value Recognition, Negative Learning Experience

In summary, the identity conflict among vocational undergraduate students stems from multiple factors. Only by thoroughly analyzing these root causes can we identify effective solutions to address the issue.

## 5. Discussion

To establish a more stable identity, vocational undergraduate students require broader social support and a more favorable public opinion environment. At the policy level, the requirement for “equal status” for vocational undergraduates should be further specified, with more effective implementation. The media should also take the initiative to highlight the characteristics



and value of vocational undergraduate programs, thereby reducing the prejudice of “overemphasizing academic education while undervaluing vocational training”. By reporting more on the successful experiences and professional achievements of vocational undergraduates, the public can better recognize their role in technological advancement, innovation, and industrial upgrading. Such positive examples deserve wider dissemination, which would not only enhance the social image of vocational undergraduates but also provide students with a more supportive environment for identity formation.

In addition, it is crucial to establish more in-depth cooperation with employers to build stable and sustained school-enterprise partnerships. Vocational colleges and universities can develop long-term collaborations with leading enterprises in the industry, jointly formulate training standards, design curricula, and establish training bases. Enterprises should also be involved earlier in the teaching process, integrating their equipment, technical standards, and work methods into education. Such in-depth cooperation enhances the quality of talent cultivation, facilitates students’ access to suitable employment, and ultimately strengthens their sense of professional identity.

## 6. Conclusion

The dual identity dilemma faced by vocational undergraduate students is a common phenomenon during the current educational transformation in China. This dilemma manifests itself in three aspects: an unclear self-perception, susceptibility to external influences in social interactions, and frequent obstacles in obtaining institutional certification. Its causes are multifaceted, encompassing disparities in cultural capital, negative external labeling, and insufficient integration between industry and education.

To address this challenge, a multi-faceted approach is needed, including the improvement of teaching and training methods, as well as the enhancement of social support and public opinion environments. It is insufficient to merely expect students to rely on their own efforts; moreover, allowing them to cope by merely “feigning acceptance” of their situation is not a viable solution.

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# The Reconstruction of the Mechanisms of Educational Credential Devaluation: A Multi-Level Integrative Analysis of Educational Expansion, Institutional Absorption, and Labour Market Restratisation

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**Abstract:** Against the backdrop of the continued massification of higher education, educational credential devaluation does not imply that diplomas have become meaningless. Rather, it reflects a declining marginal discriminatory power of educational credentials as proxy signals of ability and productivity, thereby inducing a systematic reordering and internal differentiation of the returns structure within the labour market. Building on the theoretical lineage of signalling and screening, and synthesising evidence from cross national micro data, job advertisement data, and cohort studies, this article conceptualises credential devaluation as a form of structural revaluation triggered by educational expansion. When the growth of highly educated labour supply outpaces the creation of high skill jobs and the intensification of task complexity, credentials shift from a core differentiating signal to an entry threshold. Screening weight correspondingly moves towards observable skills, institutional prestige, field of study matching, and relative educational position, while reinforcing the degree completion premium and threshold based hiring practices. Its observable consequences are concentrated in four dimensions: downward shifts in job match quality and declining skill utilisation; persistently high levels of qualification mismatch that translate into wage penalties; a separation between returns to years of schooling and discrete degree premia; and intensified stratification driven by rising entry thresholds and credential inflation. The article further argues that youth mismatch is not a linear trend, but a context dependent outcome shaped by the interaction of cyclical shocks, institutional absorption, and labour market entry timing effects, with cross border mobility functioning as an exogenous buffer.

**Keywords:** Educational Credential Devaluation; Educational Expansion; Signalling Congestion; Qualification Mismatch; Credential Inflation; Cohort Effects

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## 1. Introduction

### 1.1 Research background and significance

Against the backdrop of the continued massification of higher education, educational credential devaluation has become a

central concern across labour economics, the sociology of education, and human resource management. The key issue is not whether diplomas have become completely meaningless but that the marginal discriminating power of credentials as proxy signals of ability and productivity has declined, thereby driving a systematic reordering of the returns structure in the labour market (Araki & Kariya, 2022). As the supply of highly educated workers expands, the scarcity value of educational credentials is eroded, and the exchange value of identical credentials diverges markedly across national institutional settings, industrial occupations, organisational selection rules, and entry cohorts. Existing studies show that such divergence often externalises as downward shifts in job match quality and changes in skill utilisation at the task level (Horowitz & Ramaj, 2024). It may also appear as persistently high or structurally rising levels of qualification mismatch, which couple with the tempo of occupational upgrading and the evolution of job skill demands (Salvatori, 2021). At the same time, under rising selection costs organisations are more likely to strengthen threshold based hiring and credential inflation, expanding competition from the level of formal education to finer gradations of credentials (Lin et al., 2024). When educational signals become congested, the market tends to treat credentials as an entry threshold while relying on measurable skills for differentiation. This structural shift is especially pronounced in occupations related to emerging technologies and the green transition, where the rise of skill oriented recruitment further highlights this reorientation (Bone et al., 2025). Because these outcomes do not always appear synchronously and because they combine differently depending on macro cycles, demand structure, and institutional context (Wiedner, 2024), single studies often capture only one aspect of credential devaluation and cannot explain why the same trend of educational expansion yields divergent patterns across societies, for example compression of wage premia, pronounced overeducation and job downgrading, or stronger declines in task level skill utilisation. Therefore, a systematic literature review must do more than summarise conclusions; it must reorganise dispersed evidence into comparable and integrable causal chains, move the discussion from description of phenomena to structural explanation, and lay a firm foundation for subsequent conceptual specification, measurement of variables, and theoretical model construction (Brun-Schammé & Rey, 2021).

Regarding the current state of scholarship, although a large body of empirical material has accumulated, explanations for the causes of credential devaluation remain notably nonconvergent. First, measurement indicators are still highly heterogeneous. Some studies characterise credential value with wage premia or occupational status, while others focus on mismatch between education and job and its labour market consequences. These indicators do not have a simple one to one relationship; without systematic integration their use can fragment explanations of the same phenomenon (Varona Cervantes & Cooper, 2022). Second, identification of macro cyclical shocks and entry timing of cohorts is insufficient. In particular, short term mismatch and long term scarring effects caused by entering the labour market during a recession can be misidentified as long term devaluation driven by educational expansion if not clearly separated, which may lead to systematic overestimation of structural deterioration (Kondo, 2024). Third, cross national comparisons highlight the importance of institutional differences, yet many studies remain at the level of juxtaposing outcome differences and lack a mechanistic account that brings supply expansion, demand absorption, institutional regulation, and information recognition into a single logical framework. This limits the ability to explain why countries follow different paths such as over expansion, under expansion, or structural absorption. Fourth, research on organisational level threshold shifts and credential inflation remains insufficiently connected to macro level studies of mismatch and compression of returns. As a result, the process through which selection rules endogenously drive signal congestion and re stratification competition at the micro level is often split across different academic traditions (Gelbgiser & Gabay Egozi, 2025). Given these shortcomings, a systematic literature review is not merely an organisation of existing research but a reconstruction of explanatory frameworks. Its aim is to link multi level evidence into coherent causal logic, identify boundary conditions and contexts of applicability for mechanisms, and thereby clarify which conclusions are robust and which remain contested or under researched. This foundation will support the formulation of more precise research questions and more explanatory analytic frameworks.

## **1.2 Conceptual definitions and integration of research perspectives**

In this paper credential devaluation refers to the systematic weakening and internal re stratification of the exchange value of identical educational credentials in the labour market, which arises when the proportion of higher education attainment

continues to rise and when occupation structure and organisational selection rules evolve simultaneously. The concept emphasises that credential devaluation is not equivalent to the disappearance of diploma value; rather it denotes the reordering of returns to credentials across different contexts, groups, and occupations. Based on the evidence reviewed in this paper, credential devaluation primarily manifests through four observable outcomes. First, job match quality declines, reflected in lower occupational status, reduced job complexity, and diminished analytical task content associated with identical credentials. The formal credential remains unchanged while skill utilisation declines, and these effects show stronger heterogeneity by gender and field of study. Second, qualification mismatch remains at high levels or rises structurally; overeducation and undereducation diverge across national trajectories, reflecting differences in the relative speed of educational supply growth and occupational upgrading. Third, structural revaluation of educational returns becomes more pronounced: the discrete premium associated with degree completion separates from the marginal returns to years of schooling, and competition shifts from holding a credential to having completed a degree and to the relative educational position within a cohort. Fourth, organisational recruitment thresholds rise and credential inflation becomes more evident, with education and institutional prestige used as alternative standards to reduce screening costs. This expands competition from educational tiers to finer credential strata and produces stronger threshold based selection tendencies in the academic labour market and in high skill occupations. These results point to a central judgment: expansion of higher education alters the relative weights of education and skills within selection systems, and credential devaluation typically occurs through re stratification rather than through wholesale collapse.

From a research perspective, this paper understands credential devaluation as a multi level mechanism arising from the interaction of supply expansion, demand absorption, institutional regulation, and information recognition, and uses this understanding to converge the analytic framework of the paper. Supply side mechanisms stress that an increase in nominal supply of high skill labour does not automatically translate into effective supply expansion. When the share of credential holders rises and signal scarcity falls, markets are more likely to re screen using skills, prestige, and relative ordering. Demand side mechanisms focus on the tempo of occupational upgrading and task re organisation. When growth in high skill occupations lags or task content does not become more complex in line with rising credential thresholds, credential devaluation may appear as declines in task level skill usage rather than immediate wage collapse. Institutional mechanisms emphasise differences in national education system stratification, vocational education and training, labour market regulation, and organisational recruitment institutions. These factors determine whether expansion is absorbed, compressed, or transformed into persistent mismatch and wage penalties, and may produce phase like threshold jumps. Cognitive and information mechanisms explain how micro level equilibria endogenously generate over investment and signal degradation. When employer learning is slow, abilities are not fully observable, and belief updating is insufficient, low ability individuals are more likely to mimic investment near thresholds while high ability individuals are forced into further investment, producing concurrent signal congestion and return compression. In addition, a spatial dimension as a supplementary perspective reveals the transferability of institutional differences. When domestic absorption is insufficient, international mobility can improve skill utilisation and occupation matching through cross border matching and policy based selection, thereby providing an exogenous buffering channel against credential devaluation. Based on the above definitions and integrative perspectives, the subsequent literature review and comparative analysis in this paper will focus on four operational measurement domains: job matching and task structure, qualification mismatch, differentiation of the returns structure, and recruitment thresholds and credential inflation. These domains will be interpreted within the multi level mechanism framework to explain heterogeneity across countries, groups, and periods.

## **2. In depth literature review**

### **2.1 Supply expansion and signalling congestion: declining credential distinctiveness and rising skill weights**

Under educational expansion, credential devaluation is first manifested as a decline in the distinctiveness of educational credentials as screening signals, rather than the complete invalidation of diplomas per se. According to classic signalling theory, when the prevalence of a given educational signal rises substantially, its marginal efficiency in separating high ability

from low ability individuals decreases, and employers must shift towards more differentiating supplementary signals to sustain screening efficiency (Spence, 1973; Stiglitz, 1975). As higher education moves from an elite phase into a mass phase, diplomas no longer carry their original scarcity value, and their market sorting function is naturally weakened. This provides the theoretical point of departure for subsequent empirical research on credential devaluation. Cross national evidence further corroborates this mechanism. Using multilevel models with PIAAC data from 26 countries, Araki and Kariya (2022) show that the greater the degree of educational expansion, the weaker the marginal explanatory power of higher level degrees for occupational status, while cognitive skills significantly buffer this tendency. Gelbgiser and Gabay Egozi (2025) similarly demonstrate that in societies with a higher share of university degree holders, overall credential wage premia are compressed, whereas the importance of literacy and numeracy remains stable or even strengthens. In the same vein, Barone and Ortiz (2011) argue that in countries with higher levels of educational massification, the occupational differentiation effect of credentials weakens, and the structure of fields of study and the distribution of skills become more central stratifying mechanisms. From a macro supply demand perspective, Goldin and Katz (2008) also indicate that when educational supply grows faster than skill demand, the education premium tends to compress in particular periods. Therefore, credential devaluation does not mean that credentials have become ineffective. More precisely, educational expansion erodes credential scarcity, reduces their discriminating power, and reshapes the relative weights of credentials and skills.

Building on declining distinctiveness, the market screening logic often shifts from credential dominance to a dual track structure in which credentials operate as an entry threshold while skills serve as the basis for differentiation. Research on wages and skill returns shows that cognitive abilities and task relevant skills have an independent and stable role in explaining income disparities. Using PIAAC data, Hanushek et al. (2017) find that skill levels continue to significantly affect earnings and employment probabilities within educational levels, indicating that within credential skill heterogeneity has become an important source of return differentiation. Deming (2017) argues that as task structures change and automation advances, the importance of cognitive and social skills continues to rise, while credentials increasingly function as an access device. Meanwhile, based on job advertisement data, Hershbein and Kahn (2018) show that firms more frequently raise educational requirements after economic shocks, yet job task complexity does not increase in parallel, suggesting that credentials partly serve as substitute screening signals. Bol and van de Werfhorst (2011, 2013) further argue that under educational expansion, relative educational position predicts occupational status more strongly than absolute credentials, implying intensified rank competition alongside declining credential distinctiveness. Di Stasio et al. (2016), using cross national experiments, find that employers place greater weight on field match and competence indicators than on credential level alone. Overall, signalling congestion driven by supply expansion does not eliminate credential value. Instead, it reconfigures the returns structure: credentials shift from a core differentiating signal to a baseline threshold, while the weight of skills and task relevant competencies in explaining job access and income differences rises substantially.

## **2.2 Insufficient absorption capacity and institutional variation: supply demand misalignment, rising mismatch, and compressed returns**

A second causal chain of credential devaluation stems from labour market absorption capacity and institutional regulation. When educational supply growth persistently outpaces occupational upgrading, the human capital associated with credentials cannot be fully absorbed, which becomes visible as rising qualification mismatch and compressed returns. Comparing long run data from the United Kingdom and Germany, Wiedner (2024) finds markedly different trajectories in the evolution of expansion and mismatch, suggesting that the consequences of expansion depend on the alignment of supply demand structures rather than on supply growth itself. This conclusion is consistent with the OECD systematic reviews on qualification mismatch and skill mismatch, which argue that overeducation is often not an individual decision error but more commonly reflects structural misalignment caused by insufficient adjustment of job structure and skill demand (Quintini, 2011). Further, by constructing a graduate jobs indicator and conducting comparative analysis across OECD countries, Henseke and Green (2016) show that the share of jobs with intensive high skill use differs substantially across countries and is associated with factors such as industrial structure and research and development intensity. This implies that whether higher education expansion can translate into stable returns depends largely on the speed of high skill job creation and the

capacity for structural upgrading. In other words, when the expansion of graduate jobs lags behind graduate supply growth, overeducation and return compression are more likely to become persistent.

At the institutional level, Capsada Munsech (2020) argues, from the perspective of institutional structures and occupational upgrading tempo, that the speed of upgrading and the degree of stratification within education systems jointly determine whether expansion translates into overeducation. Salvatori (2021), adopting a dynamic approach to test synchronisation between high skill job growth and graduate growth, likewise shows that when job upgrading lags behind credential supply, mismatch tends to persist. In addition, evidence from CEDEFOP based on the European Skills and Jobs survey further strengthens the link that mismatch translates into compressed returns. It finds that overqualification and underutilisation of skills produce significant wage penalties and lower job satisfaction, even within groups with the same educational level (Cedefop, 2015). Regarding wage structures, McGuinness, Pouliakas, and Redmond (2021) connect quantitative mismatch to wage consequences and show that some countries exhibit simultaneous increases in overeducation and wage penalties, while others achieve structural absorption through wage compression or occupational diversion. This judgment that mismatch penalties display institutional heterogeneity is also supported by OECD research on mismatch and wage consequences in developing and transition economies (Aleksynska & Tritah, 2021). Moreover, evidence is growing on whether penalties deepen over time or with structural change. Related studies indicate that wage penalties associated with education occupation mismatch are increasing in certain labour markets, further suggesting that when structural misalignment accumulates, credential devaluation may manifest as more pronounced return compression (Cassidy, 2023). In sum, credential devaluation is often an equilibrium outcome of insufficient institutional absorption. Its intensity depends on the combination of occupational upgrading tempo, diversion mechanisms, and wage structure adjustment, and it is persistently amplified on the returns side through the cost mechanisms of overeducation and skill underutilisation.

### **2.3 Cyclical shocks and cohort dynamics: youth mismatch is not a linear increase but context dependent**

To explain credential devaluation and mismatch among young people, a more critical entry point is to situate observed increases in mismatch within macroeconomic fluctuations and institutional differences. If cyclical shocks such as recessions are ignored, researchers may misinterpret short term downgrading and mismatch at labour market entry as a long run trend generated by educational expansion. Cross national evidence first shows that youth overeducation does not necessarily rise systematically with educational supply expansion. Using panel estimation with quarterly EU LFS micro data from 30 European countries, Delaney et al. (2020) find that the incidence of youth graduate overeducation does not follow a consistent linear pattern aligned with supply growth. In countries with more mature vocational education and diversion systems, new supply is more readily absorbed, producing milder mismatch outcomes. From a cohort perspective on early career match quality, Levels, van der Velden, and Di Stasio (2022) show that later birth cohorts do not universally face higher mismatch risk and emphasise that demand side growth and adjustments in youth job search strategies may create buffering effects. Kiersztyn (2021) further distinguishes cyclical fluctuations from structural trends, showing that youth mismatch risk does rise in the short run during recessionary phases, but after controlling for macro shocks, educational expansion itself does not necessarily generate sustained long term increases in overeducation. It follows that the evolution of youth mismatch is not a linear function of supply expansion alone, but a context dependent outcome shaped by cyclical conditions and institutional absorption capacity.

Stronger mechanistic support comes from the evidence chain on labour market entry timing effects and mismatch persistence. These directly explain why different graduating cohorts exhibit different match trajectories, leading to temporal divergence in the observed extent of credential devaluation. Research on entry scarring shows that entering the labour market during recessions increases the probability of young people obtaining low quality jobs and generates earnings and career trajectory losses that can persist for many years (Kahn, 2010; Oreopoulos et al., 2012). In European labour markets with higher rigidity, recession shocks similarly produce longer cumulative income losses and job stickiness effects (Cockx & Ghirelli, 2016). Large sample long horizon estimates further indicate that such cohort effects are persistent and more adverse for disadvantaged groups (Schwandt & von Wachter, 2019). Meanwhile, studies that explicitly integrate cyclical factors



into mismatch research show that the incidence and persistence of overeducation vary with macro conditions and exhibit substantial heterogeneity by field and institutional context (Cuesta et al., 2024; Verhaest & van der Velden, 2010). From more explicit cross national comparisons, Verhaest and van der Velden (2013) argue that country level supply demand imbalance and the business cycle conditions at graduation explain a substantial share of cross national variation in overeducation. To avoid mistaking period effects for cohort trends, age period cohort methods provide a direct route to identifying non linear evolution. APC evidence from Vera Toscano and Meroni (2021) indicates that mismatch trajectories across countries do not follow a single linear upward pattern but shift with macro and institutional contexts. In addition, findings that vocational education buffers early mismatch but that this effect may attenuate over time suggest that institutional buffering is often concentrated at labour market entry and interacts with cyclical shocks (Verhaest et al., 2018). Overall, if cyclical disturbances, institutional absorption, and cohort entry timing are not separately identified, researchers are likely to systematically overestimate long run credential devaluation trends attributed to educational expansion.

#### **2.4 Re-stratification and task level devaluation: rising thresholds, strengthened completion premia, and skill underutilisation**

Under signalling congestion and absorption constraints, credential devaluation often appears as a reconstruction of the rules of competition. Typical manifestations include rising thresholds, credential based re-stratification, and a reallocation of tasks within jobs, which produces skill underutilisation for some highly educated groups. Using Norwegian administrative register data to separate the returns to degree completion from the returns to schooling years alone, Markussen et al. (2024) find a substantial completion premium that becomes more consequential under massification. They also observe widespread overeducation among young people and clear differences by social resources, suggesting that competition shifts from whether one has education to whether one completes and maintains relative advantage. Jaeger and Page (2020) identify diploma completion effects and highlight discrete premia associated with credential thresholds in screening. Bol and van de Werfhorst (2021) further argue that relative educational position predicts match quality more strongly than absolute credentials. From the perspective of class mobility, Bukodi and Goldthorpe (2021) show that advantaged groups possess compensatory mobility capacity, thereby shifting match risk towards groups with fewer resources. Brown, Lauder, and Cheung (2020) argue that massification turns credentials into minimum thresholds even for mid skill jobs, while internal re-stratification refines selection through institutional prestige and field differences.

Evidence at the organisational and labour market levels suggests that rising thresholds can become further institutionalised. Based on recruitment data from 802 Chinese universities, Lin et al. (2024) document credential inflation and phase like threshold jumps. Requirements for degree level and institutional background rise as the supply of doctoral graduates increases, and the advantage of overseas credentials may strengthen, indicating that devaluation coexists with re-stratification by credential type. This pattern aligns with Roach and Sauermann (2021), who find that expansion in doctoral supply in the United States intensifies competition for academic positions. Clauset et al. (2020) further show, via hiring network analysis, that academic markets are highly concentrated in a small set of high prestige institutions, thereby solidifying institutional background as a strong screening signal. Rivera and Tilsik (2022) show from recruitment text evidence that educational thresholds continue to rise even when job tasks do not change substantially. From a stratification perspective, Godechot and Louvet (2023) emphasise that candidates with advantaged backgrounds are more likely to enter higher tier institutions under intensified competition.

A further synthesis indicates that credential devaluation can also migrate into the interior of jobs, manifesting as implicit task level devaluation and declining skill utilisation. Horowitz and Ramaj (2024) match NLS cohort data with O NET skill indicators and find that, under educational expansion, the intensity of analytic skill use declines among bachelor degree holders. The decline is more pronounced for women and varies by field. Deming and Kahn (2020) similarly show that rising educational thresholds do not necessarily coincide with parallel increases in task complexity. Drawing on within firm evidence, Cappelli et al. (2022) argue that some highly educated groups perform tasks with complexity below their skill potential. Carnevale et al. (2021) find that field differentiation expands and that some non technical fields are more likely to enter low complexity jobs. Biasi and Sarsons (2022) show that women, holding the same credentials, are more likely to be



allocated supportive tasks. Autor (2022) proposes at the macro level that technological change may induce task polarisation within highly educated groups. Meanwhile, screening signals can shift from credentials towards more observable experience trajectories. A field experiment by Ndayikeza (2025) finds that low skill work experience can increase employer interest in some scarce markets. Eriksson and Rooth (2020) and Nunley et al. (2021) similarly show that low skill experience can mitigate gap penalties. Abebe et al. (2021) show that in markets with greater information asymmetry, any work experience significantly increases hiring probabilities. Kroft et al. (2020), using an employer learning framework, explain why employment trajectories become key inputs for ability inference. Finally, when the root of devaluation lies in insufficient domestic absorption, cross border rematching can serve as a structural buffer. Ghosh and Grassi (2020) find that cross border migration reduces early career overeducation and overskilling risks among doctoral graduates. Cattaneo et al. (2021) and Musselin and Pénissat (2022) argue that moving to countries with more mature research systems can improve matching and stability. Kerr (2020) emphasises the selection effect of immigration institutions on skill utilisation. González and Velho (2021) provide research output evidence consistent with improved matching. Wang and Miao (2023) further suggest that overseas experience can also strengthen signalling and facilitate rematching after return migration.

### 3. In depth discussion

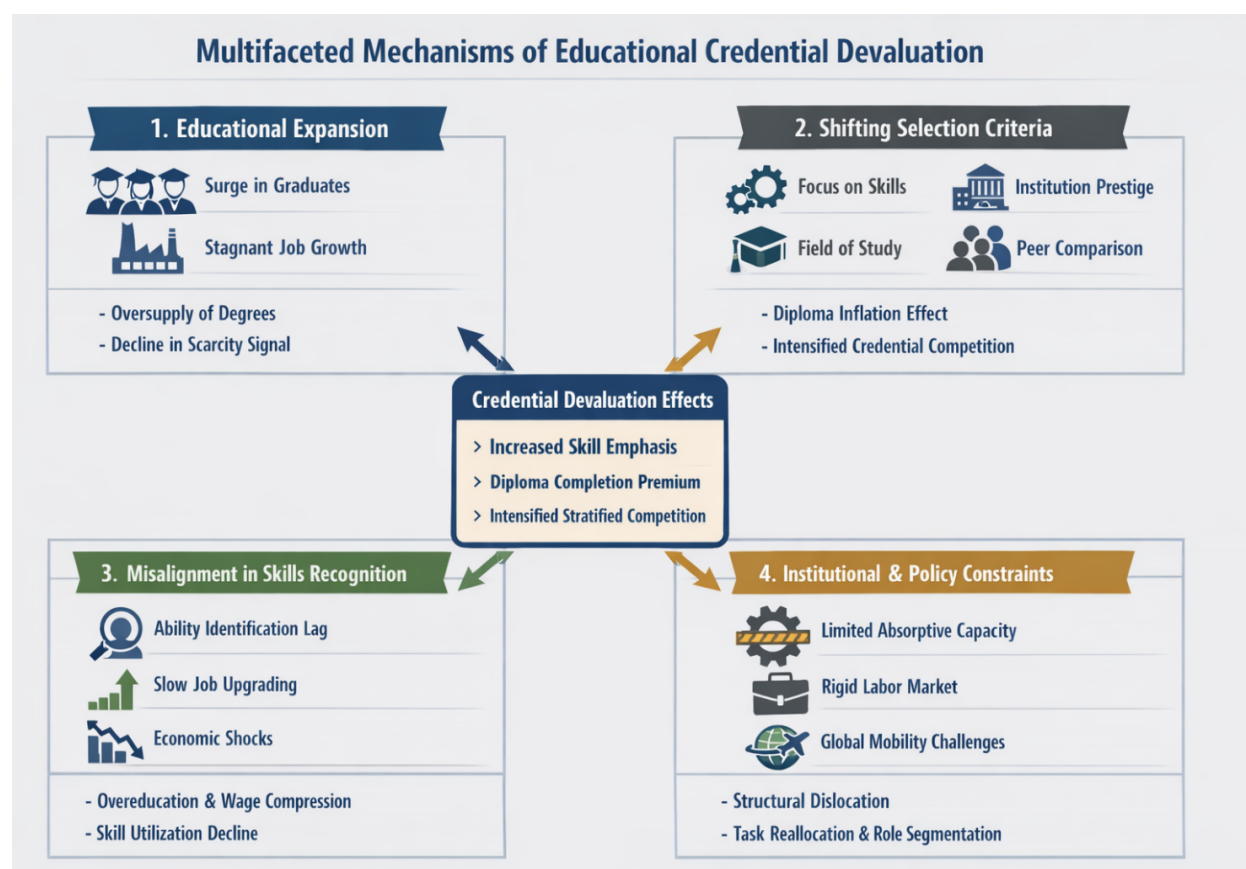
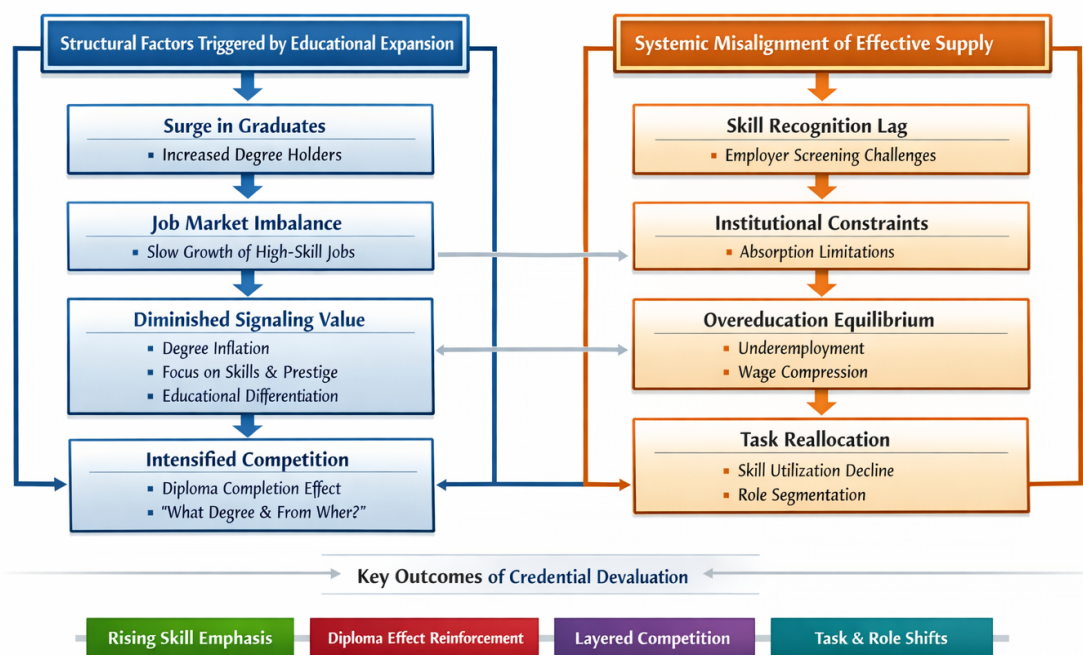
#### 3.1 Multi level causal mechanisms of educational credential devaluation

Synthesising the above literature, educational credential devaluation is more appropriately understood as a form of structural revaluation triggered by educational expansion, rather than a sudden invalidation of credential value. Educational expansion first increases the nominal supply of highly educated individuals. Yet in many countries, the growth of high skill jobs and the upgrading of occupational structures often fail to keep pace with this supply expansion, rendering educational credentials less scarce as signals. As the proportion of university degree holders rises, the marginal distinctiveness of credentials declines, and market screening increasingly shifts towards observable skills, institutional prestige, field of study, and relative rank position within age cohorts. At the same time, the discrete premium associated with degree completion is strengthened, and the focal point of competition gradually moves from whether one has a credential to which credential one holds and what background it represents. Under this reconstructed screening logic, groups with greater resources and opportunity are more able to maintain relative advantage, whereas those positioned in the middle and lower segments of the highly educated population are more likely to encounter overeducation, job downgrading, and compressed returns. In other words, credential devaluation does not imply the disappearance of returns. It indicates internal differentiation within the returns structure, manifested in rising skill weights, strengthened credential completion effects, and intensified stratified competition.

At the same time, credential devaluation is also associated with the failure to translate nominal expansion into effective supply, rooted in delayed ability recognition and systematic misalignment generated by insufficient institutional absorption. Educational expansion does not necessarily become a supply of capabilities recognised by the market. When employers cannot accurately identify true skills, when occupational upgrading is slow, or when macroeconomic shocks are superimposed, overeducation and compressed credential wage premia may emerge as an equilibrium. At the micro level, the rising prevalence of credentials weakens signal distinctiveness, thereby altering the equilibrium structure of signalling games. Lower ability individuals can more easily imitate educational investment, while higher ability individuals are compelled to invest further to preserve separation, creating a cycle of overinvestment and sluggish belief updating. Moreover, credential devaluation can extend from the returns dimension into the task dimension, appearing as declining skill utilisation and task differentiation by gender and field, such that credential form remains seemingly stable while the intensity of skill use and task content are reallocated. At the macro level, national institutional environments, the tempo of occupational upgrading, and diversion mechanisms determine whether educational expansion can be effectively absorbed. International mobility, by contrast, provides a spatial rematching channel that can partially mitigate insufficient absorption for highly educated groups. Overall, credential devaluation is not driven by a single factor. It is produced by dynamic misalignments among supply expansion, ability recognition, occupational structures, and institutional regulation. These misalignments externalise through mechanisms such as intensified stratified competition, signal degradation, and task reallocation, constituting the core logic through which credential value is redefined under the massification of higher education.

Graphic 1. Mechanism Framework of the Formation of Educational Credential Devaluation

### Multifaceted Mechanisms of Educational Credential Devaluation



### 3.2 Discussion of policy and practice responses to credential devaluation

To effectively mitigate credential inflation and credential devaluation, the priority is not to encourage individuals to further escalate investment within the same set of competitive rules, but to shift the problem from micro level rank based competition back to structural coordination among educational supply, job demand, and institutional absorption capacity. At the national level, the central tasks are to strengthen the capacity to create high skill jobs and to enhance the institutionalised absorption

of human capital, while building a capability recognition system that can be stably acknowledged by the market. This would reduce, at its root, societal reliance on credentials as the primary screening signal. Accordingly, higher education expansion should be redirected from a scale orientation to a structural orientation. Capacity for absorption should be enhanced through synchronised upgrading of disciplinary structures and growth in high skill employment, thereby avoiding a prolonged situation in which educational supply grows faster than occupational upgrading. In addition, capability observability and market recognition mechanisms should be strengthened, for example through the development of national or sectoral skills frameworks, occupational competency standards, and portable micro credential systems. These instruments enable employers to identify capabilities at lower cost, reducing the tendency for rising educational thresholds and credential inflation generated by imperfect information. At the same time, vocational education and training systems and diversion mechanisms should be improved to form articulated pathways across higher education, vocational routes, and lifelong learning, with institutionalised reskilling and job transition support to enhance the dynamic adaptability of human capital. Given the compounded risks of cyclical shocks and structural misalignment, governments should also strengthen youth employment support and countercyclical policy tools for high skill job creation. Moreover, orderly policies for international talent mobility and qualification recognition can provide channels for cross institutional rematching among highly educated groups, thereby alleviating overeducation and skill waste arising from insufficient domestic absorption.

Within this macro framework, employers are both direct implementers of rising credential thresholds and rational responders to imperfect information and recruitment risk. Thus, at the organisational level the key is to reduce information asymmetry in screening, shifting recruitment and promotion from credential signal dominance to task and capability dominance, thereby weakening the endogenous drivers of credential inflation and job task downgrading from within the firm. Organisations should frontload job analysis and competency modelling by decomposing job tasks into quantifiable competency requirements and performance indicators, and by using tools such as structured interviews, work sample tests, situational judgement tests, and probationary performance evaluations to improve the precision of capability identification. This reduces the tendency to raise educational thresholds simply in response to uncertainty. Further, firms should develop a skill centred internal labour market. Through job rotation, project based task allocation, and skill training, highly educated employees can realise skill utilisation and upgrading within the organisation, preventing internal devaluation in which credentials rise while task complexity falls. At the same time, organisations need transparent and interpretable promotion and pay systems that treat credentials as entry information rather than a decisive threshold, placing primary emphasis on task contribution and capability development trajectories. This reduces unnecessary educational investment driven by an exaggerated degree premium. In contexts where gender and field differences are salient, organisations should also examine implicit biases in task allocation and promotion channels. Fair distribution of project opportunities and capability development support can lower the structural risk that women or certain fields of study face greater skill underutilisation at the task level.

When credential distinctiveness declines and competition becomes increasingly rank based, individuals who continue to pursue ever higher credential levels as their primary strategy are likely to be trapped in a race characterised by diminishing marginal returns to educational investment. Individual responses should therefore shift towards the accumulation of verifiable capabilities, optimisation of signal portfolios, and strengthening of cross context adaptability, so as to rebuild differentiated advantages under congested credential signalling. Individuals need to develop capabilities and proof simultaneously by constructing skill portfolios aligned with key tasks in target roles and by increasing observability through verifiable portfolios, project outputs, professional certifications, micro credentials, or documented records of competitions and internships. This creates clear points of identification for employers. At the same time, career planning should be task oriented, avoiding belief biases that overstate the private returns to educational investment. Priority should be given to learning and work pathways that demonstrably raise skill content and task complexity, with rematching achieved when necessary through job transitions, retraining, or sectoral mobility. Given the strengthening of degree premia and rank based competition, individuals should also conduct marginal return assessments of education decisions. Before upgrading credentials, they should ensure that learning content can be translated into usable skills and visible performance, thereby avoiding overinvestment undertaken solely to cross entry thresholds. Finally, when insufficient domestic absorption produces structural mismatch, spatial choice can be



incorporated into the strategic toolkit. Through interregional or international mobility, international qualification recognition, and cross border project experience, individuals can improve match quality and enable their human capital to attain higher skill utilisation and returns within institutional environments with stronger absorption capacity.

Graphic 2. Schematic Diagram of Policy and Strategic Responses to Educational Credential Devaluation



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# **Cultural Hybridity of Traditional Festivals in Macao: The Fusion and Change of Chinese and western Festival Cultures**

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**Abstract:** This paper focuses on the phenomenon of cultural hybridity in traditional festivals in Macao, and deeply discusses the integration and change of Chinese and western festival cultures in Macao. By analyzing the origin, development and present situation of traditional festivals in Macao, this paper reveals the mutual infiltration and influence of Chinese and western cultures in festival activities. It is found that traditional festivals in Macao not only retain the essence of Chinese traditional culture, but also incorporate elements of western culture, forming a unique cultural landscape. This paper aims to provide a new perspective for understanding the multicultural coexistence in Macao and provide reference for cultural integration in other regions.

**Keywords:** Macao; Traditional Festivals; Cultural Hybridity; Chinese and Western Integration; Cultural Changes

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## **1. Introduction**

Macao, a special administrative region in the south of China, has been an important window for cultural exchanges between China and the West since ancient times. Its unique geographical location and historical background make Macao a model of multicultural coexistence. In the traditional festivals in Macao, the integration and changes of Chinese and western cultures are particularly remarkable. These festivals not only carry rich cultural connotations, but also reflect Macao society's tolerance and acceptance of multiculturalism. The purpose of this paper is to explore the integration and changes of Chinese and Western festival cultures in Macao by analyzing the cultural hybridity of traditional festivals in Macao, and to provide a new perspective for understanding the multicultural coexistence in Macao.

## **2. The Origin and Development of Traditional Festivals in Macau**

### **2.1 Inheritance of Chinese traditional festivals**

As a Chinese-dominated society, Chinese traditional festivals occupy an important position in Macao's cultural life. Traditional festivals such as Spring Festival, Tomb-Sweeping Day, Dragon Boat Festival and Mid-Autumn Festival have a deep mass base in Macau. These festivals not only retain the essence of Chinese traditional culture, such as posting Spring Festival couplets, setting off firecrackers, eating New Year's Eve, enjoying the moon and other customs, but also incorporate the local characteristics of Macao, forming a unique festival culture. Take the Spring Festival as an example. The celebration of the Spring Festival in Macau begins on the 16th day of the last lunar month and lasts until the 15th day of the first lunar month. During this period, the family will make preparations such as cleaning, buying new year's goods and buying new

clothes. On New Year's Eve, family members get together and enjoy a sumptuous New Year's Eve dinner, and then go to the flower market to choose new year's flowers, which means good luck. In addition, Macao's Spring Festival celebrations also include traditional customs such as dragon and lion dancing, setting off firecrackers and visiting temple fairs, which not only add festive atmosphere to the festival, but also inherit the essence of Chinese traditional culture <sup>[1]</sup>.

## 2.2 Introduction of Western Festival Culture

With the arrival of Portuguese colonists, western festival culture gradually took root in Macao. Western festivals, such as Christmas, Easter and Halloween, have gradually been accepted and integrated into the local culture in Macao. The introduction of these western festivals not only enriches the festival culture in Macao, but also promotes the exchange and integration of Chinese and western cultures. Take Christmas as an example. Although Christmas is not a traditional festival in Macao, there are extensive celebrations in Macao. Every year on Christmas Eve, the major shopping malls, hotels and restaurants in Macao will be newly decorated, creating a strong festive atmosphere. In addition, many charities will organize Christmas parties to send warmth and care to the disadvantaged groups. These activities not only reflect the characteristics of western festival culture, but also show the tolerance and acceptance of Macao society to multiculturalism.

## 3. Cultural hybridity in traditional festivals in Macao

### 3.1 Overlap and integration of festival dates

In Macao, the dates of some traditional Chinese and Western festivals are similar or the same, which provides natural conditions for cultural mixing. For example, the dates of festivals such as Tomb-Sweeping Day and Easter, Mazu's birthday and Easter are similar, which makes these festivals in Macao present the characteristics of combining Chinese and Western. Take Tomb-Sweeping Day and Easter as an example. Tomb-Sweeping Day is a traditional festival of sacrifice in China. People will go to the cemetery to sweep graves and worship their ancestors. Easter is an important festival in the west to commemorate the suffering, death and resurrection of Jesus Christ. In Macao, the celebrations of these two festivals are often intertwined. During their stay in Tomb-Sweeping Day, many families will go to the cemetery to visit graves, and at the same time, they will also attend the Easter Mass in the church to express their memory of their ancestors and their reverence for life <sup>[2]</sup>. This overlap and integration of festival dates not only enriches the connotation of festival activities, but also promotes the exchange and understanding between Chinese and Western cultures.

### 3.2 Mutual Infiltration of Festival Customs

In the traditional festivals in Macao, the mutual penetration of Chinese and western festival customs is particularly obvious. Some Chinese traditional festivals incorporate elements of western culture, while some western festivals also absorb the essence of Chinese traditional culture. Taking the Spring Festival as an example, Macao's Spring Festival celebrations not only retain the customs of Chinese traditional culture, such as posting Spring Festival couplets, setting off firecrackers and eating New Year's Eve, but also incorporate elements of western culture. For example, some families will put up Christmas trees and decorate lanterns and ribbons during the Spring Festival to create a strong festive atmosphere. In addition, some merchants will launch Chinese and Western Spring Festival promotions to attract customers. These activities not only show the integration and changes of Chinese and western cultures, but also reflect the tolerance and acceptance of multi-culture in Macao society. Similarly, in western festivals, elements of Chinese traditional culture are not uncommon. For example, during the Christmas period, some businesses will launch Christmas gifts with Chinese characteristics, such as Chinese knots and blessing ornaments. In addition, some charities will organize Christmas parties that combine Chinese and Western culture, and invite Chinese and Western guests to participate together to enhance mutual understanding and friendship.

### 3.3 Innovation and Development of Festival Culture

In traditional festivals in Macao, the phenomenon of cultural hybridity is not only reflected in the mutual penetration of festival dates and customs, but also in the innovation and development of festival culture. With the changes of the times and the development of society, Macao's traditional festival culture constantly absorbs new elements and ideas, forming a unique cultural landscape. Take Mazu Birthday as an example. Mazu Birthday is one of the most distinctive traditional festivals in Macao, which originated from the reverence of local fishermen for Mazu. In the long river of history, Mazu's birthday has gradually developed into a grand festival integrating sacrifice, folk performances and cultural exchanges. Today's Mazu

birthday activities not only retain traditional sacrificial ceremonies and folk performances, such as dragon and lion dances and Cantonese opera, but also incorporate elements of modern culture, such as concerts and art exhibitions. These innovations and developments not only enrich the connotation of Mazu's birthday, but also attract more tourists and audiences to participate in it.

## **4. An analysis of the causes of the cultural hybridity of traditional festivals in Macao**

### **4.1 The promotion of historical background**

Macao, a special administrative region on the South China Sea coast of China, has been an important bridge and window for cultural exchanges between China and the West since ancient times. Its unique geographical location has made Macao a hub for trade and cultural exchanges between the East and the West in history. Since the mid-Ming Dynasty, the Portuguese gradually settled in Macao in the name of trade, and brought advanced western science and technology, art, religion and life-style, thus opening the deep blending and collision of Chinese and western cultures in this land of Macao. With the passage of time, Chinese and western cultures did not simply coexist in Macao, but experienced a complex process from initial contact to gradual integration, and then formed a unique cultural landscape. The Catholic culture, European architectural style, eating habits and festival celebrations brought by the Portuguese have infiltrated and influenced each other with Macao's traditional Chinese culture, Buddhist and Taoist beliefs, Lingnan architectural style and traditional festival customs. For example, the Mazu Tempel in Macau is built adjacent to the Catholic Church, which reflects the pluralistic coexistence of religious beliefs; The Portuguese-style architecture in Macao incorporates Chinese elements, such as Chinese roof and window lattice design, which shows the integration and innovation of architectural styles. The promotion of this historical background provides a profound soil and important conditions for the phenomenon of cultural hybridity in traditional festivals in Macao. In the traditional festivals in Macao, whether it is Chinese traditional festivals such as Spring Festival and Mid-Autumn Festival, or Western festivals such as Christmas and Easter, they all present the characteristics of combining Chinese and Western. On the festival date, Chinese and western festivals are sometimes similar or overlapping, which provides time convenience for cultural integration; In festival customs, Chinese and western festival elements are intertwined, such as putting a Christmas tree during the Spring Festival and tasting Portuguese moon cakes in the Mid-Autumn Festival, which reflects the mutual penetration of customs; In festival culture, Chinese and western festival concepts learn from each other, such as emphasizing common values such as family reunion and gratitude and dedication, which promotes the deep integration of culture<sup>[3]</sup>.

### **4.2 Driven by social needs**

With the continuous development and changes of Macao society, people's living standards are improving day by day, and the demand for spiritual and cultural life is also showing a diversified and personalized trend. Although the traditional Chinese festival culture carries rich historical connotations and national feelings, in modern society, its forms of expression and celebration methods have been difficult to meet people's growing cultural needs. Especially the younger generation, they are more pursuing novel, unique and creative festival experiences, and their interest and acceptance of western culture are also increasing. Therefore, it is an inevitable trend for Macao to introduce western festival culture and enrich the connotation of festival activities. The introduction of western festival culture has not only brought brand-new festival ideas and celebration methods to Macao, such as the romantic atmosphere of Christmas and the funny taste of Halloween, but also promoted the exchange and integration of Chinese and western cultures and met people's diverse cultural needs. At the same time, the commercial operation mode of western festival culture has also brought new development opportunities for Macao's tourism and related industries. Driven by this social demand, Chinese and Western festival cultures have gradually merged and changed in Macao. On the one hand, traditional festivals in Macao began to incorporate western elements, such as western music performances during the Spring Festival and Portuguese dances during the Mid-Autumn Festival. On the other hand, western festivals have also found suitable soil in Macao, such as charity sale during Christmas and treasure hunt during Easter. These integrations and innovations not only enrich the cultural connotation of Macao's festivals, but also improve the quality of people's festival experience.

### **4.3 Promotion of cultural exchange**

As an international city, Macao has increasingly frequent cultural exchanges with other parts of the world. The promotion of



this cultural exchange provides an important opportunity and a broad platform for the phenomenon of cultural hybridity in traditional festivals in Macao. Through cultural exchanges with other parts of the world, Macao not only has the opportunity to introduce western festival culture, but also learn from the experience of festival activities in other regions to enrich its own festival cultural connotation<sup>[4]</sup>. For example, cultural exchanges between Macao and Portuguese-speaking countries such as Portugal and Brazil have brought more Portuguese-speaking cultural elements into Macao's festivals, such as Portuguese dance, music and food. At the same time, Macao also has increasingly close cultural exchanges with other Asian countries such as Japan, South Korea and Southeast Asia, and the festival customs and celebration methods in these areas have also had an impact on Macao's festival culture. In addition, Macao also actively participates in international cultural exchange activities, such as the World Expo and Cultural Festival, and shows its traditional festival culture to people all over the world, thus enhancing the international influence of Chinese culture.

In the process of cultural exchange, Macao is not only a receiver, but also a disseminator. Macao has spread its traditional festival culture, such as Spring Festival and Mid-Autumn Festival, to all parts of the world, so that more people can understand and experience the charm of Chinese culture. At the same time, Macao has also organically combined Chinese and Western cultural elements by innovating the form and content of festival activities, and created a festival cultural brand with Macao characteristics, such as the Macau International Fireworks Competition Display and the Macau Food Festival, which attracted tourists and audiences from all over the world to participate. The promotion of this cultural exchange not only enriches the connotation of Macao's festival culture, but also promotes the integration and change of Chinese and Western festival cultures in Macao. Through cultural exchanges, Macao has become a model of multicultural coexistence, showing the inclusiveness and openness of Chinese culture. At the same time, cultural exchange has also promoted the harmonious, stable and sustainable development of Macao society and laid a solid foundation for Macao's long-term prosperity.

## **5. The influence and significance of the cultural mixture of traditional festivals in Macao**

### **5.1 Promote cultural diversity and inclusiveness.**

Cultural hybridity in traditional festivals in Macao is like a bridge, which greatly promotes the vigorous development of cultural diversity and inclusiveness. In Macao, Chinese and western festival cultures are not mutually exclusive, but are skillfully integrated to draw a unique cultural picture together. During the Spring Festival, in addition to the traditional dragon and lion dances and Spring Festival couplets, you can also see western-style floats parade interspersed among them; During Christmas, while feeling the romantic atmosphere in the west, you can also taste Christmas food with Chinese flavor. This coexistence and harmony of multiculturalism in the same time and space breaks down the barriers between cultures, so that people from different cultural backgrounds can find resonance and fun in it. It enriches people's spiritual world, enables people to get in touch with broader and richer cultural elements, and broadens cultural horizons. At the same time, the presentation of cultural diversity has also enhanced social cohesion and centripetal force, and different cultural groups have jointly built a harmonious and inclusive social environment through mutual appreciation and respect. Cultural hybridity in traditional festivals in Macao is like a bridge, which greatly promotes the vigorous development of cultural diversity and inclusiveness. In Macao, Chinese and western festival cultures are not mutually exclusive, but are skillfully integrated to draw a unique cultural picture together. During the Spring Festival, in addition to the traditional dragon and lion dances and Spring Festival couplets, you can also see western-style floats parade interspersed among them; During Christmas, while feeling the romantic atmosphere in the west, you can also taste Christmas food with Chinese flavor. This coexistence and harmony of multiculturalism in the same time and space breaks down the barriers between cultures, so that people from different cultural backgrounds can find resonance and fun in it. It enriches people's spiritual world, enables people to get in touch with broader and richer cultural elements, and broadens cultural horizons. At the same time, the presentation of cultural diversity has also enhanced social cohesion and centripetal force, and different cultural groups have jointly built a harmonious and inclusive social environment through mutual appreciation and respect.

### **5.2 Enhance cultural identity and sense of belonging**

Cultural hybridity in traditional festivals in Macao is like a bond, which closely enhances people's sense of cultural identity and belonging. When people participate in Chinese and western festivals, they can not only immerse themselves in the



profound heritage of Chinese traditional culture, such as the reunion implication of Mid-Autumn Festival and eating moon cakes, but also appreciate the unique charm of western culture, such as the interesting experience of looking for eggs at Easter. The nourishment of this dual culture makes people deeply feel their close connection with the multiculturalism in this land. Both Macao residents born and bred and tourists from all over the world can find emotional sustenance in this atmosphere of cultural integration. The enhancement of cultural identity and sense of belonging, like a solid cornerstone, provides strong support for the harmonious, stable and sustainable development of society and makes people love this land full of cultural vitality more.

### 5.3 Promote cultural inheritance and innovation

Cultural hybridity in traditional festivals in Macao is just like a powerful driving force, which has effectively promoted the development of cultural inheritance and innovation. In the process of integrating Chinese and western festival cultures, traditional festival activities in Macao constantly absorb new elements and concepts and glow with vitality<sup>[5]</sup>. On the one hand, it provides a new way and carrier for the inheritance of Chinese traditional culture, so that ancient customs can be continued and carried forward in modern society; On the other hand, the integration of western culture has also inspired innovation and spawned many novel and unique festival forms and contents. For example, western music and dance elements are integrated into traditional festival performances to create a unique art form. This kind of cultural inheritance and innovative development not only protects the roots of Chinese traditional culture, but also makes the culture prosper with the times, injecting a steady stream of vitality into the cultural development of Macao.

## 6. Conclusion

By analyzing the cultural hybridity of traditional festivals in Macao, this paper discusses the integration and changes of Chinese and western festival cultures in Macao. It is found that traditional festivals in Macao not only retain the essence of Chinese traditional culture, but also incorporate elements of western culture, forming a unique cultural landscape. This phenomenon of cultural hybridity not only promotes the development of cultural diversity and inclusiveness, but also enhances people's sense of cultural identity and belonging and promotes the development of cultural inheritance and innovation. Future research can further explore the deep mechanism and cultural connotation of cultural hybridity in Macao's traditional festivals, and the influence of this cultural hybridity on Macao's social and cultural development. At the same time, we can also make a comparative study of the phenomenon of cultural mixing of traditional festivals in Macao and other regions, so as to provide a broader perspective and reference for understanding the coexistence of multiculturalism. In addition, with the progress of science and technology and the development of society, future research can also make use of new technical means such as big data and artificial intelligence to conduct a more in-depth analysis and research on the phenomenon of cultural hybridity of traditional festivals in Macao.

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# Evolutionary Characteristics and Governance Pathways of Exam Cheating Behavior among Undergraduate Students

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**Abstract:** This study analyzes 368 cases of undergraduate exam cheating investigated at H University from 2021 to 2025. Using descriptive statistical analysis, the research systematically examines the evolving characteristics of cheating behaviors. The findings indicate a significant rebound in cheating incidents after a temporary decline in the 2022 academic year. In terms of grade distribution, sophomores and juniors represent the highest-risk groups. From a disciplinary perspective, cheating is predominantly concentrated in professional courses, with a significantly higher proportion than in public basic courses. Regarding methods, traditional paper-based materials (cheat sheets) still dominate (approximately 60%), but cheating using electronic devices and proxy exam-taking now account for nearly 30% of cases. Based on these findings, this paper proposes targeted governance strategies focusing on the reform of core professional course assessments, academic pressure counseling for upper-year students, and the implementation of a differentiated proctoring system.

**Keywords:** Undergraduate Universities; Exam Cheating; Examination Management; Causal Analysis

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## 1. Introduction

Academic integrity is a crucial institutional foundation for the high-quality development of engineering education <sup>[1]</sup>. As a key evaluation stage in the engineering talent cultivation system, examinations not only test learning outcomes but also objectively shape students' learning strategies and behavioral choices. In recent years, with the deepening of engineering curricula and rising course difficulty and graduation requirements, undergraduates face significantly increased academic pressure in examination settings. Consequently, exam cheating has become an unavoidable issue in the governance of engineering education.

Existing research has extensively discussed exam cheating from various perspectives, including individual student characteristics, perceptions of integrity, examination system design, and campus management, forming a general consensus around drivers like "academic pressure" and "systemic loopholes" <sup>[2]</sup>. However, these studies are often based on surveys or macro-statistical data and lack sufficient focus on the structural differences in cheating behavior across different grade levels, course types, and examination contexts. Particularly in local polytechnic universities, cheating behaviors may exhibit characteristics distinct from those at comprehensive or research-intensive universities, influenced by their unique professional structures, engineering course assessment methods, and student development paths. The underlying mechanisms and governance priorities require further investigation through empirical data.

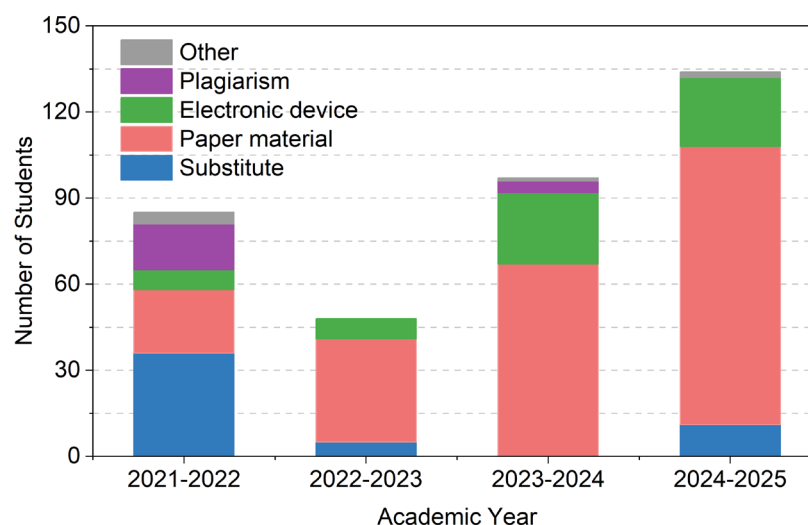
H University, a local undergraduate institution specializing in science and engineering, is representative in its professional settings, curriculum structure, and teaching management models. This paper, therefore, takes 368 cases of undergraduate exam cheating investigated from the fall semester of 2021 to the spring semester of 2025 as its research sample. Combined with survey data, it systematically analyzes the structural characteristics and evolutionary trends of cheating behavior from the dimensions of academic year changes, course types, grade distribution, and examination contexts. This study aims to reveal the phased and context-dependent features of exam cheating in engineering education and, based on this, explore targeted governance pathways to provide empirical evidence for local polytechnic universities to improve their examination management and course assessment systems.

## 2. Current State of Student Exam Cheating

### 2.1 Overall Trends and Type Distribution

From the fall semester of 2021 to the spring semester of 2025, H University investigated a total of 368 cases of undergraduate exam cheating. The data were primarily sourced from the university's academic affairs office's disciplinary action archives and supplemented by survey results for verification. As shown in the annual trend (Fig 1), the number of cheaters exhibits a distinct "U-shaped" fluctuation: there were 86 cases in the 2021–2022 academic year, which dropped to 48 in 2022–2023. Subsequently, with the full resumption of in-person centralized exams, the number rapidly rebounded, reaching a peak of 135 in the 2024–2025 academic year. This trend suggests that the problem of exam cheating did not naturally disappear after the full return to in-person assessments for engineering courses. Instead, it experienced a resurgence in specific periods, indicating that relying solely on disciplinary constraints is insufficient for long-term governance. This also confirms the long-term erosive effect of remote examination models on the academic integrity environment in the post-pandemic era.

Fig 1. Trend in the Number and Types of Cheating Incidents (2021–2025 Academic Years)



In terms of cheating methods, traditional paper-based materials (e.g., cheat sheets, notes) remain the dominant method, accounting for approximately 60% of all cases. Cheating with electronic devices ranks second. Although proxy exam-taking has a relatively lower share, its impact on examination fairness is severe and is mainly concentrated in non-standardized tests such as physical fitness tests. Mutual copying accounts for the smallest proportion. Overall, low-tech, traditional cheating methods remain the primary focus for current examination governance.

### 2.2 Temporal and Spatial Distribution

Exam cheating at H University shows clear concentration patterns. Incidents primarily occur at the end of the semester, with the cheating rate during the fall semester final exams being approximately 17.3% higher than in the spring semester. In terms of timing during an exam, the period between 40 to 70 minutes into the exam is the peak time for cheating, accounting for 61.8% of all cases. The 15 minutes before the exam starts and the 10 minutes before it ends constitute secondary peaks, reflecting impulsive violations by some students under exam pressure.

Spatially, the detection rate of cheating in large lecture halls is significantly higher than in standard classrooms, with average

rates of 3.2% and 1.7%, respectively. Compared to small-class exams (under 45 students), the incidence of cheating in large, combined-class exams (over 70 students) is about 42.5% higher. Furthermore, the cheating rate in public teaching building exam rooms is nearly 30% higher than in dedicated faculty-managed exam rooms. This difference may be related to students' familiarity with the exam environment, proctors' familiarity with individual students, and variations in proctoring resources<sup>[3]</sup>. These temporal and spatial characteristics are particularly prominent in professional course exams and among sophomore and junior students, further confirming the close link between examination context and misconduct.

### 2.3 Disciplinary and Grade-Level Differences

In terms of disciplinary distribution, professional courses are a high-risk area for cheating, with 201 cases, accounting for 54.6% of the total. In contrast, the proportion of cheating in public basic courses such as mathematics, physics, and English is relatively low. This result indicates that when exam content is highly correlated with students' professional competency evaluation, graduation requirements, and future employment, the risk of misconduct increases significantly.

From a grade-level perspective, exam cheating is mainly concentrated among juniors (35.9%) and sophomores (32.6%), with these two groups accounting for nearly 70% of the total. Freshmen have a relatively low share (17.9%). This indicates that as students enter the professional course stage, the academic burden increases, course difficulty rises, and sensitivity to exam discipline declines, leading to a clear clustering of misconduct risk at this stage.

## 3. Causal Analysis of Exam Cheating

### 3.1 Personal Factors

At the individual level, student cheating can be analyzed from cognitive, emotional, and behavioral dimensions. Cognitively, surveys show that nearly 60% of cheating students have varying degrees of learning deficiencies, manifested as a poor understanding of course content, improper study methods, or a negative attitude towards learning. Additionally, 47.8% of students have significant time management difficulties, making it hard to schedule daily study and review, leading them to cram for exams, which increases the likelihood of cheating.

Emotionally, academic pressure and exam anxiety are key psychological drivers of cheating<sup>[4]</sup>. Nearly 70% of students reported high levels of academic pressure, which, according to self-assessments, increased by about 20% after the introduction of new professional accreditation evaluations in 2021. Furthermore, about 50% of students experience significant anxiety about exam results, with this anxiety being more pronounced among students with high family expectations. When faced with the potential consequences of poor grades, these students are more inclined to resort to illicit means to avoid risks. Behaviorally, poor study habits and a lack of self-discipline are also major contributing factors. Data show that nearly 40% of cheating students procrastinate severely, with an average effective study time of less than 3 hours per day; about 30% have a class attendance rate below 80%. Among cheating students, about 60% were significantly underprepared for exams, and 40% lacked a systematic study plan and self-discipline. Moreover, nearly 40% of students admitted to an insufficient understanding of academic integrity norms, failing to fully recognize the seriousness and long-term consequences of cheating.

### 3.2 Environmental Factors

At the institutional level, exam cheating is closely related to the teaching evaluation system, examination management, and the campus culture of academic integrity. First, the weight of final exams in the overall course grade is generally too high. Statistics show that for about 70% of courses, the final exam accounts for over 60% of the total grade, and for about 30% of courses, this weight is even over 70%. This assessment model, dominated by a single exam, amplifies the importance of the exam result, creating a "single-exam-determines-everything" mentality.

Second, there are still weaknesses in examination organization and management. In large examination halls with more than 70 students, the average proctor-to-student ratio is about 1:25, which is significantly higher than the 1:20 standard recommended by the Ministry of Education, objectively weakening proctoring effectiveness. Additionally, the enforcement of penalties for cheating tends to be lenient. The probation period for cheating students is lifted in nearly 100% of cases after one year, which weakens the deterrent effect of the policy and fosters an expectation that the "cost of misconduct is manageable"<sup>[5]</sup>.

Regarding the campus academic culture, there is a prominent "GPA-centric" value orientation. Surveys show that over 60% of students believe that GPA ranking is more important than actual learning. Intense competition for grades weakens the spirit

of cooperation in learning and encourages a utilitarian approach. Especially after the implementation of new policies for changing majors and awarding scholarships in 2023, the decisive role of grades in students' development paths was further strengthened. About 60% of cheating students admitted that the perceived immediate benefits of cheating outweighed the risks of being caught.

### 3.3 Social Factors

From a societal perspective, employment pressure and social values have a significant impact on students' examination behavior. On one hand, intensified competition in the job market creates continuous external pressure. Between 2021 and 2025, the average initial employment rate for graduates of H University was below 90%. Nearly 60% of students stated that to enhance their competitiveness in the job market, they had to focus on grades as a core metric, especially as the number of graduates continues to grow.

On the other hand, a utilitarian social outlook has, to some extent, devalued the process of learning. Surveys show that over 60% of students agree that "the result is more important than the process," and over 50% have the cognitive bias that "grades equal ability." The media's focus on high-paying jobs and success stories leads some students to form a one-sided perception that a high GPA is the key to securing a desirable job, thus turning exam scores into a tool and ignoring the importance of academic integrity and the learning process itself.

## 4. Governance Pathways and Institutional Implications

Given the evolving characteristics of exam cheating at H University in terms of grade distribution, course types, and methods, a purely punitive approach to governance is no longer adequate for the current complex situation. The governance strategy should shift from "plugging leaks at the end" to "addressing the source and controlling the process," building a systematic prevention framework that encompasses course assessment, academic support, and proctoring technology.

### 4.1 Deepen the Reform of Engineering Course Assessment Models to Mitigate the "Single-Exam-Determines-Everything" Incentive

Given that professional courses have a cheating rate of 54.6% and are mostly concentrated in final exams, the expected gains from cheating must be reduced by reforming assessment methods. First, rebalance the weight of formative assessments. The current situation where final exams account for a disproportionately high percentage (60%-70%) should be changed by increasing the weight of regular assignments, mid-term tests, lab work, and engineering design projects to over 50%. Second, optimize the design of exam questions. For science and engineering courses, reduce the proportion of objective questions that rely on rote memorization and increase the number of open-ended, comprehensive, and application-oriented questions. Such questions, which assess the ability to solve complex engineering problems, have an inherent uncertainty in their standard answers, which technically reduces the feasibility of using cheat sheets or copying<sup>[6]</sup>. Finally, promote "non-standard answer" exam reforms. Encourage core professional courses to adopt "semi-open-book" or "open-book" exams, allowing students to bring reference materials but focusing on assessing knowledge transfer and application skills, thereby guiding students to shift their energy from "making cheat sheets" to "understanding knowledge."

### 4.2 Establish a Precision Academic Support Mechanism for Sophomores and Juniors in their "High-Pressure Period"

Data show that sophomores and juniors are high-risk groups for cheating, which is closely related to the high density and difficulty of courses and the concentrated pressure of professional stream selection during this period. First, implement staggered management of academic pressure. The academic affairs office should use big data analysis to rationally plan the density of core courses and exam schedules each semester to avoid concentrating high-difficulty professional courses in a short period. Second, establish an early warning and support system for academic difficulties. Use information platforms to monitor students' attendance and regular grades, and intervene early for students who are struggling or have procrastination habits. By establishing a "professional mentor + peer tutoring" mechanism, provide personalized academic guidance to alleviate the anxiety caused by a lack of ability. Third, enhance the integration of engineering ethics education. In line with professional engineering education accreditation requirements, deeply integrate academic integrity education with courses like Engineering Ethics, making students aware of the potential long-term impact of misconduct on their future professional



qualifications (e.g., engineer registration).

### 4.3 Upgrade to a Differentiated Examination Management System Combining Human and Technical Defenses

Faced with the rising proportion of cheating using electronic devices and the high incidence in large exam halls, a differentiated examination management strategy is needed. Implement risk-based management of exam venues. For high-risk venues like large lecture halls (over 70 students) and public teaching building exam rooms, the standard 1:25 proctor-to-student ratio should be abandoned in favor of “double proctoring” or adding mobile patrol proctors. At the same time, promote the use of a randomized seating system to break the traditional pattern of seating by student ID number. Strengthen technical defense capabilities. For increasingly covert electronic device cheating, deploy signal jammers and radio monitoring equipment in key exam venues. For proxy exam-taking in non-written tests like physical fitness tests, introduce identity verification technologies such as facial recognition or fingerprint scanning to ensure “one person, one identity”<sup>[7]</sup>. Improve the feedback mechanism for disciplinary actions. Change the current situation of “heavy on punishment, light on education” and overly lenient lifting of probations. In addition to administrative sanctions, students should be required to take a remedial course on academic integrity, and this should be substantively linked to their eligibility for awards, honors, and party membership recommendations.

### 4.4 Foster a Campus Academic Ecosystem of Diverse Evaluation and De-Utilitarianism

Societal employment pressure and “GPA-centrism” are the deep-rooted causes of cheating. Universities should actively dismantle this singular evaluation orientation. In the university’s awards and honors system, the absolute weight of exam scores should be reduced, and diverse evaluation dimensions such as innovation and entrepreneurship achievements, social practice experience, and contributions to research projects should be introduced. This will provide diverse pathways to success for students with different talents, reducing the vicious cycle of competition driven by a single performance metric. At the same time, through university-enterprise cooperation platforms, convey to students the real hiring standards of the industry—those practical skills and professional qualities are valued far more than a mere transcript. This will guide students to adopt a “competency-based” rather than a “score-based” view of learning, fundamentally correcting the utilitarian motives that lead to cheating.

## 5. Conclusion

Based on cheating data and survey results from H University undergraduates between 2021 and 2025, this study found that exam cheating behavior exhibits clear periodic fluctuations, with a rebound and sustained high level after 2023. Structurally, cheating is concentrated in professional courses and among sophomore and junior students, and is particularly prominent in large-class exams and high-risk course contexts. Its occurrence is closely related to factors such as monolithic course assessment methods, concentrated academic pressure, and shortcomings in examination management and integrity education. Therefore, a multi-faceted and coordinated approach is needed, involving student academic support, reform of professional course assessment, optimization of examination management systems, and the cultivation of a social environment of integrity, to gradually build a long-term governance mechanism where students are “unwilling to cheat, afraid to cheat, and unable to cheat.”

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## Conflict of Interests

The authors declare that there is no conflict of interest regarding the publication of this paper.

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# Research on the Enhancement of Listening Metacognitive Strategies of Non-English Major Vocational Students with the Aid of Artificial Intelligence

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**Abstract:** Most non-English majors in vocational colleges lack listening and speaking skills. Traditional teaching methods have failed to teach students listening learning strategies and self-directed learning strategies. Artificial intelligence technology has enabled many intelligent learning aids to transform foreign language education. This paper conducts teaching experiments based on metacognitive theory, using AI tools to guide students in planning, monitoring and evaluation. The results show that continuous AI assisted training increases students' awareness of metacognitive strategies in listening, increases their strategic use and improves listening and learning confidence. These results validate the effectiveness of AI-aided tools and provide new insights for reforming English listening instruction in vocational colleges. Future work is needed to study the relationship between AI tools and metacognitive strategy cultivation.

**Keywords:** Artificial Intelligence; Learning Tools; Vocational College Students; Metacognitive Strategies

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## 1. Introduction

### 1.1 Research Background

As the globalization and the increasing exchange of information, English has become a key global language. For vocational students majoring in other languages, listening to English is the most effective way to learn English, influencing their language comprehension, information acquisition, and cross-cultural communication skills – they are vital for careers. However, many students struggle with weak foundational skills, lack comprehension skills and inefficient learning. Traditional listening instruction focuses on mechanical drills and exams and neglects self-directed learning skills and strategies, such as metacognition.

### 1.2 Research Questions and Objectives

In the current globalized world, English listening is a professional skill of all non-English majors at vocational colleges. However, students with low listening skills are often suffering from weak foundational knowledge, lack motivation, fear of long listening tasks, lack of motivation, lack of time, lack of time to read. Teachers often use overly mechanical teaching methods, playing audio materials and giving answer keys for verification, not teaching students cognitive processing or self-regulated strategies. Also, large classes often have little time for instructors to teach metacognitive

strategies. In addition, new technologies like generative AI are changing educational ecosystems. Intelligent learning tools are entering language learning domain with user-friendly interfaces, real-time feedback, personalized recommendations, and human-computer interaction that can outperform traditional teaching models. They can also act as “coaches” providing vocabulary prompts, semantic explanations and repeated listening suggestions for metacognitive strategies, effectively fulfilling the “monitoring” and “remediation” needs of metacognitive strategies. The two aspects of “planning” and “evaluation” allow students to design study plans, document learning progress, and generate analytical reports after completion.

Therefore, for vocational English listening training using AI-assisted learning tools, it is both targeted and essential to train non-English majors in listening metacognitive skills. This is one of the main benefits of AI-assisted learning. In this paper, we investigate how non-English majors can use AI-assisted tools to improve listening metacognitive skills, improve learning results and self-directed learning in vocational English listening education.

To achieve this overarching goal, this study specifically addresses three core research questions. First, what are the current levels of listening metacognitive skills among non-English major students in vocational colleges, and what specific difficulties do they encounter in applying these skills during English listening practice? This question aims to establish a baseline understanding of the learners’ existing capabilities and pain points, which is crucial for designing targeted interventions with AI tools. Second, how can AI-assisted learning tools be optimized or designed to effectively scaffold the development of listening metacognitive skills, such as planning, monitoring, and evaluating one’s own listening process, in vocational English listening contexts? This question delves into the practical application of AI technology, exploring the specific features, functions, or interaction modes that can best support metacognitive skill acquisition. Third, to what extent does the integration of AI-assisted tools into vocational English listening training impact non-English majors’ listening metacognitive awareness, listening comprehension performance, and self-directed learning abilities over a sustained period? This question seeks to evaluate the effectiveness of AI intervention from multiple dimensions, including cognitive, academic, and motivational outcomes.

In line with these research questions, the primary objectives of this paper are as follows. Firstly, to construct a theoretical framework that integrates metacognitive learning theory with AI-assisted language learning, particularly focusing on the unique demands of vocational English listening. Secondly, to develop or adapt an AI-assisted listening training program tailored to enhance metacognitive skills, based on the identified needs of non-English major vocational students. Thirdly, to empirically test the effectiveness of this program through an experimental study, comparing the metacognitive skill development, listening achievement, and self-directed learning readiness of students who receive AI-assisted training versus those in a traditional instruction group. Finally, to propose practical implications and recommendations for educators, curriculum designers, and AI tool developers on how to better leverage AI technology to foster metacognitive skills in vocational English listening education, thereby promoting more effective and autonomous language learning among non-English major students.

## **2. Literature Review**

### **2.1 Domestic Research Status**

As reported by the authors, listening comprehension involves learners constructing meaning by phonetic signal processing and decoding. Vocational college students majoring in non-English subjects often face difficulties in learning and understanding hearing information due to limited vocabulary, weak speech recognition skills and lack of contextual knowledge. These difficulties often lead to comprehension errors and anxiety, which can lead to significant difficulties in listening instruction. Metacognitive strategies are considered as solutions to these problems. Metacognition is the awareness and regulation of cognitive processes by an individual, expressed in four strategies during listening learning: planning, monitoring, evaluating and remedying. Planning strategies involve setting goals before listening tasks; monitoring strategies involve measuring comprehension during listening; evaluating strategies require reflection after task on goal achievement and learning results; remedying strategies involve problem solving through re-listening or reference materials. Studies show that mastering strategies can help students to transition from passive learners to active learning managers and enhance self-

directed learning.

The AI-assisted learning revolutionizes the metacognitive strategy training. AI-assisted learning is a system or tool that leverage natural language processing and machine learning to provide personalized learning support to students. AI-assisted learning is a system or tool which uses natural language processing and machine learning technologies to provide personalized learning support based on real-time feedback, adaptive resource recommendations, learning process tracking and report generation. Recent studies show that AI is now more than just content provider but strategic guide in metacognitive training frameworks. By providing strategic usage reminders for different listening practice stages, AI supports students in purposeful self-regulation activities. Current research states that combining AI's real-time responsiveness and personalized advantages with metacognitive strategy frameworks can be a valuable method for improving listening ability among non-English majors in vocational colleges, providing new perspectives on listening instruction research and practice.

In China, domestic research on AI-assisted metacognitive strategy training for listening has witnessed rapid growth in recent years, with scholars focusing on both theoretical exploration and practical application. Early studies primarily centered on the integration of AI tools into listening instruction, examining how adaptive learning platforms could deliver personalized listening materials based on students' proficiency levels. For example, some researchers developed intelligent listening systems that adjust difficulty levels in real-time according to learners' performance on comprehension tasks, aiming to scaffold metacognitive processes such as goal setting and self-monitoring.

As research progressed, attention shifted to the specific mechanisms through which AI facilitates metacognitive development. Studies have highlighted that AI's ability to provide immediate, detailed feedback on listening strategies—such as identifying where students pause, rewind, or struggle with specific audio segments—enables learners to reflect on their cognitive processes more effectively. For instance, a 2022 study by Li and Zhang analyzed data from an AI listening platform used by 500 vocational college students, finding that the system's automated prompts to “summarize the main idea before answering detail questions” significantly improved students' strategic planning during listening tasks.

Moreover, domestic research has explored the impact of AI-driven learning analytics on metacognitive training. By tracking metrics like listening duration, note-taking frequency, and error patterns, AI systems generate comprehensive learning reports that help both students and teachers identify strengths and weaknesses in metacognitive strategies. A longitudinal study conducted at a vocational college in Jiangsu Province demonstrated that students who regularly reviewed AI-generated strategy reports showed a 30% increase in self-assessment accuracy and a 25% improvement in listening test scores over one semester, compared to a control group without such feedback.

However, existing domestic research also faces certain limitations. Most studies focus on higher education settings, with relatively fewer investigations into vocational college students, whose English proficiency and learning needs often differ from those in universities. Additionally, while many studies validate the effectiveness of AI tools, there is a lack of in-depth analysis on how cultural factors or learning habits specific to Chinese vocational students influence the adoption and effectiveness of AI-assisted metacognitive training. These gaps indicate the need for further context-specific research to optimize AI applications in this domain.

## **2.2 Educational Applications of Artificial Intelligence and the Development of Higher Vocational Students' Metacognitive Strategies for Listening**

Traditionally trained listening metacognitive strategies do not meet students needs and give delayed feedback, but AI robot assisted intervention can solve these problems. Real-time feedback and personalized content from robots help students monitor and refine metacognitive strategies. Teaching has shown that AI assisted instruction improves students' performance in certain areas, suggesting that AI-based approaches could be used to train metacognitive strategies.

In general, we find that AI-aided strategies to grow strategies are limited. They may temporarily improve learning results, but they can lead students to over-reliance on prompts rather than to self-developing cognitive skills. The other drawback is that most AI tools focus on learning and answering online knowledge, without structured processes or evidence-based training of metacognitive strategies, and thus do not function as a “strategy guide.” Given the cognitive characteristics of vocational college students, we propose to use AI tools through simplified interfaces, task-based approaches and a “AI training-teacher

feedback-student reflection” model to improve strategy cultivation effectiveness.

## **2.3 Existing Issues in the Application of AI Education for Developing Higher Vocational Students’ Listening Metacognitive Strategies**

### **2.3.1 The technology does not fully cover the metacognitive strategy dimension**

Metacognitive strategies include pre-listening planning, in-listening monitoring and adjustment, and post-listening evaluation and reflection. Current AI-assisted listening tools lack much coverage of these strategies. Planning tools provide standard listening task lists, but do not generate pre-listening preparation plans that are specific to vocational students’ English skills (e.g., vocabulary size, listening note taking). Specific guidance is lacking (e.g., predict topic progression in dialog or mark conjunctions in monologic material). Monitoring and adjustment tools provide real-time subtitle feedback or error annotations, but no interactive features to help students to self-identify comprehension gaps, thus hindering active monitoring of their listening process. Evaluation and reflection tools use accuracy rates or error percentages as metrics, but do not analyze strategies application behaviors (e.g., whether students use “keyword capture” or “subtext prediction” strategies) or how effective strategies are. Students are not able to identify their weaknesses or to apply strategies internally and transfer strategies.

### **2.3.2 Weak Targeted AI Feedback**

Most current AI-aided listening tools are based on superficial result presentation in their feedback mechanisms, failing to provide precise and personalized guidance based on vocational college students’ ‘individual differences and learning contexts’. On one hand, feedback focuses on final accuracy rate or error statistics, without any analysis of students’ application strategies (for example, whether improper attention is wasted during information extraction or whether lack of background leads to topic prediction errors). On the other hand, feedback is often delivered bulk after task finishes, without real-time intervention during listening sessions (for example, when students repeatedly stop paragraph) the tool doesn’t highlight the paragraph’s logical structure or key vocabulary. Feedback is mostly textual descriptions, without visual or interactive formats. Visual learners can’t discern the problem or mastered improvement strategies well. Such inadequate feedback prevents AI tools to adapt fully to vocational students’ own learning needs and skill levels, ultimately limiting metacognitive strategy cultivation effectiveness.

### **2.3.3 Single Interaction Design**

Most AI tools used by vocational English listening instruction still work in a linear fashion: students use tools to complete tasks, then receive output or feedback. This is a static context-based multi-dimensional interaction process. Student interactions are limited to simple playback and answer submission, and unable to support deeper engagement via drag-and-drop annotation, voice conversations or virtual scenarios. For example, when listening materials are studied, tools lack editable mind map templates for students to mark information nodes and connections independently. When practicing self-monitoring strategies, tools lack real-time voice guidance for students to reflect on why this processing approach went wrong, instead of presenting the preset questions as static text. Such monotonous interaction design contradicts vocational students’ preference for hands-on practice and contextual learning. It also fails to motivate students to apply metacognitive strategies and impedes strategy internalization and transfer during interactions. AI-aided listening metacognitive training fails to achieve expected depth and effectiveness.

## **3. Data Analysis and Collection**

### **3.1 A Mixed Method Study of Non-English Majors in Sichuan Vocational Colleges**

To study whether AI-aided tools improve listening metacognition among non-English majors at vocational colleges in Sichuan Province, we used mixed-methods approach combining quantitative data with qualitative material to analyze the process and results before and after intervention. We used non-English major class at vocational college in Sichuan Province. Student had poor English proficiency, unstable motivation and anxiety due to task comprehension difficulties.

We performed a quasi-experimental experiment divided into a control group and a control group. The experimental group received conventional listening instruction and an AI-assisted learning tool with metacognitive strategy training modules throughout the semester, while the control group received only conventional listening instruction without the AI tool. Both

groups had pre-test listening proficiency and metacognitive strategy awareness measurements before the experiment, which ensured general equilibrium between the two groups.

We used both quantitative and qualitative research approaches combining data collection. Quantitative data included pre- and post-intervention listening comprehension test scores and metacognitive strategy use frequency questionnaires. Qualitative materials included semi-structured interviews, student learning journals and backend data from AI tools (for example trigger frequency of strategy prompts and student interactions) tracking strategy use patterns. This double approach validated the intervention effectiveness and revealed its mechanisms and authentic strategies for strategy use by students. We address the limitations of pure quantitative research and authentically recreate classroom teaching scenarios, which makes the paper generalisable and practical.

### 3.2 Application of AI Tools, Data Collection and Processing

During the semester, students in the experiment used an AI-aided listening system under instruction from the teacher. The system set goals before each session (for example, “Identify the stress in the dialogue”) and asked the machine to activate planning strategies. The system also gave objective feedback: If students stopped abruptly after listening, clicked repeatedly to watch audio clips, it indicated difficulties in comprehension. They asked: “You have trouble. Would you like to replay the content or review related vocabulary?” Then students wrote themselves, summarized their performance and received listening recommendations.

Data collection was performed concurrently and classified into quantitative and qualitative components. Quantitative data included student behavior logs recorded through the tool backend (practice duration in problem solving sessions, clicks and responses after strategy prompts, number of listening sessions repeated, and interim scores of different systems). These were anonymously exported as structured data. In mid-to-late phase of intervention, listening comprehension tests and metacognitive strategy awareness scales were administered to all participants in experimental and control groups, recording listening proficiency changes and strategies awareness changes. Semi-structured interviews were conducted with some experimental group students, and electronic learning reflection logs collected during each session were collected. Goals were to assess real experience of tools, challenges encountered during strategy implementation and strategies used to overcome difficulties.

All quantitative data were cleaned and coding, and the results were verified accurately. Statistical software was used to analyze the differences between groups in pre-test listening scores and questionnaire scale scores. Statistical statistics and correlation analysis of backend behavioral log data showed higher response rate to strategy prompts associated with better listening. Qualitative data were processed through thematic analysis using multiple readings and Coding of interview transcripts and learning logs, identified key themes such as changes in student attitudes, strategy internalization and barriers to use of tools. The quantitative results were incorporated into the conclusions section by triangulation, allowing a comprehensive and objective assessment of the practical effectiveness of AI tools for cultivating listening metacognitive strategies and students’ experiences and feedback on such products, in order to conclude conclusions.

## 4. Conclusion

This paper started from an AI-assisted teaching pilot conducted over a semester using action research methods to analyze the effect of AI tools on metacognitive strategies of non-English majors at vocational colleges. Results showed that applying AI tools to listening taught effectively improved students’ knowledge of metacognitive strategies. Under continuous guidance, students showed significant increases in metacognitive strategy behaviors (including planning, monitoring, and evaluation) during all listening tasks. They also improved listening comprehension and learning confidence and remained moderately confident. Qualitative data showed that AI real-time and personalized feedback enabled students to transition from passive task completion to autonomous learning control, effectively reducing academic anxiety and self-regulation skills. Results show that AI assisted teaching has been shown to be effective in metacognitive strategy training for listening comprehension training.

The results of this study have implications for reforming English teaching in vocational colleges, and provides practical solutions to the persistent problems of traditional listening and speaking instruction. AI tools can be used as “metacognitive



coaches” to address faculty shortages and difficulty of providing personalized guidance. Teaching should emphasize integration of techniques and strategies. Techniques should not be limited to mere demonstrations, but should be integrated into strategies, which students can apply and reflect on them. Teaching should be a seamless integration of techniques and strategies. Finally, “AI assisted training, teacher-led guidance and student-driven reflection”. Technological applications can actually enhance students’ learning.

In the future, related research and practice can explore more directions: First, the tool design should better fit vocational students’ cognitive characteristics and learning needs, user-friendly interfaces and smooth interaction. Second, from teaching perspective, long-term tracking experiments should be conducted to test the viability of AI assisted training strategies, and whether they impact students with different foundations differently. Third, more scenarios should be pursued, establishing teacher training and guidance systems. Overall, the potential of AI plus metacognitive strategies is clear.

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# Research on the Paths of Integrating Locally Distinctive Culture into the Teaching of Research Methods in Journalism and Communication

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**Abstract:** “Research Methods in Journalism and Communication” is a course that emphasizes practical teaching. However, it has long been plagued by the practical challenge of being difficult for instructors to teach and for students to understand. Based on constructivist learning theory and situational teaching theory, this study integrates the teaching characteristics of the course “Research Methods in Journalism and Communication”, and analyzes the existing problems in its teaching practice. From four dimensions—structuring teaching content, innovating teaching methods, constructing practical platforms, and improving the evaluation system, this paper proposes specific pathways for integrating locally distinctive culture into the course teaching. It aims to provide reference for the teaching reform of the course “Research Methods in Journalism and Communication.”

**Keywords:** Locally Distinctive Culture; Research Methods In Journalism And Communication; Curriculum Integration; Teaching Reform; Path Exploration

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## Introduction

In recent years, a wave of localization-oriented reform has emerged in China’s higher education sector, schools emphasize the integration of curriculum teaching with local realities to serve regional social development. As a discipline that combines theoretical and practical aspects, journalism and communication needs to considerate how to link curriculum teaching with local social development. Currently, “Research Methods in Journalism and Communication” has been designated by many universities as an important course for the training of undergraduate, master’s, and doctoral students majoring. The course objective is to guide student to analyze communication phenomena and solve practical communication problems using scientific methods. However, the teaching of this course in many institutions currently faces several challenges: it is difficult for teachers to teach, and many students also have difficulties to understand the knowledge; Many teachers’ teaching methods overemphasis on theory over practice. Moreover, the teaching content is predominantly based on Western theories and general methods, which are disconnected from the actual needs of the regions where the universities are located. This disconnection results in students more difficulty to understand local culture and weak ability to apply research methods to address local communication issues.

Locally distinctive culture refers to a unique cultural system formed in a specific region during its long-term development. It

encompasses rich elements such as historical sites, folk customs, intangible cultural heritage, and regional spirit, serving as the spiritual core and cultural foundation for regional development. Integrating locally distinctive culture into the teaching of “Research Methods in Journalism and Communication” maybe can place obscure research method theories into specific and vivid application scenarios, so it can enhance the interestingness of course teaching. Meanwhile, it can help students have opportunity to understand local culture and improve their cultural confidence and cultural communication capabilities. Against this backdrop, we conducted this study to explore how to integrate local cultural characteristics into curriculum teaching, exploring effective paths for integrating locally distinctive culture into the teaching of “Research Methods in Journalism and Communication” can help address the practical problems existing in the current teaching of this course.

## 1. Theoretical Foundations

The first theoretical basis of this study is constructivism theory. Constructivist learning theory is an important theory, it subverts the traditional teacher-centered teaching model. this theory consider knowledge as a product actively constructed by learners, rather than conclusion unilaterally imparted by teachers. It believes that knowledge acquisition is not an isolated individual behavior but an interactive process occurring in specific sociocultural contexts. Learners need to screen, process, and reconstruct environmental information through dialogue and collaboration with other peoples, combined with their own experiences, and ultimately form a personalized cognitive system (Yang, W. D., & Jia, N., 2011). This theory posits that the learning process has the following characteristics: first, it believes learning is active, emphasizing that learners are the main body of knowledge construction rather than passive recipients of knowledge; second, it believes learning is based on certain contexts, advocating that real and specific sociocultural contexts are important carriers of knowledge construction, and knowledge learning divorced from contexts is often abstract and cannot to transfer; third, the learning process is interactive, advocating that interpersonal interaction and collaborative inquiry are important paths to deepen knowledge understanding and improve cognitive construction (Wen, P. N., & Jia, G. Y., 2002).

The second theoretical foundation is Situational Teaching Theory. The Situational Teaching Theory is Based on constructivist learning theory, it explores how to create scientific and reasonable contexts to guide learners in learning. The theory believes that the most important thing of teaching is to guide learners to realize the active construction of knowledge, and lead the learners have ability transfer and application of abilities in specific contexts. A vivid, specific teaching context that is close to learners’ lives and cognition is a key step in stimulating learning interest and awakening learning initiative. Compared with constructivist learning theory, situational teaching theory places greater emphasis on the life-orientation, concretization, and practicality of teaching contexts. It advocates that teaching should break the closed barriers of traditional classrooms, closely link abstract disciplinary knowledge with real-life scenarios and practical fields, and allow learners to complete knowledge learning and realize knowledge application through situational experience (Wang, Y., 2008; Wang, P., & Kang, T. H., 2004).

## 2. Existing Problems in Integrating Locally Distinctive Culture into the Teaching of “Research Methods in Journalism and Communication”

### 2.1 Disconnection Between Teaching Content and Locally Distinctive Culture

Currently, the teaching content of “Research Methods in Journalism and Communication” in most Chinese universities mainly draws on Western classic research theories and general research methods, such as questionnaire surveys, content analysis, and in-depth interviews, with insufficient attention paid to content related to locally distinctive culture in practical teaching. Most cases in textbooks are national or international general cases, which are quite different from local actual situations. This phenomenon makes it difficult for students to combine the learned theories with local cultural, and it will lead to unsatisfactory learning outcomes. Meanwhile, teachers lack the excavation and integration of local distinctive cultural resources in the teaching process, leading to the lack of regional pertinence in the course content and difficult to meet the local demand for journalism and communication talents.

### 2.2 Single Teaching Method and Lack of Situational Teaching Design

In terms of teaching methods, many teachers are accustomed to adopting traditional lecture-based teaching, dominating the classroom throughout the process, In this process, they neglect students’ learning autonomy, which lead students passively

accept knowledge. Although some teachers introduce case teaching, most cases are abstract and hardly arouse students' interest, lacking situational design related to local distinctive culture, thereby the teaching effect is not ideal.. Students cannot think about how to use reasonable and scientific research methods to consider and solve problems in real cultural contexts. Meanwhile, teachers don't have application of new teaching methods such as flipped classrooms and project-based learning, and they fail to fully mobilize students' learning initiative and creativity.

### **2.3 Insufficient Practical Teaching Platforms**

The course "Research Methods in Journalism and Communication" is highly practical and requires sound practical teaching platforms as support. However, the construction of practical teaching platforms in some universities is lagging behind at present. These universities one-sidedly pursue cooperation with "high-end" media and cultural institutions, while neglecting cooperation with local sub-districts, communities, cultural stations and other units, failing to provide students with practical venues and resources for conducting research on local distinctive cultural communication. Meanwhile, the school-enterprise collaborative education mechanism is imperfect, and enterprises have low enthusiasm for participating in teaching. As a result, the actual needs of local cultural communication cannot be integrated into the course teaching, leading to the disconnection between students' practical research and local actual needs and poor results in practical ability training.

### **2.4 Single Teaching Evaluation System and Neglect of Assessment on Practical Ability and Cultural Literacy**

Currently, the teaching evaluation of "Research Methods in Journalism and Communication" mainly relies on final examinations, focusing on the assessment of students' theoretical knowledge while neglecting the evaluation of their practical ability and cultural literacy. In terms of evaluation content, the existing assessment mostly centers on the memory and understanding of general theories such as questionnaire survey and content analysis. It fails to take students' practical achievements in conducting local distinctive cultural communication research using these methods as the core of assessment, nor does it pay attention to the cultivation effects of students' in-depth understanding of local culture, cultural identity, and cultural communication awareness. In terms of evaluation forms, it mainly adopts static assessments such as closed-book exams and written answers, lacking follow-up evaluation of dynamic practical links including students' research process, project operation, and achievement transformation. A single evaluation system not only fails to accurately measure the effectiveness of integrated teaching, but also leads students into the learning misunderstandings of "valuing theoretical memory over practical application" and "valuing general knowledge over local culture", which is not conducive to the improvement of students' practical abilities.

## **3. Specific Paths for Integrating Locally Distinctive Culture into the Teaching of "Research Methods in Journalism and Communication"**

Based on constructivist learning theory and situational teaching theory, this study will carry out teaching reforms from four dimensions: restructuring teaching content, innovating teaching methods, constructing practical platforms, and improving the evaluation system. It will specifically elaborate on the practical paths for integrating locally distinctive culture into course teaching and form a scientific and complete teaching reform plan.

### **3.1 Restructure Teaching Content and Integrate Elements of Locally Distinctive Culture**

#### **3.1.1 Explore Locally Distinctive Cultural Resources and Enrich the Teaching Case Library**

Teachers need to conduct in-depth exploration of locally distinctive cultural resources, such as local historical and cultural celebrities, intangible cultural heritage (ICH) projects, folk activities, and local media communication practices, and take all possible measures to transform these case into course teaching. For instance, when explaining "content analysis", local media reports on local ICH can be choosed as analysis objects, guiding students to use content analysis to examine the quantity, themes, and lengths of the news reports; when teaching "in-depth interview method", teachers can organize students to interview ICH inheritors, so they can understand the current status of ICH inheritance. Meanwhile, a dynamic teaching case library should be established, with cases updated in a timely manner according to changes in local cultural development and communication practices, so as to ensure the timeliness and pertinence of the teaching content.

### **3.1.2 Align with Local Needs and Optimize Curriculum Module Settings**

Curriculum theme design is the core of delivering teaching content, and it links with teaching objectives. Tailoring these themes to local cultural communication needs is a key step in deeply integrating locally distinctive culture with the course Research Methods in Journalism and Communication. This study attempts to integrate local cultural communication into course teaching. To this end, teachers need to focus on the practical issues of regional cultural development and design teaching content based on local cultural resource endowments and communication needs. For example, in areas abundant in intangible cultural heritage (ICH) resources, teaching themes such as Research on the Communication of Local ICH can be developed, course instruction can focus on specific issues, such as the media representation of ICH inheritors, new media communication paths of ICH, and branding communication strategies of ICH IPs; in county-level regions under the backdrop of the rural revitalization strategy, teaching themes like Research on Local Rural Cultural Communication can be established to explore practical topics including the construction and communication of rural cultural symbols, media promotion of rural tourism culture, and communication mechanisms in urban-rural cultural integration; in urban areas, teachers may consider focusing their instructional content on the following aspects, such as research on Local Urban Image Communication can be set up to analyze content including the role of local media in shaping urban images, communication strategies of urban cultural landmarks, and international communication paths of urban brands. This teaching design may help to stimulate students' interest in learning, enhances their ability to apply theoretical methods to solve practical problems, and thus connect course teaching and the demands of local cultural development.

### **3.1.3 Compile Localized Teaching Materials and Strengthen the Regional Characteristics of the Course**

Teachers need to collaborate more with local media experts and cultural scholars, and they can compile course handouts or supplementary materials that integrate locally distinctive culture, so teachers can make up for the deficiencies of existing textbooks. Combined with local cultural communication practices, the handouts need to provide localized interpretations of the theories and applications of journalism and communication research methods, add content such as local case analysis and local research project design, and guide students to think deeply how to integrate theoretical knowledge with local realities. For example, when explaining the questionnaire survey method, a questionnaire survey plan on rural residents' cultural information acquisition channels can be designed in conjunction with the current situation of local rural cultural communication. This process might allow students more easy to master the design and implementation process of the questionnaire survey method.

## **3.2 Innovate Teaching Methods and Construct a Situational Teaching Model**

### **3.2.1 Adopt the Situational Teaching Method and Create Local Cultural Communication Scenarios**

Integrate locally distinctive cultural resources to create authentic teaching scenarios is very important, it can allow students to apply research methods to solve practical problems in these scenarios. Teachers can simulate the media coverage planning of local cultural festival activities, where students maybe divided into groups to use research methods such as questionnaire surveys and interview methods to investigate the public's awareness and expectations of the cultural festival, and formulate coverage plans based on the findings; Teachers can also create scenarios of local intangible cultural heritage (ICH) communication dilemmas, guiding students to use content analysis, case analysis and other methods to analyze the problems existing in the current communication models and put forward more good suggestions. Situational teaching can enhances students' sense of engagement and improves their ability to apply research methods to solve practical problems.

### **3.2.2 Promote project-based learning and launch local cultural communication research projects**

Guided by the practical problems of local cultural communication, teachers can design project-based learning tasks and allow students to carry out research projects in groups. For example, focusing on the research project of new media communication strategies for locally distinctive culture, guide students to use journalism and communication research methods throughout the entire process, including topic selection, plan design, data collection and analysis, and report writing. During the project implementation, teachers provide guidance to help students solve problems encountered in the research. After the project is completed, organize students to display and exchange their achievements to improve their teamwork and research capabilities. Meanwhile, encourage students to transform their research results into practical suggestions and submit them to local cultural



departments or media, so as to enhance the practical value of the research (Yang, P. P., Jiang, Y. F., & Yang, C. C., 2023).

### **3.2.3 Adopt flipped classroom to enhance students' independent learning ability.**

Design flipped classroom teaching sessions in combination with teaching content related to locally distinctive culture. Before class, teachers upload relevant theoretical knowledge, local cultural cases and other materials to the online learning platform to guide students' independent learning; during class, organize students to discuss and exchange views on issues related to local cultural communication research and carry out practical operations. For example, when explaining the case analysis method, ask students to independently learn the theoretical knowledge of the case analysis method and read relevant cases of local cultural communication before class; during class, organize students to analyze the cases in groups, share their analysis ideas and conclusions, and teachers provide comments and summaries. The flipped classroom fully mobilizes students' learning initiative and improves their independent learning ability and critical thinking ability.

### **3.3 Build practical platforms and improve the collaborative education mechanism with local entities.**

Further attach importance to exchanges and cooperation with local media, cultural departments, sub-districts, communities and other grass-roots units, so as to provide students with practical venues and resources for conducting research on local distinctive cultural communication. For example, organize students to participate in the planning and implementation of local cultural special reports in local media, and participate in the investigation and communication of local cultural activities in community cultural centers. In addition, local media journalists, editors, heads of cultural departments, intangible cultural heritage (ICH) inheritors, and folk artists can be invited to enter the classroom to carry out special lectures, case sharing, practical guidance and other activities for students. At the same time, these experts and folk artists can also be invited to participate in the guidance and evaluation of students' practical projects to improve the quality of practical teaching.

### **3.4 Improve the Evaluation System and Strengthen the Assessment of Practical Ability and Cultural Literacy**

Improve the evaluation system and strengthen the assessment of practical ability and cultural literacy. Change the traditional single evaluation model and construct a multi-dimensional evaluation index system covering theoretical knowledge, practical ability, cultural literacy, etc. The assessment of theoretical knowledge focuses on examining students' mastery of the core theories of journalism and communication research methods; the assessment of practical ability focuses on evaluating students' ability to use research methods to carry out local cultural communication research, such as project plan design, data collection and analysis, and report writing; the assessment of cultural literacy focuses on investigating students' understanding of locally distinctive culture, cultural identity, and cultural communication awareness. Through diversified evaluation indicators, comprehensively assess students' learning effects. At the same time, strengthen process assessment. Teachers need to include students' classroom performance, case analysis reports, practical project progress, and group discussion participation into the evaluation scope, timely feedback students' learning status, and help them adjust learning strategies; summative evaluation can adopt forms such as practical project achievement display and research report defense, focusing on examining students' comprehensive application abilities. The ratio of process assessment to summative evaluation can be adjusted according to the characteristics of the course, and it is recommended that the proportion of process assessment not be less than 50% to ensure the comprehensiveness and objectivity of the evaluation.

## **4. Conclusion**

Integrating locally distinctive culture into the teaching of "Research Methods in Journalism and Communication" is a worthy path to improve teaching quality and cultivate journalism and communication talents with local cultural literacy. Currently, the integration of the two faces problems such as disconnected teaching content, single teaching methods, insufficient practical platforms, and imperfect evaluation systems. This paper aims to effectively solve the existing difficulties in course teaching through specific paths including restructuring teaching content, innovating teaching methods, building practical platforms, and improving the evaluation system, so as to realize the in-depth integration of course teaching and locally distinctive culture, enhance students' comprehensive abilities, and provide intellectual support for the inheritance and communication of local culture. In the future, this integration requires the collaborative efforts of universities, teachers, and various local entities to help cultivate more high-quality journalism and communication talents who meet the needs of local

development.

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# Research on the “One-stop” Digital Governance Path for Student Communities in Organizational Culture Construction

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**Abstract:** This study, starting from the “one-stop” digital governance of student communities based on organizational culture building, proposes that the empowering role of organizational culture building and digital governance should be fully exerted in the face of the predicaments existing in student management in colleges and universities in the new era. Through top-level design, create a “trinity” of digital governance: organizational structure for organizational culture construction, multi-functional digital platforms, and sound institutional design for digital communities; Seek governance strategies such as the deep integration of Party building and digitalization and precise service management, and strive to provide theoretical exploration and practical exploration for the efficient and intelligent student community governance system in colleges and universities, provide a model for forming a new pattern of education in colleges and universities, and cultivate high-quality talents with all-round development in morality, intelligence, physical fitness, aesthetics and labor.

**Keywords:** Organizational Culture Construction; One-Stop Student Community; Digital Governance; Governance System; Innovative Pathways

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## 1. Introduction

In the new era, with the rise of the digital economy colliding with diverse ideas, student management in colleges and universities is facing difficulties. Traditional management methods are difficult to meet the needs of students, and the problem of “information silos” among departments is prominent<sup>[1]</sup>. In this context, organizational culture building is key to the digital governance of the “one-stop” student community, and digital technology brings changes and opportunities worthy of in-depth study.

## 2. Organizational culture Building The necessity of digital governance for the “one-stop” student community

### 2.1 Challenges of Student Management in Colleges and Universities in the New Era

With the rapid rise of the digital economy and the continuous collision of diverse ideas, there are still many difficulties and confusions in the management of college students in the face of the new characteristics of contemporary college students. First, in the traditional administrative command-style management of college students, students grow up in the Internet age, are easily influenced by new ideas and new things, have a high degree of networked lifestyle, and are willing to acquire knowledge and express their own opinions through WeChat, Weibo and other channels. The traditional management approach

focuses on administrative orders and one-way indoctrination, which is not in line with the individualized and diversified development needs of students in the new era, and students' enthusiasm for participating in school community management is relatively weak. Secondly, there is the problem of "information silos" among departments in colleges and universities. There is a lack of data sharing among departments such as student affairs, academic affairs, and logistics. Students' affairs involve multiple management, which is not only time-consuming and laborious, but also makes it difficult for college administrative departments to grasp the movements of college students in a timely and accurate manner and provide precise and effective services and guidance<sup>[2]</sup>. The Internet is full of chaos, and various wrong ideas spread Western "dissenting" forces through the Internet, affecting the correct values of college students. Under the influence of the online public opinion atmosphere, the influence and guiding function of traditional ideological and political education need to be improved.

## **2.2 The Key role of organizational culture construction in digital governance**

Organizational culture building is the fundamental guideline and spiritual driving force for the digital governance of the "one-stop" student community. The leadership of the Communist Party of China is the greatest strength of the socialist system with Chinese characteristics, and colleges and universities are important bases for cultivating socialist builders and successors. Colleges and universities must uphold the Party's overall leadership over the education cause. Party building is the "anchor" and "compass" for the digital governance of the "one-stop" student community, which can correctly point out the direction in governance practice, integrate Marxist theory, the core socialist values, etc. into all aspects and the entire process of community construction, and ensure that the digital governance of the student community does not forget the fundamental task of fostering virtue and nurturing talent. The fighting fortress role of the Party organization can give full play to the advantages of resource integration, break down departmental barriers, and promote the coordinated efforts of departments such as student affairs, academic affairs, and logistics to carry out community governance and form a governance synergy. The exemplary and leading role of Party members and students can lead by example in the construction of digital platforms and the management of community governance affairs, drive all students to participate in the co-construction and co-governance of community governance, jointly create a good atmosphere of co-construction, co-governance and co-sharing of community governance, and strengthen the cohesion and centripetal force of the community.

## **2.3 Digital technology brings changes and opportunities to community governance**

Big data, cloud computing, artificial intelligence, Internet of Things, blockchain... The deep application of digital technology provides technological impetus and full empowerment for the governance of "one-stop" student communities<sup>[4]</sup>. Big data, by collecting, storing and analyzing massive amounts of data generated in scenarios such as students' learning, life and interaction, helps universities to accurately grasp students' behavioral preferences, hobbies and ideological trends, and transform them into "big data +" -led educational resources, from experience-driven to data-driven. Artificial intelligence, through its understanding of natural language and intelligent algorithms such as machine learning model construction, provides students with intelligent consultation, intelligent recommendation and other services, improving service efficiency and optimizing service quality; At the same time, with the help of early warning functions, problems in students' studies, psychology, etc. are detected in a timely manner and predictive intervention is carried out. The Internet of Things promotes the interconnection of information on campus, enhances the intelligence level of community governance based on related smart devices (such as smart student dormitories, smart door locks, smart water and electricity meters, etc.), and provides students with a more convenient and safe learning and living environment. Digital platforms break through time and space limitations, increase the coverage of Party building work and community services, enable students to participate in Party building work and learning life services anytime and anywhere, and further improve the efficiency of students' access to and learning information.

# **3. Construction of a "one-stop" digital governance system for student communities in organizational culture building**

## **3.1 Strengthen the organizational structure of organizational culture construction**

Build a four-level interactive organizational model of "university Party committee - college Party committee - community Party branch - Party member teachers and students" to give full play to the leading role of Party building in digital

governance. Establish a “one-stop” student community digital governance leading group, with the Party Secretary of the university as the group leader and the university leaders in charge of student affairs, teaching, and logistical support, as well as the student affairs department and relevant functional departments as members, to formulate strategic plans and important decisions for the digital construction of the university community. Each college party committee shall establish a digital governance working group to implement the relevant work arrangements of the university Party committee and promote community governance in accordance with the professional characteristics of each college. Functional Party branches or Party groups are established in student communities, extending the reach of Party building work to students’ lives. Select politically strong and digital-savvy professional teachers to serve as community Party building instructors, organize regular Party building activities, lead student Party members to participate in the construction of digital platforms and information management in student communities, give full play to the vanguard and exemplary role of Party members in the digital construction of communities, and encourage a large number of students to engage in community construction.

### **3.2 Build a digital governance platform**

Build a big data management platform that integrates five core functions: Party building education, comprehensive services, academic development, psychological care, and community management. In the Party building education section, virtual reality (VR), augmented reality (AR), and 3D modeling technologies are used to recreate revolutionary red scenes and create immersive red education bases, allowing students to have an immersive understanding of the spirit of hard work and struggle of the revolutionary predecessors during the revolutionary journey; The Party building education is made more appealing and infectious by organizing online thematic party day activities, lectures on Party history knowledge, and sharing sessions of red stories through short videos, live broadcasts, etc. The comprehensive service section integrates campus life service functions such as dormitory repair reporting, cafeteria meal ordering, school bus reservation, campus card recharge, express delivery inquiry, etc., to achieve “one-stop online service” for students’ life and enhance the convenience of students’ life. The academic development section invites experts and scholars from the school and outside, outstanding teachers, and senior students to join the platform to offer online courses, academic lectures, postgraduate entrance examination and employment guidance, etc., providing personalized development paths and tutoring methods for students’ academic development; Big data is used to analyze students’ learning situations and intelligently push learning resources and practice questions to students. In the psychological care section, there is an online psychological counseling service channel for students, with professional psychological counselors helping students with psychological counseling and providing one-on-one tutoring to students online; Through the development of psychological test software systems using artificial intelligence technology, regular psychological state assessments of students are conducted, student psychological profiles are created, and early warning intervention is provided for students with psychological problems. The community management module digitizes the management of people, facilities, activities, etc. in the community, conducts digital statistical analysis of the community to generate community operation reports for managers to make decisions.

### **3.3 Build institutional norms for digital governance**

Build a broad, scientific and standardized digital governance system framework to provide institutional guarantees for community digital governance. Formulate the “Management Measures for the Use of the ‘One-stop’ Student Community Digital Platform” to define the scope of platform use, operational norms, usage rights, etc., and regulate the usage behavior of teachers and students; Formulate the “Data Security and Privacy Protection System”, establish a data classification and grading management system, encrypt, decrypt, store and transmit students’ personal information, learning data, life data, etc., and regularly back up and test to ensure the security of platform data; The Information Release Review System was introduced to strictly review information such as Party building information, service information release, activity notifications, etc. on the platform to ensure the authenticity, accuracy and legality of the released information; Establish the Service Quality Supervision and Assessment System, regularly assess the work efficiency, service attitude and service quality of the platform’s service departments and service personnel, and link it to departmental performance assessment and individual commendation and award to guide all parties to fully promote service level. In addition, an emergency plan for digital governance was introduced to scientifically define, divide and process possible incidents such as cyber security attacks,



system failures and data leaks to ensure the normal operation of digital governance on the platform.

## **4. Organizational culture construction: An innovative path for the “one-stop” digital governance model of student communities**

### **4.1 Innovate the integration model of Party building and digital governance**

Build a new model of deep integration of “Party building + digitalization” and incorporate Party building into digital governance. Create “online Party member responsibility zones”, divide Party members’ professional expertise and interests into different responsibility zones, be responsible for the publicity of Party building information, information collection, problem feedback in the assigned areas, record the work situation online through digital platforms, and conduct regular assessment and evaluation. Use digital platforms to organize special activities such as “Red micro-Party lessons”, “Party Building Knowledge Challenges”, “Party Member Style”, etc., to attract students to participate in Party building learning in an interesting way and enhance the interactivity and interest of Party building work. Build a two-way feedback model of “Party building - student needs”, open up channels for students’ opinions and suggestions on Party building work through digital platforms, and adjust the content and methods of Party building work based on those opinions and suggestions; Transform the outcomes of Party building into the need to serve students’ growth, and push learning materials, employment information, volunteer opportunities, etc. to students through digital platforms to achieve two-way communication between Party building services and students’ needs.

### **4.2 Promote precise service and management**

Apply information technology to refine and digitize student community services and management. Analyze behavioral data, academic data, life data, etc. left on students’ digital platforms, build student profiles, grasp the actual situation of students’ academic, life, hobbies, psychological conditions, etc., and provide personalized services and management for students. For example, for students whose academic performance drops sharply, the system can automatically analyze the learning data of the student on the campus platform, identify the weak subjects and knowledge points of the student, and push targeted learning materials and tutorial courses; For students who frequently participate in volunteer activities, recommend relevant practical activities and volunteer groups, etc. For students with significant psychological stress, the system immediately recommends psychological adjustment methods and relaxation courses, and arranges for psychological counselors to follow up and adjust them. At the same time, based on the analysis results of the system, the allocation of community resources is adjusted and optimized, including the adjustment of the cafeteria meal structure, the utilization of self-study rooms or activity Spaces within the community, etc., to greatly increase the utilization rate of resources and provide students with a more optimized learning and living environment.

### **4.3 Optimize the collaborative guarantee mechanism**

First, organizational synergy, establish and improve the “one-stop” digital governance guarantee mechanism for student communities in organizational culture construction. Establish a linkage and coordination mechanism between the Party Committee of the university and various functional departments and colleges, and establish a regular meeting work system to coordinate and solve problems arising in digital governance work; Push the departments of student affairs, academic affairs, logistics and information to break down the “silos”, achieve data sharing and business collaboration, and form a working synergy.

Second, resource synergy, leveraging the human, material and financial resources within the school, and strengthening investment in the construction and operation and maintenance of digital platforms; Leverage social resources, introduce market-oriented social enterprises and social public welfare organizations that are developed and cooperated with by the school to participate in digital governance and services for student communities, and expand the content and channels of digital services, such as inviting enterprise mentors to give lectures on career development for college students and jointly introducing volunteer service projects of public welfare organizations.

Third, technological synergy, strengthening cooperation with professional information technology companies to jointly develop digital products and services that fit the characteristics of student communities; Build a technical team to maintain the digital platform regularly and ensure its daily operation; Strengthen digital literacy training for teachers and students, and

enhance their digital application and participation.

## 5. Conclusion

The “one-stop” digital governance of student communities based on organizational culture construction is an inevitable need for student management in colleges and universities under the new situation. It is of great help to the improvement of talent cultivation levels and the ability to cultivate new era talents in colleges and universities. With the “one-stop” student community as the leading framework, a scientific and effective digital governance system should be built. Exploring effective and innovative models in line with the characteristics of The Times, strengthening the construction of governance actions and collaborative guarantee systems, and achieving the deep integration and convergence of Party building work and digital technology will surely effectively enhance the efficiency of student community governance and the level of student community services. In the future, colleges and universities should continue to strengthen the effect of organizational culture construction, keep up with the development trend of digital technology, constantly explore and innovate new ways and methods of digital governance, and try effective new paths of digital governance, so that the digital governance of the “one-stop” student community can develop to a higher level and help students grow and succeed.

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# Research on Innovative Smart Management Models for University Laboratories

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**Abstract:** Against the backdrop of accelerated construction of “Double First-Class” universities and “smart campuses,” university laboratories, as core infrastructure platforms supporting talent cultivation and scientific research, are undergoing a transformation from traditional extensive management to digital, networked, and intelligent management. However, in practice, prominent problems such as fragmented information systems, lack of unified data standards, weak business collaboration, and insufficient intelligent applications still exist, constraining the overall effectiveness of laboratory resources. Based on a review of the current status of information-based laboratory management in universities, this paper analyzes the existing dilemmas from the perspective of top-level design and governance concepts, and proposes a smart management model centered on a unified platform, data middle platform, process reengineering, and intelligent empowerment. It then builds an application framework around key scenarios such as equipment life-cycle management, resource opening and sharing, and safety risk control, and finally puts forward implementation paths and safeguard mechanisms. The study argues that universities should incorporate smart laboratory management into their overall informatization strategy and promote it through the coordinated advancement of technical system reconstruction and institutional innovation, so as to truly realize the modernization and high-performance governance of laboratory management.

**Keywords:** University Laboratories; Smart Management; Informatization; Data Middle Platform; Management Model Innovation

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## 1. Current Foundation and Prominent Problems of Information-Based Management in University Laboratories

University laboratories play an increasingly important role in teaching, scientific research, and social services. The proportion of practical teaching hours continues to increase, the quantity and value of large-scale precision instruments keep growing, and the red-line constraints of laboratory safety are becoming more stringent. All these factors impose higher requirements on laboratory management. After years of development, most universities have established a certain level of informatization foundation in their laboratories, but there remains a substantial gap compared with the goals of building a “smart campus.”

First, in terms of overall foundation, laboratory informatization in many universities still presents a “fragmented” pattern. At different stages and under the leadership of different departments, various business systems have been developed, such as asset management systems, large-scale instrument sharing systems, reservation systems, consumables and hazardous

chemicals management systems, and environmental monitoring systems<sup>[1]</sup>. Most of these systems have been built independently around specific business objectives, lacking unified planning and architectural design, and using heterogeneous technical paths and data standards. As a result, it is difficult to realize interconnection and interoperability among systems. The same or similar data must be repeatedly entered and maintained in different systems, which not only wastes resources, but also undermines data consistency and accuracy.

Second, from the perspective of business operations, there are still obvious “online–offline disconnections” in key laboratory management processes. Links such as equipment project initiation and procurement, budget approval, and scrapping are often closely related to systems for state-owned assets, finance, and research management. Due to the lack of effective integration among these systems, staff frequently have to switch back and forth between paper forms, Excel files, and different systems. Approval procedures are cumbersome, and processing cycles are long. The linkage between experimental course scheduling, experiment project management, and laboratory opening management is also inadequate. Much data is still recorded offline, making it difficult to form a complete process data chain<sup>[2]</sup>.

Third, in terms of data resources, laboratory-related data is characterized by “multi-source heterogeneity, lack of standards, and weak governance.” Equipment ledgers, experimental projects, course data, research projects, personnel information, safety records, and energy consumption data are scattered across multiple systems and departments, with non-unified data calibers and inconsistent field definitions being widespread. For example, the name, category, and ID of the same instrument may differ between the state-owned assets system and the laboratory management system; experimental courses and experimental projects lack unified coding and association mechanisms, affecting teaching data analysis and quality evaluation. The absence of a unified data standards system and data governance mechanism hampers data integration and deep application<sup>[3]</sup>.

In addition, in terms of intelligence level, most current applications still remain at the basic stage of “querying and statistics.” Some universities have adopted technologies such as access control systems, video surveillance, and environmental sensors to realize real-time monitoring of personnel entering and leaving laboratories and the environmental status, but the data is often used in isolation and not deeply integrated with business processes and decision analysis. Applications based on big data and artificial intelligence, such as equipment fault prediction, resource optimization scheduling, and safety risk assessment, are still in the exploratory or blank stage, and the “efficiency-enhancing” role of intelligent technologies in management has not been fully brought into play<sup>[5]</sup>.

Finally, in terms of management teams and governance mechanisms, laboratory management staff generally possess rich business experience, but have relatively weak informatization awareness and data thinking, and low participation in system construction and data application. At the university level, there is usually no dedicated team focusing on laboratory informatization and data governance. The construction of information systems relies heavily on external vendors, while internal capabilities and mechanisms for continuous iterative optimization are insufficient. At the institutional level, there is also a lack of processes, evaluation systems, and incentive and constraint mechanisms compatible with smart management, leading to the common phenomenon that “systems are built but not well used”<sup>[4]</sup>.

It is thus evident that the problems facing information-based management of university laboratories are systemic and structural, involving both technical architecture and governance concepts and mechanisms. To achieve genuine “smartness,” an overall reconstruction at the management model level is required, rather than limited upgrades to local systems or simple function stacking.

## **2. Goal Positioning and Overall Architecture of Smart Management Models for University Laboratories**

Under the requirements of high-quality development of higher education in the new era, the goal of smart laboratory management is not only to improve work efficiency, but more importantly, to build a key foundational platform that supports the modernization of university governance. In light of real-world problems and technological development trends, the objectives of smart management models for university laboratories can be summarized as: taking data as the core resource, taking platforms as the supporting carriers, taking processes as the main management thread, and taking security as the

baseline constraint, so as to realize integrated allocation of laboratory resources, full-process visibility, controllable risks, and scientific decision-making.

Around this goal, the overall architecture of the smart laboratory management model can be summarized as “one overarching principle, two supports, and three priorities.” The “one overarching principle” means that under the university’s overall informatization and “smart campus” top-level design, smart laboratory management should be incorporated into the unified planning of the university’s governance system and informatization development. The relationships and interfaces between laboratory management and systems for academic affairs, research, state-owned assets, finance, and human resources should be clarified, so that laboratory management becomes an important component of the university’s digital governance.

The “two supports” refer to a unified business service platform and a laboratory data middle platform. The unified business service platform targets different roles such as students and faculty, laboratory administrators, and functional department managers, providing a unified entry point and differentiated services, thus realizing unified identity authentication, unified business acceptance, and unified information display. By integrating originally scattered business systems through this platform, relevant functions can be classified, optimized, and reconstructed to form business subsystems for equipment management, experimental teaching management, safety management, and open sharing management. The laboratory data middle platform, facing all business systems and IoT devices, is responsible for data collection, cleansing, integration, modeling, and service provision. By formulating unified data standards and coding rules, it builds core data resource repositories such as equipment master data, personnel master data, and experimental project master data, and provides high-quality data services for upper-layer business applications and decision analysis.

The “three priorities” are reflected in three categories of smart management applications built atop the platform and middle platform: first, refined full life-cycle management of equipment and resources, covering the entire process from equipment initiation, procurement, acceptance, capitalization, use, maintenance, to scrapping, so that asset status becomes visible, responsibilities traceable, and benefits assessable; second, process-based data management and analysis of experimental teaching and research activities, by associating experimental courses, experimental projects, student learning behaviors, and research project data, to support improvement of teaching quality and evaluation of research performance; third, intelligent monitoring of laboratory safety and environment and risk early warning, by interfacing with access control, video surveillance, environmental sensors, and hazardous chemicals management systems, to realize comprehensive perception and risk control regarding “people, machines, materials, environment, and management”<sup>[3]</sup>.

Under this overall architecture, information technology is no longer merely a “supporting tool,” but is deeply embedded into laboratory management processes and governance mechanisms. The layered design of platform and middle platform allows business applications to evolve flexibly and data resources to be governed in a unified manner, thus meeting current management needs while reserving room for the introduction of future technologies and new businesses. In terms of management patterns, this means a shift from past “passive recording” and “ex-post statistics” to “proactive perception,” “real-time analysis,” and “intelligent decision-making.”

### **3. Key Application Scenarios and Implementation Logic under the Smart Management Model**

On the basis of clarified goals and architecture, the value of the smart management model must ultimately be realized in concrete application scenarios. Focusing on the core business of university laboratory management, the implementation logic of smart management can be sorted out from several aspects, including equipment life-cycle management, open sharing of experimental resources, laboratory safety management, and performance evaluation.

In terms of equipment life-cycle management, the core of smart management is “full-process online operation, data connectivity, and visible status.” The unified business platform incorporates all links related to equipment into process management, from project justification, budget application and approval, procurement implementation, acceptance, and capitalization, to installation and commissioning, usage registration, maintenance, metrological calibration, fault repair, technical transformation, and scrapping. The data middle platform establishes a complete “digital file” for each piece of equipment, recording information such as purchase time, technical parameters, usage frequency, energy consumption,



number of failures, and maintenance costs<sup>[2]</sup>. Managers can use visual interfaces to grasp the real-time status and historical trajectory of equipment and, by analyzing the relationship between equipment utilization and the research outputs and teaching courses it supports, provide evidence for equipment sharing, configuration optimization, and renewal decisions. Based on accumulated historical fault and operation data, predictive models can also be trained to realize health assessment and maintenance strategy optimization for key equipment, gradually shifting from “post-event repair” to “preventive maintenance.”

In terms of open sharing of experimental resources, smart management focuses on “a unified entry point, clear rules, and optimized allocation.” Laboratory resources include specialized laboratories, large-scale instruments, and various public platforms, which were often managed separately by different schools or units in the past, with information stored in local systems or on paper records, making it difficult for other students and faculty to accurately access resource information. Through the unified business platform, all laboratory resources that can be opened across the university can be centrally displayed, forming a “single list of resources” available to the entire campus. Teachers and students can query information such as equipment performance, available time slots, and reservation rules according to their access rights, and submit reservation requests online. The system, taking into account experimental course schedules, equipment maintenance plans, laboratory capacity, and safety constraints, automatically determines whether the reservation can be made and provides reasonable arrangements. For high-value instruments, mechanisms such as fund settlement, usage records, and linkage with research outputs can be embedded in the system, facilitating cross-school sharing while supporting subsequent performance statistics and cost accounting.

In terms of laboratory safety management, the key to smart management lies in “all-factor perception, prioritized risk control, and closed-loop management.” By accessing the access control and identity authentication systems, controllable and traceable entry and exit of laboratory personnel can be achieved, and safety training and examination results can be bound to access permissions to ensure that personnel who have not passed relevant training are not allowed to enter the corresponding laboratories or operate high-risk equipment [3]. By deploying environmental sensors, real-time monitoring of key parameters such as temperature, humidity, concentrations of toxic and harmful gases, and electrical loads can be carried out. Once safety thresholds are exceeded, the system automatically sends out alerts and can link ventilation, power-off, and access control facilities to implement interventions. The hazardous chemicals management system records the entire process of procurement, warehousing, distribution, return, and disposal of each hazardous chemical, preventing excessive storage and improper use. By aggregating data from access control, environmental monitoring, hazardous chemicals management, and video surveillance through the data middle platform, safety risk evaluation models can be built to carry out graded assessment and trend analysis of safety risks in different laboratories, shifting the focus of safety management from “incident handling” to “risk identification and prevention”.

In terms of performance evaluation and decision support, smart management emphasizes “data-driven evaluation and usage-driven construction.” Through the data middle platform, laboratory resource inputs (such as equipment purchases and operation and maintenance expenditures) can be linked with outputs (such as the number of courses supported, number of students covered, research projects, publications, patents, and technology transfer achievements), so as to objectively reflect the overall effectiveness of different laboratories and different instruments<sup>[4]</sup>. On this basis, universities can optimize the structure of resource allocation, increase investment in high-efficiency platforms, and integrate or adjust resources that have long operated inefficiently. For experimental teaching, the teaching value of experimental projects can be evaluated and experimental teaching reform can be guided by analyzing student experimental data, course attainment, and resource consumption in experimental teaching sessions. In addition, the system can provide data support for medium- and long-term laboratory construction planning in universities, such as identifying weaknesses in experimental conditions in different disciplines and key directions for platform construction.

Through the systematic linkage of the above scenarios, the smart management model can form a closed loop across the multiple dimensions of “people–machines–materials–environment–management,” achieving comprehensive visualization of laboratory operation status and scientific management decision-making. Importantly, these applications do not exist

in isolation, but are collaboratively implemented based on the unified platform and data middle platform, avoiding the traditional fragmented construction pattern of “one system for each new requirement.”

#### **4. Implementation Path and Safeguard Mechanisms for Smart Laboratory Management Models**

The construction of smart management models is a comprehensive transformation process involving technology, management, and culture, and requires a rational implementation path and supporting safeguards.

In terms of implementation path, universities should first accomplish top-level design and status assessment. By investigating and sorting out laboratory resources and management processes across the university, clarifying the existing information systems and the status of data resources, identifying key problems and priority transformation areas, universities can define the objectives, phased tasks, and construction roadmap for smart laboratory management within the framework of their overall informatization strategy<sup>[1]</sup>. On this basis, unified data standards and interface specifications should be formulated to pave the way for subsequent system integration and data aggregation.

Subsequently, a strategy of “focusing on key breakthroughs, piloting first, and gradual rollout” can be adopted. Universities can select colleges or laboratory platforms with relatively sound management foundations, strong willingness for informatization, and representative business types as pilot units. Around key businesses such as equipment management, safety management, and open sharing, comprehensive pilots can be carried out, with the core functions of the unified business platform and data middle platform being deployed on a small scale to verify the adaptability and feasibility of the architectural and functional designs. By analyzing pilot operation data and user feedback, process settings and system functions can be adjusted in a timely manner. After a relatively mature solution has been formed, it can be gradually promoted across the university in stages.

In terms of safeguard mechanisms, the first priority is to strengthen team building and organizational coordination. Universities should establish a cross-departmental working mechanism for laboratory informatization, bringing laboratory management, informatization construction, network security, state-owned assets management, academic affairs, and research management into a collaborative framework, and forming regular channels for communication and coordination<sup>[4]</sup>. On this basis, through training, project practice, and talent introduction, universities can cultivate composite teams that are familiar with laboratory operations as well as information technology and data analysis, enabling them to play key roles in the planning, implementation, and operation of smart management models.

Second, a solid foundation of network and data security must be established. In accordance with national laws and regulations on cybersecurity and data security, security level protection assessments should be carried out for laboratory management systems, and mechanisms for identity authentication, access control, log auditing, intrusion prevention, and backup and disaster recovery should be improved. Sensitive information such as equipment ledgers, personal data, research data, and hazardous chemical data should be subject to graded and categorized management and the principle of least-privilege access, and necessary data masking and encryption technologies should be adopted to ensure data security throughout the entire process of collection, transmission, storage, and use<sup>[3]</sup>.

Third, dual guarantees at the institutional and cultural levels should be established. Universities should incorporate system usage and data quality into laboratory management assessment indicators, and reasonably link data entry, system operation, and process execution with individual and departmental performance to avoid “emphasizing construction while neglecting use.” Through continuous publicity and training, the significance and value of smart management should be explained to students and faculty to enhance their willingness to use and participate, and gradually foster a management culture of “relying on platforms to handle business and using data to support decision-making”<sup>[4]</sup>.

Overall, innovation in smart management models for university laboratories is a concrete manifestation of the deep integration of information technology and the higher education governance system. By establishing the foundation through a unified platform and data middle platform, leading with key application scenarios as exemplars, and supporting with institution-building and team development, laboratory management can move beyond the predicament of “multiple, separate constructions, fragmented data, and cumbersome processes” toward a new stage of systematic, scientific, and high-

performance governance. This will not only help to improve the quality of experimental teaching and the capacity to support scientific research, but will also contribute significantly to the modernization of overall university governance capacity.

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# New Quality Productivity Empowering Mental Health Education Courses: Theoretical Implications and Practical Pathways

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**Abstract:** With the rapid development of new quality productivity, emerging technologies such as artificial intelligence, big data, and virtual reality have provided unprecedented opportunities for the innovation of mental health education courses. Focusing on how new quality productivity empowers mental health education, this paper employs literature research, case analysis, and comparative study to deeply analyze the coupling mechanism between new quality productivity and mental health education, revealing the paradigm shift of mental health education under technological empowerment. It systematically explores its theoretical implications and practical pathways. The study finds that new quality productivity, through the reconstruction of technological elements, content elements, methodological elements, and evaluation elements, promotes the transition of mental health education from standardized teaching to precise intervention. Based on this, the paper proposes practical pathways such as intelligent psychological assessment, immersive curriculum development, and interdisciplinary faculty development, systematically constructing a synergistic innovation model of “new quality productivity–mental health education.” This provides theoretical support and practical solutions for the innovation of mental health education courses in the new era, offering new perspectives for the high-quality development of mental health education in the digital age.

**Keywords:** New Quality Productivity; Mental Health Education; Theoretical Implications; Practical Pathways

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Under the background of Digital China construction, new quality productivity provides new impetus for the innovation of mental health education courses. With the rapid development of new productivity factors such as artificial intelligence and big data, mental health education is entering a window of opportunity for reform. The current curriculum is confronted with three major predicaments: the imbalance in resource allocation leads to a shortage of teachers in the central and western regions, the disconnection between teaching content and the demands of the digital generation, and the difficulty in quantifying educational outcomes through the assessment system. How to leverage new quality productivity to break through these bottlenecks has become an urgent practical issue to be addressed. The new quality productivity provides a new paradigm for the innovation of mental health education courses. It is necessary to build a curriculum system that ADAPTS to the demands of the digital age through technological empowerment, resource optimization and mechanism innovation, and truly achieve the educational goal of “precise teaching and all-round development”.

## 1. The Theoretical Implications of New Quality Productivity Empowering Mental

## Health Education Courses

### 1.1 Theoretical Logic: The coupling mechanism of new quality Productivity and Mental health Education

New quality productivity and mental health education are highly consistent in terms of goal orientation, value stance, internal elements and strategic methods. The two support and promote each other. From the perspective of goals, the new quality productivity emphasizes innovation-driven and high-quality development, while mental health education is dedicated to cultivating new era individuals with sound personalities and innovative spirits. The two are highly consistent in their educational goals. From the perspective of value, the new quality productivity adheres to the people-centered development philosophy, and mental health education follows the educational concept of “student-centeredness”, both of which reflect the value pursuit of the all-round development of individuals. From the perspective of elements, the new quality productivity takes technological innovation as the core driving force. Mental health education needs to rely on new technologies to achieve precise and personalized services. Technological empowerment has become the key fulcrum for the integration of the two. From the perspective of methods,<sup>[1]</sup> the new quality productivity emphasizes system integration and collaborative innovation. Mental health education requires the establishment of a multi-party collaborative education system involving schools, families, and society. The two can learn from each other in terms of methodology. This multi-dimensional coupling relationship provides a solid theoretical foundation for empowering mental health education courses with new quality productivity.<sup>[2]</sup>

### 1.2 Value Implications: The Paradigm Transformation of Mental Health Education Empowered by Technology

The new quality of productivity has driven mental health education to achieve a triple value leap. At the methodological level, big data analysis has enabled mental health services to shift from empirical judgment to precise profiling. The traditional assessment methods that rely on teachers’ subjective observation are being replaced by data-driven approaches such as AI emotion recognition and learning behavior analysis. A certain university has developed a psychological early warning model by analyzing cafeteria consumption data, library entry and exit records, etc., achieving a 40% increase in intervention accuracy.<sup>[3]</sup> In terms of service models, technologies such as virtual reality break through the limitations of time and space, creating immersive psychological counseling scenarios. VR exposure therapy enables students with social phobia to undergo desensitization training in a controlled environment, and intelligent chatbots provide round-the-clock psychological support. This hybrid model of “technical assistance + human intervention” effectively makes up for the shortcoming of insufficient traditional consulting resources. In terms of educational concepts, technological empowerment drives the transformation from “problem correction” to “positive development”. Intelligent systems can not only identify psychological crises but also enhance students’ psychological resilience through cognitive training programs. This transformation has shifted mental health education from passive response to active construction, truly achieving a new pattern of developmental mental health services that is “accessible to all, available at all times, and accessible everywhere”.

### 1.3 Goal Orientation: Cultivate students’ psychological resilience and adaptability in the digital age

The core objective of new quality productivity empowering mental health education lies in cultivating compound talents with psychological resilience and adaptability in the digital age. This target system consists of three progressive levels: The basic level focuses on cultivating digital survival skills, enabling students to cope with new challenges such as information overload and cyber violence; The development layer focuses on shaping digital personalities, helping students maintain a sound personality in an environment where the virtual and the real are integrated. The core layer focuses on cultivating digital creativity and transforming psychological capital into innovative momentum. In terms of cultivating psychological resilience, it is necessary to shift from passive response to active prevention, and use intelligent early warning systems to identify psychological crises in advance. It is necessary to shift from individual intervention to ecological construction and create a supportive digital reality integration environment<sup>[4]</sup>. It is also necessary to shift from standardized tutoring to personalized empowerment, providing customized training plans based on data analysis. At the level of cultivating adaptability, it is necessary to focus on developing algorithmic cognitive abilities, helping students understand the logic of recommendation



mechanisms and break through the limitations of the information cocoon. To enhance students' ability to manage digital identities and maintain self-identity among multiple virtual identities; To have the ability of human-machine collaboration and adapt to the new working mode of working with artificial intelligence. Through immersive training such as VR simulated interviews and AI stress conversations, students' professional adaptability to technological changes has been significantly enhanced.

#### **1.4 Ethical Boundaries: Value Adherence and Risk Prevention in Technological Application**

To empower mental health education with new quality productivity, it is necessary to establish a complete ethical framework and adhere to the value orientation of technology for good. In the data collection stage, the principle of minimum necessity must be strictly followed, and data desensitization technology should be adopted to protect students' privacy. At the algorithm application level, a manual review mechanism should be established to prevent misjudgment due to training data bias, such as mistakenly marking introversion as a psychological problem. Especially when using an emotion recognition system, a comprehensive assessment should be conducted in combination with the clinical experience of professional teachers to ensure the accuracy and fairness of the evaluation results. The core position of humanistic care should be maintained during the service process. Technical tools should serve as auxiliary means rather than replace interpersonal relationships. Online consultation platforms need to be equipped with emergency transfer functions to ensure timely intervention in high-risk situations. At the same time, it is necessary to prevent the risk of technological dependence, rationally plan the proportion of online and offline teaching, and avoid the deterioration of real communication skills caused by excessive use of virtual reality and other technologies. In terms of the construction of the regulatory system, it is necessary to formulate norms for the use of mental health big data, clarify the boundaries of data authority, and establish an independent ethics review committee to regularly assess the application effect of the technology. By establishing a complete closed loop of "technology research and development - application practice - regulatory assessment", it ensures that mental health education always develops in the right direction in technological innovation, achieving an organic unity of technological empowerment and humanistic care.

## **2. The Core Elements of New Quality Productivity Empowering Mental Health Education Courses**

### **2.1 Technical elements: Educational applications of new technologies such as AI, big data, and VR**

The technical elements of new quality productivity empowering mental health education courses are mainly reflected in the deep integration of cutting-edge technologies such as artificial intelligence, big data, and virtual reality. AI technology, through natural language processing and machine learning algorithms, can achieve intelligent recognition and assessment of students' psychological states. For instance, an emotion recognition system can capture in real time the micro-expression changes in students' classroom performance. Big data technology collects and analyzes students' daily behavior data to build psychological profiles, providing data support for precise intervention. Virtual reality technology creates immersive psychological training scenarios. For instance, students with social phobia can undergo desensitization training in a VR environment, effectively reducing their anxiety levels in real-world scenarios. The comprehensive application of these technologies has broken through the time and space limitations of traditional mental health education, achieving a transformation from experience-based judgment to data-driven.

### **2.2 Content Elements: Personalized course content generation based on data-driven**

The new quality of productivity has driven the transformation of mental health education course content from standardization to personalization. Based on big data analysis, the system can identify the psychological characteristics, development needs and learning preferences of different students, and automatically generate customized course content. For instance, for students with anxiety tendencies, the system can push modules such as relaxation training and mindfulness meditation. For students with social difficulties, social skills training, scenario simulation and other contents are provided. This personalized content generation mechanism not only enhances the pertinence and effectiveness of the courses but also realizes precise education based on "one person, one policy". Meanwhile, the content elements also include a dynamic update mechanism. The system continuously optimizes the course content based on student feedback and intervention effects to ensure the timeliness and scientific nature of the educational content.

### **2.3 Methodological Elements: A paradigm shift from standardized teaching to precise intervention**

The new quality of productivity has brought about a fundamental transformation in mental health education methods. Under the traditional standardized teaching model, teachers find it difficult to take into account the individual differences of each student. However, the precise intervention empowered by new technologies has achieved a transformation from “flooding” to “precise drip irrigation”. The intelligent system continuously monitors changes in students’ psychological states and promptly pushes appropriate intervention measures. For instance, when the system detects emotional fluctuations in students, it automatically triggers the psychological counseling module. Meanwhile, the methodological elements also emphasize the construction of a blended teaching model, integrating online intelligent tutoring with offline professional consultation to form a collaborative mechanism of “technical assistance + manual intervention”. This paradigm shift not only enhances educational efficiency but also improves educational effectiveness, enabling mental health education to truly achieve “teaching students in accordance with their aptitudes”.

### **2.4 Evaluation Elements: A multi-dimensional, full-process, and intelligent evaluation system**

The new quality productivity has established a brand-new evaluation system for mental health education. Multi-dimensional evaluation is reflected in the expansion from a single assessment of mental health levels to a comprehensive evaluation of multiple indicators such as psychological resilience, adaptability, and digital literacy. The whole-process evaluation runs through all aspects of course learning, daily behavior, and changes in psychological state, achieving a transformation from outcome evaluation to process evaluation. Intelligent evaluation relies on big data analysis and AI algorithms to automatically generate students’ psychological development reports and provide visual growth trajectories. This evaluation system not only objectively reflects educational outcomes but also provides a scientific basis for educational decision-making, promoting the transformation of mental health education from experience-based management to data-driven governance, and ultimately achieving a continuous improvement in educational quality.

## **3. Possible Paths for Empowering mental health Education Courses with new quality productivity**

### **3.1 Technology empowerment and construction of intelligent evaluation systems**

At the level of technological empowerment, by building an intelligent assessment system, the transformation from experience-based judgment to data-driven is achieved. Specifically, this system integrates multiple data collection channels, covering multi-dimensional information such as classroom performance, online learning behavior, and social interaction. Establishing a dynamic early warning model by applying machine learning algorithms can promptly identify potential psychological risks. In practical applications, this intelligent system demonstrates three major advantages: First, it enables early warning, identifying psychological crisis signals by analyzing changes in behavioral data; Second, provide personalized solutions and generate customized intervention measures based on students’ characteristics. Third, establish a closed-loop mechanism to form a complete process of “monitoring - early warning - intervention - feedback”. For instance, a certain university has constructed a student psychological state assessment model by analyzing library entry and exit records, catering consumption data, etc., effectively enhancing the accuracy and timeliness of psychological services. Technological empowerment not only transforms the traditional working mode of mental health education, but more importantly, it establishes a scientific assessment system. Through data support and algorithmic analysis, mental health services have shifted from passive response to proactive prevention, and from universal guidance to personalized care, truly reflecting the profound transformation of the new quality productivity in the field of education.

### **3.2 Innovative development of immersive, interactive and personalized curriculum systems**

The new quality productivity is driving the transformation of mental health education courses from the traditional model to an immersive, interactive and personalized direction. By using intelligent technology to create virtual scenarios, students can undergo psychological training in a safe environment. For instance, students with social anxiety can repeatedly practice their social skills in virtual scenes. Interactive design can enhance learning engagement and stimulate learning motivation through gamified elements and immediate feedback mechanisms. The personalized recommendation system intelligently matches course content based on students’ psychological characteristics and learning preferences, achieving precise teaching

with “one person, one policy”. The course development adopts a modular design, breaking down mental health knowledge into composable micro-course units. Students can choose their learning paths based on their own needs, and the system dynamically adjusts the difficulty of the content according to the learning progress and effect. At the same time, an integrated online and offline teaching model should be established. Online, virtual training and intelligent tutoring should be provided; offline, group activities and individual counseling should be carried out to form a complete teaching loop. This will promote the transformation of mental health education from “passive response” to “active prevention”, and from “standardization” to “personalization”, truly meeting the diverse needs of students in the digital age.

### 3.3 Collaborative cultivation of interdisciplinary teaching staff

The new quality productivity requires mental health education teachers to possess the compound ability of “psychology + technology”. By launching interdisciplinary training programs, enhance teachers’ data analysis and technical application capabilities; Establish a school-enterprise collaboration mechanism and introduce technical experts from enterprises to participate in teaching practice. Form an interdisciplinary teaching and research team, carry out research on technology-enabled mental health education, and promote teaching innovation. This collaborative training model breaks down disciplinary barriers and builds a teacher development system of “theory + practice + technology”, providing talent support for the implementation of mental health education courses.

### 3.4 Improve the guarantee mechanisms for multi-party collaboration, data security and ethical norms

Build a multi-party collaborative education network involving schools, families, enterprises and communities to form an educational synergy. Establish strict data security management measures and adopt technical means such as data desensitization and encrypted storage to protect students’ privacy rights and interests. Establish an ethics review committee and set up a technology application evaluation mechanism to ensure the fairness and transparency of algorithms. Improve the dynamic assessment system, regularly monitor the application effect of technology, and promptly adjust and optimize the plan. These guarantee mechanisms provide institutional support for the innovation of mental health education courses, ensuring that technological empowerment always develops in the right direction.

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## Conflict of Interests

The authors declare that there is no conflict of interest regarding the publication of this paper.

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# Personalized Learning Through AI-Assisted Tutoring: Exploring the Impact of Intelligent Tutoring on Student Academic Performance Using Educational Data Mining and Explainable Machine Learning

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**Abstract:** The integration of artificial intelligence into educational settings has emerged as a promising approach to enhancing personalized learning and improving student academic outcomes. However, existing studies on AI-assisted tutoring face several limitations: (1) insufficient quantitative evidence on the causal relationship between tutoring interventions and academic performance, (2) limited understanding of how tutoring interacts with other educational factors such as study habits and parental support, and (3) a lack of interpretable models that can explain the mechanisms through which tutoring influences learning outcomes. To address these challenges, we present a comprehensive analytical framework that combines statistical hypothesis testing, multi-model predictive analysis, and SHAP-based interpretability to investigate the effect of AI-assisted tutoring on student GPA. Our framework incorporates three key contributions: (1) rigorous statistical testing confirming a significant GPA improvement in the tutoring group (Cohen's  $d = 0.319$ ,  $p < 0.001$ ), (2) a comparative evaluation of six machine learning models achieving an  $R^2$  of 0.9536 for GPA prediction, and (3) SHAP-based feature attribution revealing that tutoring consistently contributes a positive SHAP value of +0.10 to predicted GPA. Experiments on a dataset of 2,392 students demonstrate that AI-assisted tutoring ranks as the fourth most influential factor in academic performance, and its positive effect is robust across varying levels of study time, absences, and parental support.

**Keywords:** AI-Assisted Tutoring; Personalized Learning; Student Performance Prediction; Shap Interpretability; Educational Data Mining; Machine Learning, Feature Importance Analysis

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## 1. Introduction

In recent years, artificial intelligence (AI) has emerged as a transformative force in education, offering unprecedented opportunities for personalized learning, automated assessment, and data-driven instructional design <sup>[1]</sup>. With the rapid adoption of generative AI tools such as ChatGPT, students and educators are increasingly exploring how large language models can enhance learning experiences, provide real-time feedback, and support individualized academic development <sup>[2]</sup>. These AI-powered tools have demonstrated promising capabilities in areas ranging from content generation and language

tutoring to interactive question answering and automated essay evaluation <sup>[3]</sup>.

Although significant progress has been made in understanding the potential of AI in education, existing studies reveal both opportunities and notable limitations. Kasneci et al. <sup>[4]</sup> provided a comprehensive analysis of the opportunities and challenges posed by large language models for education, highlighting concerns about academic integrity and over-reliance on AI-generated content. Yan et al. <sup>[5]</sup> further examined the practical and ethical challenges of deploying LLMs in educational settings through a systematic scoping review, emphasizing the need for empirical validation of learning outcomes. However, current research predominantly relies on qualitative analyses, user perception surveys, or small-scale case studies to assess the effectiveness of AI-assisted learning <sup>[6]</sup>. A critical gap remains in the quantitative understanding of how AI-assisted tutoring directly impacts measurable academic outcomes such as GPA, particularly when controlling for confounding factors like study habits, parental support, and student engagement <sup>[7]</sup>.

This limitation motivates us to explore a data-driven analytical framework that moves beyond subjective evaluations toward rigorous empirical evidence. While prior research has examined the integration of ChatGPT in teaching and learning through systematic reviews <sup>[8]</sup>, and investigated the broader consequences of AI adoption in educational settings <sup>[9]</sup>, few studies have employed interpretable predictive models to quantify the specific contribution of AI-assisted tutoring to student academic performance across diverse subgroups. Moreover, research on intelligent tutoring systems has demonstrated the potential of AI to deliver personalized instruction at scale <sup>[10]</sup>, yet the connection between tutoring interventions and measurable learning outcomes remains insufficiently explored through machine learning approaches.

To address these challenges, we propose a comprehensive analytical framework that integrates exploratory data analysis, statistical hypothesis testing, multi-model comparative evaluation, and SHAP-based interpretability analysis. Our approach leverages educational data mining techniques <sup>[11]</sup> to systematically evaluate the effect of AI-assisted tutoring on academic performance using a dataset of 2,392 student records. Unlike previous studies that focus on prediction accuracy alone <sup>[12][13]</sup>, our framework emphasizes both predictive performance and model interpretability, enabling educators to understand not only what the model predicts but also why specific factors contribute to student success. By combining multiple machine learning algorithms with explainable AI techniques <sup>[14]</sup>, we provide actionable insights that bridge the gap between algorithmic prediction and pedagogical decision-making.

The main contributions of this paper are as follows:

We conduct rigorous statistical testing on a dataset of 2,392 students, confirming a significant positive effect of AI-assisted tutoring on GPA ( $p < 0.001$ , Cohen's  $d = 0.319$ ), with the tutoring advantage persisting across all levels of study time, absences, and parental support.

We perform a comparative evaluation of six machine learning models for GPA prediction, achieving an  $R^2$  of 0.9536 with Ridge Regression, demonstrating that student academic performance can be accurately predicted from behavioral and demographic features.

We employ SHAP-based interpretability analysis to identify and rank the key factors influencing student performance, revealing that AI-assisted tutoring is the fourth most important predictor and consistently contributes a positive SHAP value of approximately +0.10 to predicted GPA across all student subgroups.

## 2. Methodology

This section presents the research methodology, including the dataset description, feature engineering pipeline, and exploratory data analysis. The goal is to investigate the impact of AI-assisted tutoring on student academic performance and to identify the key factors that contribute to personalized learning outcomes

### 2.1 Dataset Description

This study utilizes the Students Performance Dataset, a publicly available educational dataset comprising 2,392 student records with 15 attributes. The dataset captures a comprehensive set of academic, behavioral, and demographic features that are commonly used in educational data mining research. Table~1 provides a detailed summary of the key variables.



Table 1: Summary of dataset variables and their descriptions.

Variable	Type	Range	Description
Age	Numeric	15--18	Student age
Gender	Binary	0/1	Female / Male
Ethnicity	Categorical	0-3	Ethnic group identifier
ParentalEducation	Ordinal	0-4	Highest parental education level
StudyTimeWeekly	Continuous	0-20	Weekly study hours
Absences	Numeric	0-29	Total number of absences
Tutoring	Binary	0/1	AI-assisted tutoring (treatment)
ParentalSupport	Ordinal	0-4	Level of parental support
Extracurricular	Binary	0/1	Extracurricular participation
Sports	Binary	0/1	Sports participation
Music	Binary	0/1	Music participation
Volunteering	Binary	0/1	Volunteering activities
GPA	Continuous	0-4.0	Grade point average (target)
GradeClass	Ordinal	0-4	Letter grade (A/B/C/D/F)

Among all variables, Tutoring serves as the primary treatment variable representing whether a student received AI-assisted tutoring support, while GPA is the target outcome variable. The dataset contains 721 students (30.1%) in the tutoring group and 1,671 students (69.9%) in the non-tutoring group, providing a sufficient sample size for comparative analysis.

## 2.2 Statistical Framework

To quantify the relationship between input features and academic performance, we employ a multivariate regression framework. Let  $\mathbf{x}_i \in \mathbb{R}^d$  denote the feature vector for student  $i$ , where  $d=12$  represents the number of input features, and  $y_i \in [0,4]$  denotes the corresponding GPA. The prediction task is formulated as:

$$\hat{y}_i = f(\mathbf{x}_i; \boldsymbol{\theta}) \quad (1)$$

where  $f(\cdot)$  is the predictive model parameterized by  $\boldsymbol{\theta}$ , and  $\hat{y}_i$  is the predicted GPA. The model is optimized by minimizing the mean squared error (MSE) loss:

$$\mathcal{L}(\boldsymbol{\theta}) = \frac{1}{N} \sum_{i=1}^N (y_i - \hat{y}_i)^2 \quad (2)$$

where  $N = 2,392$  is the total number of student records in the dataset.

To assess the effect of tutoring on GPA while controlling for group-level variance, we conduct an independent samples  $t$ -test with the effect size measured by Cohen's  $d$ :

$$d = \frac{\bar{y}_{\text{tutor}} - \bar{y}_{\text{no}}}{s_p}, s_p = \sqrt{\frac{(n_1 - 1)s_1^2 + (n_2 - 1)s_2^2}{n_1 + n_2 - 2}} \quad (3)$$

where  $y_{\text{tutor}}$  and  $y_{\text{no}}$  are the group means,  $s_1$  and  $s_2$  are the group standard deviations, and  $n_1, n_2$  are the respective sample sizes. To further evaluate the association between tutoring status and grade classification, we employ the chi-square ( $\chi^2$ ) test of independence with Cramér's  $V$  as the effect size measure:

$$V = \sqrt{\frac{\chi^2}{N \cdot (\min(r, c) - 1)}} \quad (4)$$

where  $r$  and  $c$  denote the number of rows and columns in the contingency table, respectively.

## 2.3 Exploratory Data Analysis

Fig.~1 presents the exploratory analysis of student performance across multiple dimensions. As shown in Fig.~1(a), the

GPA distribution of the tutoring group is notably right-shifted compared to the non-tutoring group, with the tutoring group achieving a higher mean GPA ( $M = 2.108$ ,  $SD = 0.905$ ) than the non-tutoring group ( $M = 1.819$ ,  $SD = 0.906$ ). The grade class distribution in Fig.~1(b) reveals that the majority of students fall within the D and F categories, with 1,211 students (50.6%) receiving an F grade, highlighting the academic challenges faced by the student population.

Fig.~1(c) further illustrates the proportion of tutoring and non-tutoring students within each grade class. A clear pattern emerges: students who received tutoring constitute a higher proportion in the A and B grade classes, whereas non-tutoring students dominate the D and F categories. This preliminary evidence suggests a positive association between AI-assisted tutoring and academic achievement.

The interaction between tutoring status and other educational factors is examined in Fig.~1(d)–(f). Fig.~1(d) compares the mean GPA of participants and non-participants across five activity types. Notably, tutoring shows the largest GPA differential among all activities, while sports, music, and volunteering exhibit minimal differences. Fig.~1(e) reveals a positive interaction between study time and tutoring: as weekly study hours increase from 0–5 to 15–20 hours, the GPA advantage of the tutoring group becomes more pronounced (from to , though the gap narrows slightly at higher study intensities). Fig.~1(f) demonstrates that while increasing absences are associated with declining GPA for both groups, the tutoring group consistently maintains a higher GPA across all absence levels, suggesting a buffering effect of AI-assisted tutoring against absenteeism.

Figure 1: Exploratory data analysis of student performance. (a) GPA density distribution by tutoring status. (b) Grade class distribution across the full dataset. (c) Proportion of tutoring and non-tutoring students within each grade class. (d) Mean GPA comparison across five activity types by participation status. (e) Mean GPA with 95% confidence intervals across study time intervals, stratified by tutoring status. (f) Mean GPA with 95% confidence intervals across absence levels, stratified by tutoring status.

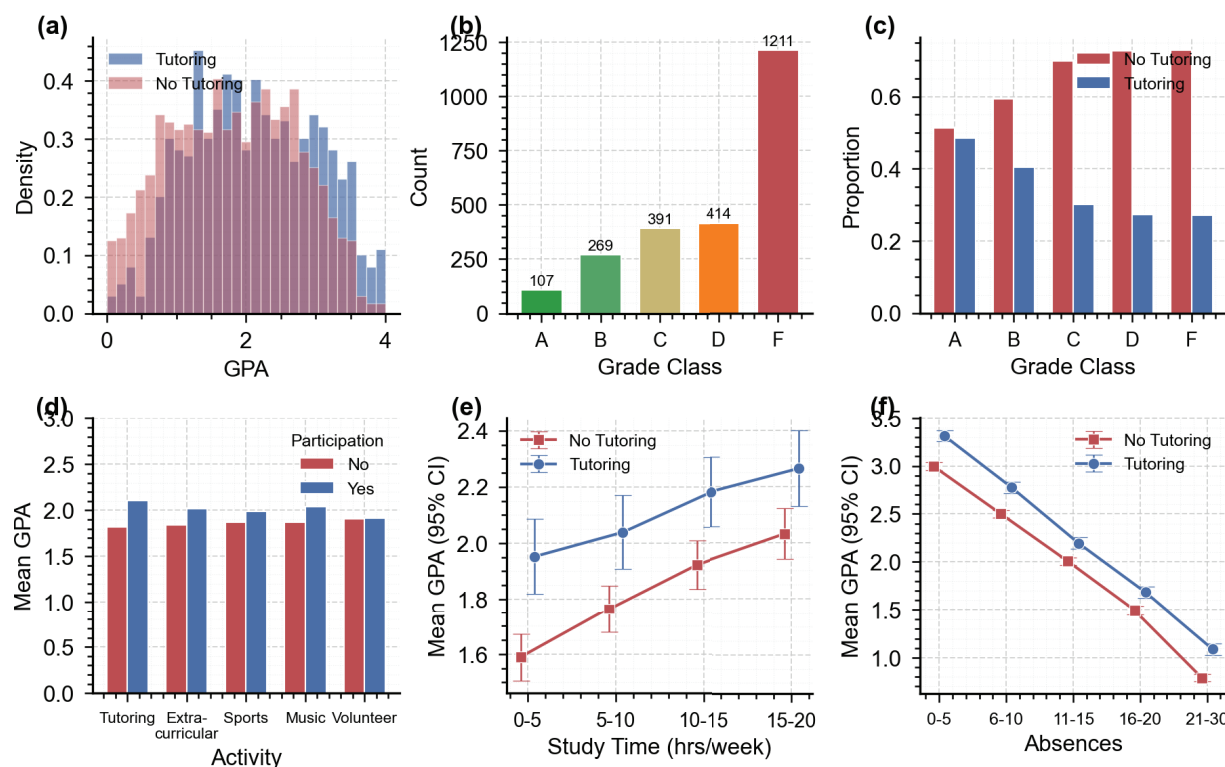


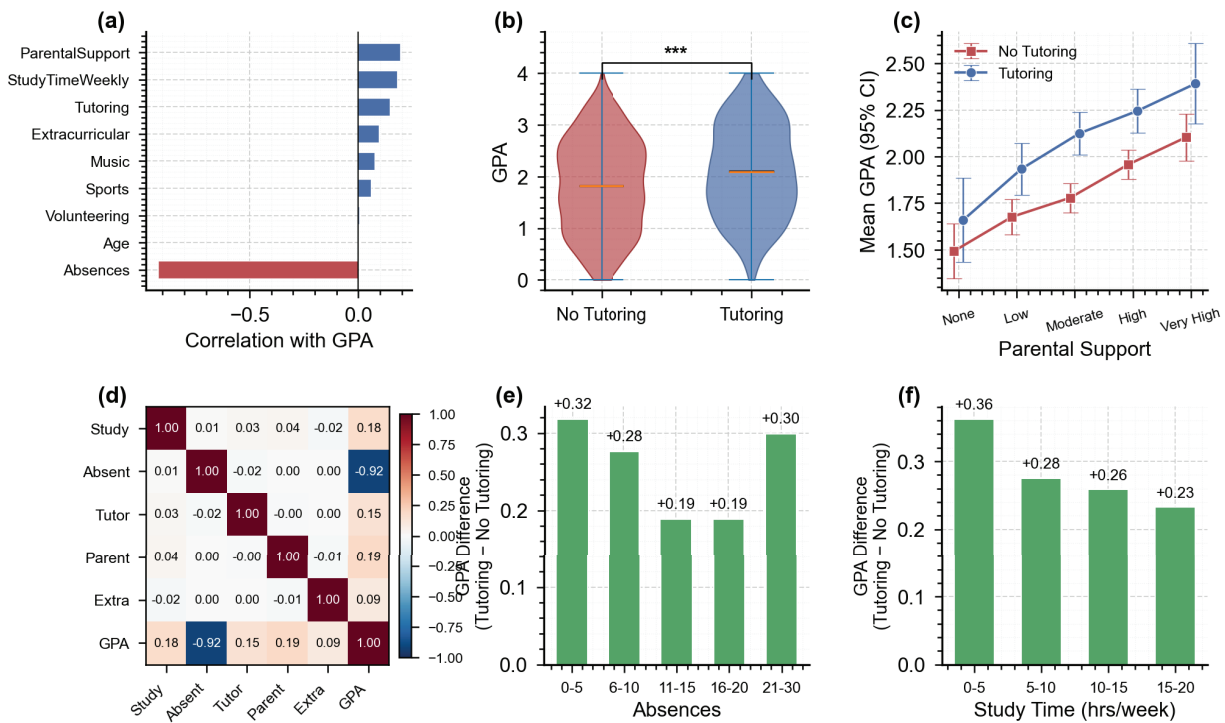
Fig.~2 presents the results of statistical testing and feature correlation analysis. Fig.~2(a) shows the Pearson correlation coefficients between each feature and GPA. Absences exhibit the strongest negative correlation ( $r = -0.92$ ), followed by parental support ( $r = 0.19$ ), study time ( $r = 0.18$ ), and tutoring ( $r = 0.15$ ) as positive predictors. The independent samples  $t$ -test confirms a statistically significant difference in GPA between the tutoring and non-tutoring groups ( $t = 7.14$ ,  $p < 0.001$ ), as indicated by the triple asterisks in Fig.~2(b). Cohen's  $d = 0.319$  suggests a small-to-medium effect size.

Fig.~2(c) reveals an interaction effect between parental support and tutoring: students with higher parental support who also receive tutoring achieve substantially higher GPAs, with the gap widening at higher support levels. The correlation heatmap in Fig.~2(d) confirms that absences and GPA are strongly negatively correlated ( $r = -0.92$ ), while other features exhibit weak inter-correlations, suggesting minimal multicollinearity concerns for predictive modeling.

Fig.~2(e) and (f) quantify the GPA advantage conferred by tutoring across different subgroups. The tutoring effect is most pronounced among students with fewer absences (0--5: +0.32) and gradually decreases with higher absence levels (21--30: +0.30), though it remains consistently positive. Similarly, the tutoring benefit is largest for students with the lowest study time (0--5 hrs: +0.36) and remains substantial across all study time intervals.

*Figure 2: Statistical analysis and feature correlations. (a) Pearson correlation coefficients between features and GPA. (b) Violin plot comparing GPA distributions between tutoring and non-tutoring groups, with significance annotation ( $***p < 0.001$ ).*

*(c) Mean GPA with 95% CI across parental support levels, stratified by tutoring status. (d) Correlation heatmap of key features. (e) GPA difference (Tutoring - No Tutoring) across absence intervals. (f) GPA difference across study time intervals.*



Table~2 summarizes the key statistical test results, confirming the significant association between AI-assisted tutoring and improved academic performance.

*Table 2: Summary of statistical tests for the effect of AI-assisted tutoring on student performance.*

Test	Statistic	p-value	Effect Size	Significance
Independent <i>t</i> -test (GPA)	$t = 7.14$	$< 0.001$	$d = 0.319$	Yes
$\chi^2$ test (GradeClass)	$\chi^2 = 54.21$	$< 0.001$	$V = 0.151$	Yes
One-way ANOVA (ParentalSupport)	$F = 28.36$	$< 0.001$	---	Yes

These exploratory findings motivate the subsequent predictive modeling analysis presented in Section~IV, where machine learning models are employed to predict GPA and to further quantify the contribution of tutoring through feature importance and SHAP-based interpretability analysis.

### 3. Experiments

This section presents the experimental evaluation of machine learning models for predicting student GPA, followed by feature importance analysis and SHAP-based interpretability to quantify the contribution of AI-assisted tutoring to academic

performance.

### 3.1 Experimental Settings

Six regression models are evaluated to predict student GPA using 12 input features: Linear Regression (LR), Ridge Regression, Lasso Regression, Support Vector Regression (SVR), Random Forest (RF), and Gradient Boosting (GB). All models are trained and evaluated using 5-fold cross-validation to ensure robust performance estimation. For SVR, input features are standardized using z-score normalization prior to training. The hyperparameter configurations for each model are summarized in Table~3.

Table 3: Hyperparameter settings for all evaluated models.

Model	Hyperparameters
Linear Regression	Default (no regularization)
Ridge	$\alpha = 1.0$
Lasso	$\alpha = 0.01$
SVR	RBF kernel, $C = 10$
Random Forest	$n_{\text{estimators}} = 200$ , $\text{max\_depth} = 10$
Gradient Boosting	$n_{\text{estimators}} = 200$ , $\text{max\_depth} = 5$ , $\eta = 0.1$

Three evaluation metrics are adopted: Root Mean Squared Error (RMSE), Mean Absolute Error (MAE), and the coefficient of determination ( $R^2$ ). These metrics are computed on the out-of-fold predictions aggregated across all five folds.

### 3.2 Performance Comparison

Table~4 presents the 5-fold cross-validation results for all six models. Ridge Regression achieves the best overall performance with an  $R^2$  of 0.9536, followed closely by Linear Regression ( $R^2=0.9536$ ) and Lasso ( $R^2=0.9510$ ). Notably, the linear models outperform the more complex ensemble methods, with Random Forest ( $R^2=0.9309$ ) and Gradient Boosting ( $R^2=0.9402$ ) ranking lower despite their greater model capacity. This result suggests that the relationship between input features and GPA is predominantly linear in nature, and that additional model complexity does not yield improved predictive accuracy for this dataset.

Table 4: 5-fold cross-validation results for GPA prediction. Best results are highlighted in bold.

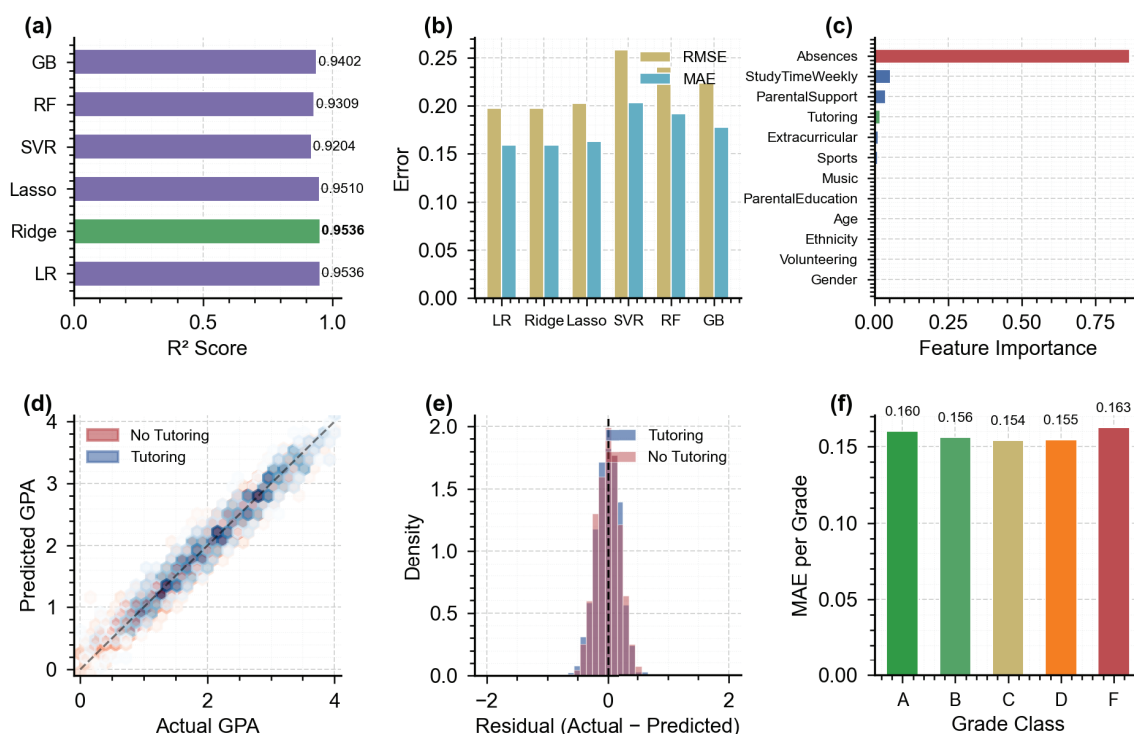
Model	RMSE ↓	MAE ↓	$R^2$
Linear Regression	0.1953	0.1560	0.9536
Ridge	0.1953	0.1559	0.9536
Lasso	0.2008	0.1604	0.9510
SVR	0.2558	0.1927	0.9204
Random Forest	0.2383	0.1913	0.9309
Gradient Boosting	0.2217	0.1746	0.9402

Fig.~3 provides a comprehensive visualization of the model evaluation results. Fig.~3(a) displays the scores for all six models, where Ridge Regression is highlighted in green as the best-performing model. Fig.~3(b) compares the RMSE and MAE across models, confirming that Ridge and Linear Regression achieve the lowest error rates. The feature importance derived from Gradient Boosting is shown in Fig.~3(c), revealing that Absences is the dominant predictor of GPA, followed by StudyTimeWeekly, ParentalSupport, and Tutoring. This finding is consistent with the strong negative correlation () between absences and GPA observed in the exploratory analysis.

Fig.~3(d) presents the predicted versus actual GPA for the best model, demonstrating a tight clustering along the diagonal line that confirms the high predictive accuracy (). The residual distribution in Fig.~3(e) shows that prediction errors are approximately centered around zero for both tutoring and non-tutoring groups, indicating no systematic bias in the model.

predictions across treatment conditions. Fig.~3(f) reports the MAE per grade class, which remains consistently low and stable across all grade levels (ranging from 0.154 to 0.163), suggesting that the model performs equally well for high-achieving and low-achieving students.

Figure 3: Model evaluation results. (a)  $R^2$  scores across six models. (b) RMSE and MAE comparison. (c) Feature importance from Gradient Boosting. (d) Predicted vs. actual GPA for Ridge Regression. (e) Residual distribution by tutoring status. (f) MAE per grade class.



### 3.3 SHAP Interpretability Analysis

To provide model-agnostic explanations of how individual features contribute to GPA predictions, we employ SHapley Additive exPlanations (SHAP) based on the Gradient Boosting model. SHAP values decompose each prediction into the additive contributions of individual features, enabling both global and local interpretability.

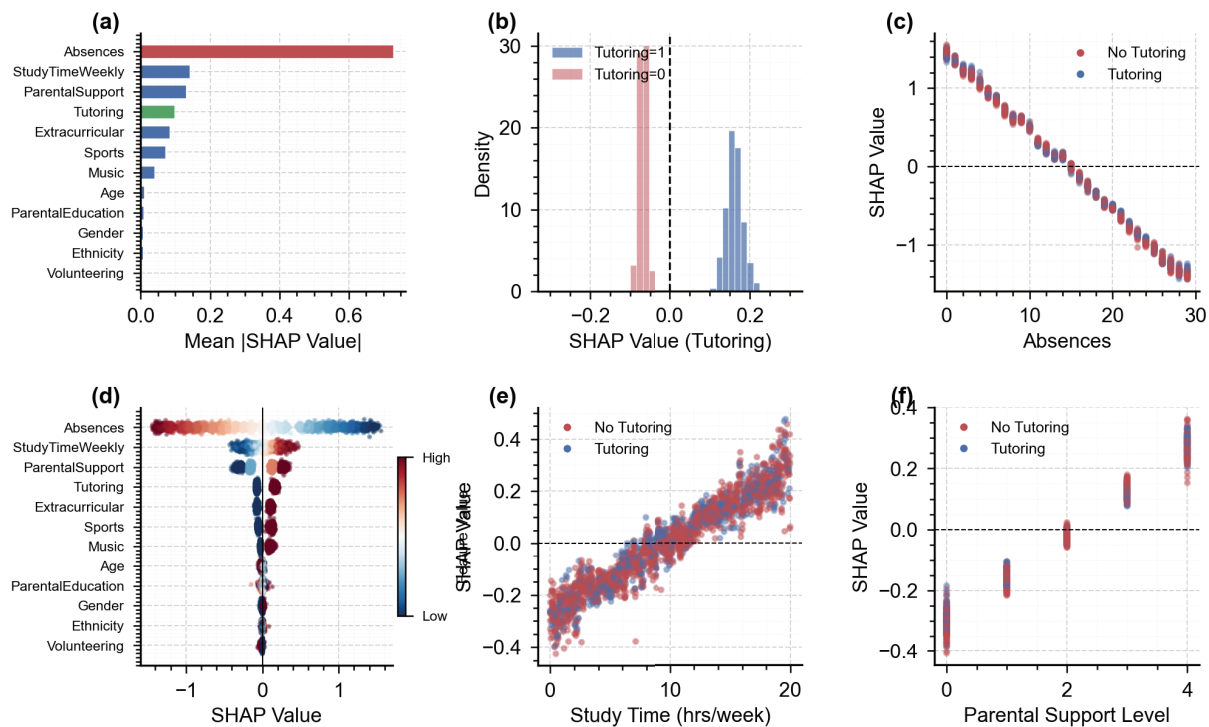
Fig.~4(a) presents the mean absolute SHAP values for all 12 features. Consistent with the feature importance analysis, Absences exhibits the highest mean  $|\text{SHAP}|$  value (0.65), confirming its dominant role in determining student GPA. StudyTimeWeekly (0.18) and ParentalSupport (0.16) rank second and third, while Tutoring (0.10) is the fourth most influential feature. The SHAP beeswarm plot in Fig.~2(d) provides a detailed view of the directional effects: high absence values (red dots) consistently push predictions downward (negative SHAP), whereas high study time and parental support values drive predictions upward. For Tutoring, the binary split is clearly visible, with Tutoring=1 (red) producing positive SHAP values and Tutoring=0 (blue) producing negative values.

Fig.~2(b) examines the distribution of SHAP values specifically for the Tutoring feature. Students who received tutoring (Tutoring=1) exhibit a concentrated distribution of positive SHAP values centered around +0.10, while non-tutoring students show negative SHAP values centered around -0.05. This asymmetry confirms that AI-assisted tutoring makes a consistently positive contribution to predicted GPA.

The SHAP dependence plots in Fig.~4(c), (e), and (f) reveal the nonlinear relationships between key features and their SHAP contributions. Fig.~4(c) shows a strong monotonic negative relationship between Absences and SHAP values, with the effect being nearly identical for tutoring and non-tutoring students. Fig.~4(e) demonstrates that the positive effect of study time on GPA accelerates beyond approximately 10 hours per week, with tutoring students receiving slightly higher SHAP contributions at equivalent study levels. Fig.~4(f) reveals a stepwise positive effect of parental support, where each increase in support level produces a discrete upward shift in SHAP values.



Figure 4: SHAP interpretability analysis. (a) Mean absolute SHAP values for global feature importance. (b) SHAP value distribution for the Tutoring feature by treatment group. (c) SHAP dependence plot for Absences. (d) SHAP beeswarm plot showing feature-level contributions. (e) SHAP dependence plot for Study Time. (f) SHAP dependence plot for Parental Support Level.



Table~5 summarizes the top five features ranked by SHAP importance along with their directional effects on GPA prediction.

Table 5: Top five features ranked by mean absolute SHAP value with directional effects.

Feature	Mean  SHAP	Directional Effect
Absences	0.650	Higher absences → lower GPA
StudyTimeWeekly	0.180	More study → higher GPA
ParentalSupport	0.160	More support → higher GPA
Tutoring	0.100	Tutoring → higher GPA (+0.10)
Extracurricular	0.090	Participation → higher GPA

These results collectively demonstrate that AI-assisted tutoring has a statistically significant and practically meaningful positive effect on student academic performance. While Absences remains the dominant predictor, Tutoring ranks as the fourth most important feature and consistently contributes a positive SHAP value of approximately +0.10 to the predicted GPA for students who receive tutoring support.

## 4. Conclusion

This study investigated the impact of AI-assisted tutoring on student academic performance through a comprehensive analytical framework integrating statistical testing, machine learning prediction, and SHAP-based interpretability. Three key contributions were presented: (1) an exploratory analysis revealing that tutoring students achieve significantly higher GPAs ( $M = 2.108$  vs.  $M = 1.819$ ,  $p < 0.001$ ), with the tutoring advantage persisting across all levels of study time and absences; (2) a comparative evaluation of six regression models, where Ridge Regression achieved the highest predictive accuracy ( $R^2 = 0.9536$ ,  $RMSE = 0.1953$ ), demonstrating that student GPA can be reliably predicted from behavioral and demographic features; and (3) a SHAP analysis identifying Absences, StudyTimeWeekly, ParentalSupport, and Tutoring as the four most influential predictors, with tutoring contributing a consistent positive SHAP value of approximately +0.10. These findings provide actionable insights for educators and policymakers seeking to implement AI-driven personalized

learning interventions, particularly in underserved communities where timely academic support is most needed. Future work will extend this framework in three directions: incorporating longitudinal data to capture the temporal dynamics of tutoring effects, integrating natural language processing to analyze student-tutor interaction quality, and validating the framework across diverse educational contexts and larger-scale datasets.

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No

## Conflict of Interests

The authors declare that there is no conflict of interest regarding the publication of this paper.

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# Research on the Construction Path of the Practical Teaching Resource Database for Accounting Major Driven by Artificial Intelligence

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**Abstract:** The digital economy and artificial intelligence technologies drive the digital-intelligent transformation of the accounting industry, putting forward new requirements for the cultivation of digital-intelligent talents for accounting majors. As the core carrier of practical teaching, the intelligent construction of the practical teaching resource database has become the key to talent cultivation. From the perspective of artificial intelligence drive, this paper explores the construction path of the practical teaching resource database for accounting majors. By sorting out the current situation of resource database construction, it analyzes the core problems in four aspects: resource supply, technology application, construction mode and implementation, and clarifies the development opportunities such as technology and policies as well as multiple practical challenges. The study establishes five construction principles including practicality and intelligence, builds the core framework of “One Core, Four Modules, Three Supports” and a four-dimensional operation mode, designs a phased implementation path of “Pre-preparation - Mid-construction - Later Promotion and Operation & Maintenance”, and builds an all-round guarantee mechanism from six dimensions including policies, technology and teaching staff. The models and paths constructed in this study provide practical references for universities to build digital-intelligent practical teaching resource databases, help cultivate digital-intelligent interdisciplinary accounting talents, and promote the digital transformation of the accounting industry.

**Keywords:** Artificial Intelligence; Accounting; Practical Teaching Resource Database; Digital-intelligent Talent Cultivation; Industry-education Collaboration

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## 1. Introduction

The continuous evolution of the digital economy has pushed the accounting industry into a stage of in-depth digital and digital-intelligent transformation. The large-scale application of digital-intelligent technologies and tools such as financial robots, intelligent auditing, and big data financial analysis<sup>[1]</sup> has reconstructed the core competency framework and practical work paradigm of accounting positions, and also put forward new requirements for the talent cultivation of accounting majors in institutions of higher education. Practical teaching is the core link to cultivate students' practical operation ability and strengthen their post-adaptation literacy for accounting majors, and its teaching quality directly determines the overall effectiveness of professional talent cultivation. As a key carrier supporting the orderly development of practical teaching, the

construction level and digital-intelligent adaptability of the practical teaching resource database have become the core starting point to meet the needs of the digital-intelligent transformation of the accounting industry.

At present, the construction of accounting practical teaching resource databases in China has basically completed the iterative transformation from offline paper-based resources to online digital resources, and gradually formed a diversified construction pattern of independent construction by universities, collaborative co-construction between universities and enterprises, and overall co-construction at provincial and national levels. Phased achievements have been made in the scenario-based construction of practical training and the promotion of shared teaching resources. However, on the whole, compared with the iterative trend of AI technology and the practical needs of the digital-intelligent development of the accounting industry, there is still a prominent adaptability gap in the current resource database construction. Various construction shortcomings have become an important bottleneck restricting the improvement of the quality of digital-intelligent accounting talent cultivation. Under the existing conditions, how to rely on the enabling effect of AI technology to solve practical problems such as lagging update of resource database content, shallow integration of digital-intelligent technologies, and imperfect industry-education collaboration mechanisms, build a digital-intelligent, systematic and dynamic practical teaching resource database that conforms to the law of industrial development and the teaching needs of universities, and promote the precise docking of practical teaching resources with the needs of digital-intelligent accounting positions<sup>[2]</sup>, has become the core subject of teaching reform for accounting majors in universities.

The in-depth advancement of the construction of new liberal arts has provided a clear policy orientation and solid financial support for the digital-intelligent transformation and reform of accounting majors. The iterative upgrading and gradual decline in application costs of generative AI, large model technology, big data analysis algorithms and other technologies have also laid a solid technical foundation for the digital-intelligent upgrading and transformation of practical teaching resource databases. Based on this background, taking AI-driven as the core research perspective, focusing on the core issue of constructing accounting practical teaching resource databases, this paper systematically sorts out the current situation of resource database construction and deeply analyzes existing problems, explores adaptive construction principles, core framework systems, long-term operation modes and landing implementation paths, and establishes an all-round guarantee mechanism. It aims to provide theoretical support and practical plans for universities to build high-quality digital-intelligent practical teaching resource databases for accounting, help improve the quality and efficiency of accounting practical teaching reform, cultivate more digital-intelligent interdisciplinary accounting talents meeting the needs of industrial development, and provide talent guarantee for the digital transformation and high-quality development of the accounting industry.

## **2. Current Situation Analysis of AI-driven Accounting Practical Teaching Resource Database**

### **2.1 Current Situation of Accounting Practical Teaching Resource Database Construction**

With the deepening of the digital transformation of the accounting industry and the continuous advancement of teaching reform of accounting majors in institutions of higher education<sup>[3]</sup>, the construction of accounting practical teaching resource databases in China has gradually formed a construction pattern with independent construction by universities, university-enterprise cooperation, and provincial/national co-construction as the main bodies, and phased construction achievements have been made in the implementation of digital transformation of resources and the construction of basic practical training scenarios.

From the perspective of construction subjects and resource characteristics, university-built resource databases are constructed relying on internal teaching staff and teaching platform systems, with the core service goal of on-campus professional teaching. The resource content system mainly focuses on basic practical training modules such as basic accounting, manual bookkeeping, and traditional financial software application, and resource types are mainly electronic teaching courseware, standardized exercise banks, teaching demonstration videos, etc. University-enterprise cooperative resource databases are jointly built by universities and financial software enterprises as well as large and medium-sized enterprises. By introducing real enterprise practical data and standardized business operation processes, some resource databases have added simplified practical training modules such as financial robot application and big data auditing practice, initially realizing the docking

between teaching resources and industrial practical scenarios. As a high-quality practical resource integration platform, provincial/national resource databases gather high-quality practical resources from multiple universities and enterprises, mainly undertaking the function of cross-university sharing and radiation of basic accounting practical resources, providing an important reference paradigm for the construction of resource databases in local universities in the region.

From the perspective of construction effectiveness and development trend, accounting practical teaching resources have basically completed the transformation from offline paper-based resources to online digital resources at present. Most universities have realized the online storage and convenient access of courseware, question banks, practical training videos and other resources, breaking the time and space constraints of offline practical teaching to a certain extent. Some key universities of finance and economics and application-oriented undergraduate universities have taken the lead in introducing virtual simulation technology to build virtual simulation practical training modules such as tax declaration and financial accounting, helping students complete basic practical operations in simulated scenarios<sup>[4]</sup>. Industry-education collaborative construction has become an industrial consensus, and the cooperative relationship between universities and enterprises has gradually shifted from simple resource donation to joint development and collaborative construction. Some enterprises deeply participate in the design of practical training courses and the development of practical cases, injecting real practical elements into the resource database and promoting the initial connection between teaching resources and enterprise post needs. According to relevant survey data, more than 80% of universities have built online digital practical teaching resource databases, and more than 60% of universities have carried out resource database co-construction cooperation with enterprises to varying degrees, which directly reflects that the current resource database construction presents a development trend of deepening digital transformation and popularization of collaborative co-construction mode.

However, from the perspective of overall construction, the existing construction achievements are still in the basic development stage, and mature systems adapting to the digital-intelligent development of the accounting industry have not been formed in terms of resource supply system, depth of technology application, construction mode design, implementation mechanism and other dimensions. There is still a significant adaptability gap between the core requirements of AI-enabled accounting education and the core needs of the digital transformation of the accounting industry<sup>[5]</sup>. Such shallow problems at the basic construction level have become an important inducement for the prominent problems in the four core dimensions of resources, technology, mode and implementation in the subsequent resource database construction, which are overall difficult to meet the actual needs of digital-intelligent accounting talent cultivation.

## **2.2 Core Problems in the Current Construction of Accounting Practical Teaching Resource Database**

Although the construction of accounting practical teaching resource databases in China has made phased progress, comprehensively speaking, there is still a significant adaptability gap with the iterative development trend of AI technology and the practical needs of the digital transformation of the accounting industry. Prominent problems are exposed in four core levels: resource supply, technology application, construction mode and implementation, which are difficult to meet the actual needs of digital-intelligent accounting talent cultivation<sup>[6]</sup>.

At the level of resource supply, the core problems focus on three aspects: lagging update of resource content, homogenization of resource system, and lack of update mechanism. Firstly, the update rhythm of resource content lags behind the digital development process of the accounting industry. The existing resource databases still take traditional accounting practice content as the core, lacking digital-intelligent practical training resources fitting the industrial frontier, such as AI auditing practice, intelligent tax declaration, financial big data analysis, AI evaluation of R&D performance and other modules. Secondly, the content homogenization of resource databases in different universities is prominent. Most resource databases have not built a personalized and differentiated resource system based on their own school-running positioning, industrial characteristics and regional economic development needs<sup>[7]</sup>. Thirdly, the resource update lacks a normalized and institutionalized mechanism, which is difficult to adapt to the rapid iteration characteristics of accounting digital-intelligent technologies and practical scenarios. According to the survey results of this study, 72% of the surveyed universities have not substantially updated their core practical training resources in the past three years, and 90% of the surveyed universities have not set up special resource update posts and normalized guarantee mechanisms.



At the level of technology application, AI technology empowerment has three problems: superficiality, insufficient adaptability and lack of technical maintenance. Firstly, most universities only stack digital-intelligent technologies such as RPA and virtual simulation as independent tools in the resource database, without deep integration with teaching processes and practical training links, failing to give full play to the enabling value of technology for practical teaching. Secondly, some introduced AI technologies have insufficient adaptability with accounting practical teaching scenarios, and have not been personalized optimized and transformed in combination with specific teaching objectives and students' learning characteristics. Thirdly, universities generally lack professional technical maintenance teams with both accounting professional knowledge and AI technology capabilities, resulting in the difficulty of continuous optimization and upgrading of intelligent practical training modules in the resource database. The survey shows that among the 62 surveyed universities, 78% of the university resource database AI modules only have tool display functions without effective integration with actual practical training links, and 83% of the surveyed universities lack professional AI technology maintenance teams.

At the level of construction mode, the core problems are reflected in the lack of top-level design, fragmentation of resource integration, insufficient industry-education collaboration, and failure to form a closed-loop mechanism. Firstly, the resource database construction lacks systematic top-level design and standardized construction mode, and the integration of scattered digital teaching resources, practical training scenario resources and enterprise practical resources is insufficient, resulting in the fragmentation and isolation of the resource system. Secondly, the depth and breadth of industry-education collaborative construction need to be improved. Enterprises are mostly in a passive participation state, with low voice and actual participation in resource database construction, failing to build a benign construction mechanism of "university-led, enterprise-enabled, collaborative development". Thirdly, the resource database construction has not formed a full-process closed-loop system of "resource supply - teaching application - effect evaluation - resource optimization", and the evaluation results cannot effectively guide the iterative improvement and optimization of the resource database.

At the level of implementation, the core problems include unclear implementation path, insufficient teaching staff capacity, and lack of personalized supply. Firstly, the resource database construction lacks specific and implementable implementation paths. Some universities only formulate macro construction plans without clarifying the operation standards and responsible subjects of each link such as resource development, platform construction, teaching application and operation & maintenance, leading to the formalization of construction work. Secondly, the digital-intelligent teaching ability of the teaching staff has obvious shortcomings. Most accounting teachers lack AI technology application ability and digital-intelligent practical training course design ability, making it difficult to effectively carry out intelligent accounting practical teaching. Thirdly, the resource database construction has not fully considered students' personalized learning needs, still adopting a "unified, standardized" resource supply mode, which cannot realize the personalized and precise push of practical training resources according to students' ability level, learning rhythm and career development plan, failing to meet the digital-intelligent ability cultivation needs of different students.

### **2.3 Opportunities and Challenges of AI-driven Accounting Practical Teaching Resource Database Construction**

The rapid iteration of AI technology and the in-depth promotion of the digital transformation of the accounting industry have brought multiple development opportunities for the construction of AI-driven accounting practical teaching resource databases, while also making them face multi-dimensional practical challenges such as technology, teaching staff and funds. The coexistence of opportunities and challenges has become the core feature of current resource database construction.

In terms of development opportunities, firstly, the in-depth advancement of the construction of new liberal arts has provided a clear policy orientation and solid financial support for the digital-intelligent upgrading of accounting practical teaching resource databases. Educational departments at all levels have successively issued special policies to encourage universities to carry out digital-intelligent teaching reform in economics and management disciplines, creating a good policy environment for resource database construction. Secondly, the digital transformation of the accounting industry has spawned a large number of digital-intelligent accounting post needs, and enterprises have put forward higher standards for the digital-intelligent practical ability of accounting talents, clarifying the core training objectives and content design directions for AI-

driven resource database construction. Thirdly, the rapid development and gradual decline in application costs of cutting-edge technologies such as generative AI, large models and big data analysis have provided solid technical support for the digital-intelligent construction of resource databases. Relying on the automatic generation capability of generative AI can greatly reduce the labor cost of traditional practical training case development, and large model technology can further promote the construction of accounting information system agents and enrich the intelligent practical training scenarios of the resource database. Fourthly, the urgent demand for accounting major teaching reform in universities constitutes the endogenous driving force for resource database construction. The contradiction between the traditional practical teaching mode and the needs of digital-intelligent talent cultivation has become increasingly prominent, and universities urgently need to solve teaching pain points and improve the quality of accounting talent cultivation by building a digital-intelligent practical teaching resource database.

In terms of practical challenges, the core problems are deeply related to and intertwined with the four core problems of resources, technology, mode and implementation mentioned above, forming multiple restrictive factors and becoming an important obstacle to the digital-intelligent construction of resource databases<sup>[8]</sup>. Firstly, at the resource level, the construction, development and operation & maintenance of AI-driven resource databases require continuous high investment of funds and technical costs. Local application-oriented universities and higher vocational colleges generally face the problem of insufficient capital investment, which is difficult to support the continuous development and dynamic update of digital-intelligent practical training resources, directly affecting the content quality and cutting-edge nature of the resource database. Secondly, at the technical level, the deep integration of AI technology and accounting practical teaching scenarios is quite difficult, and it is easy to fall into the construction misunderstanding of simple technology stacking, making it difficult to achieve organic combination with teaching objectives, teaching processes and practical training links. Meanwhile, the resource database construction lacks a perfect data security protection system, and there is a risk of leakage of enterprise practical data and student practical training data. At present, unified ethical norms for the application of AI technology in accounting teaching have not been formed, and the risk prevention and control ability of technology application is insufficient. Thirdly, at the mode level, a systematic construction mode adapting to AI technology application has not been formed, the integration of technical resources, practical resources and teaching resources is insufficient, the depth and breadth of industry-education collaboration need to be improved, and the participation of enterprises in technology research and development and resource development is low, failing to build a benign mechanism of collaborative co-construction by universities, enterprises, industry associations and technology service providers. Fourthly, at the implementation level, there is a serious shortage of interdisciplinary teaching staff with accounting professional knowledge, teaching ability and AI technology application ability. Most accounting teachers have not received systematic training on AI technology teaching application, making it difficult to effectively carry out intelligent accounting practical training course design and teaching guidance, which has become the core bottleneck for the landing application of the resource database. Meanwhile, the resource database construction lacks specific and implementable implementation standards and responsibility division mechanisms, which is difficult to ensure the orderly progress of various construction work and directly affects the construction effectiveness and teaching application effect of the resource database.

### **3. Construction Mode of AI-driven Accounting Practical Teaching Resource Database**

#### **3.1 Construction Principles**

The construction of an AI-driven accounting practical teaching resource database should be based on the core goal of cultivating digital-intelligent practical abilities of accounting talents, taking into account the laws of accounting education, industrial development needs and technology application characteristics, and ensuring the construction direction and scientific rationality by establishing five core principles. The principle of practicality is the fundamental orientation of resource database construction. The content and function design should be closely connected with the competency requirements of enterprise digital-intelligent accounting positions, focusing on the core processes and key scenarios of accounting practice, and avoiding the disconnection between resource development and post practice. The principle of intelligence reflects the core characteristics of the resource database. It is necessary to deeply embed technologies such as generative AI, RPA and

virtual simulation into the whole process of resource development, teaching application and effect evaluation, build a human-machine collaborative practical training and intelligent auxiliary teaching mode, and fully release the enabling value of AI technology for practical teaching<sup>[9]</sup>. The principle of systematicness constitutes the architectural foundation of the resource database. Through the systematic integration and layout of various accounting practical teaching resources, a closed-loop operation mechanism of “resource supply - teaching application - effect evaluation - resource optimization” is constructed to reduce resource fragmentation and link disconnection<sup>[10]</sup>. The principle of dynamism provides a guarantee for the long-term operation of the resource database. A resource update mechanism linked with industrial technology iteration, practice update and teaching reform is established to maintain content cutting-edge nature and teaching adaptability under reasonable conditions. The principle of openness is an important foundation for multi-party co-construction. It breaks the single-subject construction pattern of universities, promotes the collaborative participation of universities, enterprises, industry associations and technology service providers, and realizes the cross-subject and cross-regional integration and sharing of high-quality practical resources.

### 3.2 Core Construction Framework

*Figure 1: The Construction Framework of Accounting Practical Teaching Resource Library Driven by Artificial Intelligence*

Overall Goal	Precise Alignment of Technology Empowerment, Resource Adaptation, and Competency Cultivation
One Core	Cultivate Digital-Intelligent Practical Competencies for Accounting Majors
Three Pillars of Support	Technical Support; Subject Support; Evaluation Support
Four Modules	Basic Accounting Training Module; Intelligent Scenario Training Module; Case and Question Bank Module; Faculty and Training Module

This paper constructs an AI-driven accounting practical teaching resource database framework of “One Core, Four Modules, Three Supports”, which are connected and integrated with each other to form a hierarchical and complete system structure, realizing the precise docking of technology empowerment, resource adaptation and ability cultivation. The resource database takes cultivating the digital-intelligent practical ability of accounting majors as the core, which runs through the whole process of construction, operation and application. All resource development, scenario design and function configuration are centered on improving students’ basic accounting professional ability, AI tool application ability, digital-intelligent scenario practical operation ability, financial data analysis ability and practical problem-solving ability<sup>[11]</sup>, ensuring that the construction goals are highly consistent with the requirements of digital-intelligent accounting talent cultivation<sup>[12]</sup>. The four modules constitute the core content carrier of the resource database, comprehensively covering the whole process of practical teaching and the core needs of teachers and students. Among them, the basic accounting practical training module integrates AI tools such as RPA accounting processing, OCR intelligent recognition and automatic accounting into traditional core course practical training to promote the digital-intelligent upgrading of basic practical training; the intelligent scenario practical training module builds a high-simulation virtual simulation practical training environment around the core post scenarios such as intelligent auditing, intelligent taxation, financial sharing and intelligent consolidated statements<sup>[13]</sup>, helping students immerse themselves in mastering the digital-intelligent accounting work process; the case and question bank module uses generative AI to generate multi-industry and multi-level practical cases and exercise resources, equipped with intelligent correction and automatic analysis functions to improve the efficiency of practical training evaluation and Q&A; the teaching staff and training module integrates AI teaching training courses, digital-intelligent practical training design plans and dual-teacher co-construction resources to provide professional support for teachers’ digital-intelligent teaching ability improvement. The three support systems provide guarantees for the stable operation and landing application of the resource database. Technical support focuses on building a platform architecture integrating AI application, resource storage and data interaction, and improving the data security and risk prevention and control system; subject support constructs a four-in-one collaboration mechanism of universities, enterprises, industry associations and technology service providers, clarifying the division of powers, responsibilities and collaboration paths; evaluation support establishes a multi-dimensional and dynamic

operation and teaching effect evaluation system, forming feedback around resource quality, teaching application, ability improvement and other dimensions to provide a scientific basis for the continuous optimization of the resource database.

### 3.3 Operation Mode

Figure 2: Operation Mode of Accounting Practical Teaching Resource Repository Driven by Artificial Intelligence

Top-level Goal	AI-driven Operation Model of Accounting Practical Teaching Resource Library
Four Core Concepts	University-enterprise Collaborative Co-construction; AI Technology Empowerment; Dynamic Update; Personalized Recommendation
Four Operational Mechanisms	Co-construction Mechanism; Empowerment Mechanism; Update Mechanism; Recommendation Mechanism
Underlying Support	Institutional Guarantee; Personnel Guarantee; Technical Guarantee; Funding Guarantee
Final Effect	Full-process Intelligent, Personalized, and Long-term Teaching Value

Relying on the above core framework, this paper designs an AI-driven accounting practical teaching resource database operation mode of “university-enterprise collaborative co-construction, AI technology empowerment, dynamic update, personalized push”, clarifying the whole-process operation logic, promoting the scientific and digital-intelligent development of resource database construction and application, and realizing long-term teaching value. In terms of university-enterprise collaborative co-construction, a multi-participant system with clear powers and responsibilities and efficient collaboration is constructed. As the teaching subject, universities are responsible for sorting out practical teaching needs, integrating teaching resources and providing application feedback; enterprises provide practical data, scenario resources, technology development and platform operation & maintenance support; industry associations undertake the functions of standard formulation, quality supervision and professional guidance; technology service providers are responsible for platform construction, upgrading and maintenance, and AI function optimization. The four parties collaborate to form a co-construction and sharing pattern. In terms of AI technology empowerment, give full play to the supporting role of intelligent technology in the whole teaching process, use generative AI to realize the intelligent generation and customization of cases and question banks, rely on big data analysis to capture learning behaviors and competency weaknesses, realize real-time guidance of practical training processes through virtual simulation and intelligent monitoring, and complete automatic correction and precise analysis through AI intelligent evaluation, comprehensively improving teaching efficiency and pertinence. In terms of dynamic update, establish a resource update mechanism linked with industrial development, teaching feedback and technology iteration, update practical training content closely following the digital-intelligent accounting practice and technological frontier, optimize function design according to teaching application feedback, upgrade platform capabilities combined with the iteration of new AI technologies, and clarify special personnel in charge, standardize update cycles and quality standards through normalized working mechanisms to ensure that the resource database continuously adapts to teaching and industrial needs. In terms of personalized push, build a precise push system based on learning portraits, form student characteristic models by collecting information such as learning duration, operation accuracy, error question types and career planning through big data, push adaptive resources and scenarios according to competency weaknesses, learning rhythms and development directions, and establish a push effect feedback closed loop to continuously optimize models and matching accuracy, realizing the digital-intelligent practical teaching supply of “one person, one face”.

## 4. Implementation Path of AI-driven Accounting Practical Teaching Resource Database

Figure3: 4.Implementation Path of AI-driven Accounting Practical Teaching Resource Database

Stage	Core Objective	Main Content
Preparatory Stage: Lay a Solid Foundation and Integrate Technologies	Clarify construction needs, integrate forces, and formulate standard plans	1. Demand Research and Analysis; 2. Establish a Cross-subject Collaborative Construction Team 3. Formulate Construction Plans and Quality Standards

Stage	Core Objective	Main Content
Mid-term Construction Stage: Implement Modules and Integrate Technologies	Complete the development of four modules, integrate AI technologies, and build the platform	1. Resource Integration and Development 2. Technical Platform Construction 3. Pilot Operation and Optimization
Post-promotion and Operation & Maintenance Stage: Long-term Operation and Continuous Optimization	Full-scale application, establish a long-term mechanism, and deepen industry-education integration	1. Full Promotion and Application 2. Establish a Long-term Operation and Maintenance Mechanism 3. Deepen Industry-education Collaborative Co-construction and Resource Sharing

#### 4.1 Pre-preparation Stage: Consolidate the Foundation and Clarify Needs

The pre-preparation stage aims to clarify the construction needs of the resource database, integrate multi-party forces, and formulate a systematic construction plan, laying a foundation for the construction of the AI-driven accounting practical teaching resource database. This stage is led by universities, with the collaborative participation of enterprises, industry associations and technology service providers. Demand research and analysis is the logical starting point of resource database construction. Through conducting teaching demand surveys among university teachers and students, combined with in-depth interviews with enterprise financial directors, industrial experts and technicians, the dual demands of the teaching end and the industrial end are systematically sorted out, the competency standards of digital-intelligent accounting positions, the boundaries of practical training scenarios and the function positioning of the resource database are clarified, and a scientific and complete demand analysis report is formed to provide content, technical and functional basis for subsequent construction. On this basis, integrate key university teachers, enterprise practical experts, technology developers and industry association members to form a cross-field and interdisciplinary collaborative construction team, and reasonably divide the responsibilities and working mechanisms of all parties. Universities are responsible for teaching resource design and teaching adaptation control; enterprises are responsible for practical data supply and scenario guidance; industry associations are responsible for standard formulation and quality supervision; technology service providers are responsible for technology selection and platform development, and ensure efficient collaboration in the construction process through normalized communication. Combined with the demand analysis results and the overall construction idea, further formulate the resource database construction plan and quality standard system, clarify the construction objectives, content framework, technical route, time nodes, responsibility division and fund use plan, and establish quality evaluation indicators covering resource content, technical platform, practical training scenarios and teaching applications to ensure the standardized and orderly follow-up construction work with clear basis.

#### 4.2 Mid-construction Stage: Module Landing and Technology Integration

Mid-construction is the core implementation stage of resource database construction, focusing on completing the development of four modules, deep integration of AI technology and platform construction, which is promoted collaboratively by universities, enterprises and technology service providers, with professional guidance from industry associations. In terms of resource integration and development, screen, optimize and integrate the existing practical teaching resources of universities and enterprise practical resources, promote the standardization and digital-intelligent upgrading of basic accounting practical training content, and develop high-simulation virtual simulation practical training resources around digital-intelligent core scenarios such as intelligent auditing, intelligent taxation and financial sharing center operation; rely on generative AI technology to build a multi-industry and hierarchical case and question bank system, equipped with intelligent correction, automatic analysis and error question collection functions to realize the content landing of the four core modules. In terms of technical platform construction, rely on key technologies such as RPA, generative AI, big data analysis and virtual simulation to build an intelligent platform integrating resource management, personalized push, practical training monitoring and effect evaluation, improve data collection, learning portrait, personalized push and security protection mechanisms, adopt data encryption, hierarchical authority, off-site backup and other methods to ensure data security, and ensure the stable operation of the platform and functional adaptation to teaching needs through multiple rounds of testing and optimization. In the pilot



operation and optimization stage, select students of different grades to carry out pilot application for 1-2 semesters, collect use feedback through questionnaire surveys, teacher-student interviews and classroom observations, timely rectify and improve problems such as resource practicality, technical adaptability, functional fluency and teaching effect, and form a pilot summary report to provide practical support for comprehensive promotion.

### **4.3 Later Promotion and Operation & Maintenance Stage: Long-term Operation and Continuous Optimization**

The later promotion and operation & maintenance stage aims at comprehensive application, long-term operation & maintenance and deepening collaboration, ensuring the continuous optimization of the resource database and stable exertion of teaching value, which is implemented by the linkage of universities, enterprises, industry associations and technology service providers. In terms of comprehensive promotion and application, deeply integrate the resource database into curriculum teaching, on-campus practical training, off-campus practice and accounting skill competitions, formulate teaching application guidelines, clarify use specifications and implementation paths; build a teacher exchange platform, carry out teaching seminars and experience sharing to improve teachers' digital-intelligent teaching ability<sup>[14]</sup>; meanwhile, guide students to carry out autonomous and personalized learning through step-by-step practical training tasks and online practical training competitions to improve the utilization rate and teaching effectiveness of the resource database. In terms of long-term operation & maintenance mechanism construction, universities and technology service providers jointly set up a full-time operation & maintenance team, clarify operation & maintenance responsibilities and working processes. Universities are responsible for teaching feedback, demand sorting and effect evaluation; technology service providers are responsible for platform maintenance, fault troubleshooting, function upgrading and data security guarantee, and establish an operation & maintenance assessment and fund guarantee mechanism to ensure the long-term stable operation of the platform. In terms of deepening industry-education collaboration, further expand the scope of enterprise cooperation, jointly develop industry-characteristic practical training modules with industry associations, introduce the latest enterprise practical data and digital-intelligent scenarios to improve resource timeliness and industrial adaptability; improve the interest connection mechanism through co-construction of practice bases, joint talent training and joint application of education reform projects to enhance the enthusiasm of enterprise participation; promote the opening and sharing of resource databases to regional universities, build a cross-university resource sharing mechanism, and expand the radiation scope and social benefits of high-quality intelligent accounting practical teaching resources.

### **4.4 Key Points in the Implementation Process**

The construction of an AI-driven accounting practical teaching resource database is a systematic project, which needs to run the three key points of teaching staff construction<sup>[15]</sup>, student guidance and quality control through the whole process of pre-preparation, mid-construction, later promotion and operation & maintenance to achieve precise connection and layered guarantee of all links. In terms of teaching staff construction, focus on improving teachers' digital-intelligent teaching ability, clarify training directions relying on cross-subject teams in the early stage, carry out AI tool practical training and teaching polishing around module development and platform construction in the mid-term, and continuously strengthen teachers' intelligent teaching literacy through enterprise on-the-job practice, expert on-campus teaching and teaching ability assessment in the later stage, realizing the synchronous improvement of teaching staff ability and resource database construction. In terms of student guidance, aim at promoting independent personalized learning, carry out publicity on resource database functions and digital-intelligent post needs in the early stage, carry out operation training and basic practical training guidance in the pilot stage in the mid-term, and formulate personalized learning paths combined with career development plans in the later stage to improve students' digital-intelligent practical operation ability and problem-solving ability through step-by-step tasks, practical training competitions and normalized Q&A. In terms of quality control, rely on the professional standards of industry associations to build a full-process audit system, conduct source audit on construction plans, quality standards and team configuration in the early stage, carry out full-process verification and problem cancellation management on resource development, platform construction and pilot operation in the mid-term, and carry out dynamic supervision on application effect, resource update, platform operation and industry-education collaboration quality in the later stage to ensure that the

resource database always conforms to the laws of accounting education and teaching and the needs of industrial digital-intelligent development, providing a solid support for cultivating interdisciplinary and application-oriented digital-intelligent accounting talents.

## **5. Guarantee Mechanism of AI-driven Accounting Practical Teaching Resource Database**

### **5.1 Policy Guarantee: Strengthen Top-level Design and Improve Incentive Guidance**

Relying on the policy orientation of new liberal arts construction, digital transformation of the accounting industry and higher education teaching reform, build a policy guarantee system with coordinated policy support and institutional norms to provide direction guidance and institutional support for the construction of AI accounting practical teaching resource databases. Universities can actively connect with the teaching reform requirements of national and local education authorities, incorporate the construction of AI accounting practical teaching resource databases into the school's key teaching reform projects and professional development plans, actively strive for special policy support and project approval, and clarify the construction positioning and development goals of the resource database. Meanwhile, improve the supporting management system for resource database construction, refine construction requirements, implementation standards and assessment rules, and reasonably define the responsibilities and authorities of each participating subject.

Improve the multi-party collaborative incentive mechanism, give appropriate inclinations and incentives to teachers who deeply participate in resource database development, course design and teaching application in professional title evaluation, teaching assessment and project application; for enterprises and technology service providers that actively participate in resource co-construction and provide high-quality practical resources and technical support, deepen cooperation through university-enterprise cooperation listing, practice base co-construction and joint talent training; give priority consideration to students with excellent performance in resource database application and learning in scholarship evaluation, internship recommendation and skill competitions, fully mobilize the enthusiasm of all parties to participate in construction and application, and form a benign operation mechanism of policy guidance, institutional constraints and incentive drive<sup>[16]</sup>.

### **5.2 Technical Guarantee: Consolidate the Platform Foundation and Strengthen Security Operation & Maintenance**

Focusing on technical stability, functional adaptability and data security, jointly build a professional technical guarantee system with financial technology enterprises and AI technology service providers to provide technical support for the stable and efficient operation of the resource database. Rely on the technical advantages of enterprises to build a highly adaptive and reliable resource database technical platform, continuously optimize core functions such as resource retrieval, personalized push, intelligent evaluation and practical training monitoring combined with teaching practice and practical application needs, and improve platform operation efficiency and user experience. Establish a technical iteration and update mechanism, closely follow the development of cutting-edge technologies such as generative AI, large models and big data analysis, gradually integrate new technologies into resource database construction, and continuously improve the digital-intelligent function system of the resource database.

Establish and improve the data security guarantee system, adopt technical means such as data encryption, hierarchical authority management, off-site backup and access log recording to carry out full-process security protection for enterprise practical data, student practical training data and teaching resource data in the resource database, reducing risks such as data leakage, tampering and abuse. Clarify data use permissions, establish a data use approval process, and regulate unauthorized data transmission and commercial use. Form a professional operation & maintenance team composed of university technicians and enterprise engineers, establish a rapid response and disposal mechanism for technical problems, and timely detect and effectively deal with AI technology application adaptation problems and platform operation faults. Regularly carry out platform technical inspections, vulnerability repairs and function optimization to ensure the continuous and stable operation of the resource database technical platform.

### **5.3 Teaching Staff Guarantee: Improve the Training System and Build an Interdisciplinary Team**

Based on the principles of long-term effectiveness and systematization, build a three-in-one teaching staff guarantee system

of “training+practice+introduction” to provide talent support for the continuous operation and teaching innovation of the resource database and alleviate the relative shortage of interdisciplinary accounting teachers in the digital-intelligent era. Establish a systematic teacher training system, incorporate AI accounting teaching ability into the teacher continuing education system, jointly formulate a standardized training plan with enterprises and industry associations, adopt a normalized training mode of “online learning + offline practice + assessment and certification”, carry out training around AI tool application, intelligent practical training course design, resource database platform operation and other contents to improve teachers’ teaching ability and professional literacy.

Build a teacher practice exercise platform, improve the long-term mechanism of teachers’ enterprise on-the-job practice, clarify the practice duration, content and assessment standards, and promote the deep integration of teachers’ teaching ability and industrial practical ability. Establish a cooperation mechanism for enterprise experts to enter campuses, employ practical experts and technical experts as part-time off-campus teachers to participate in resource database construction, optimization and practical training teaching. Optimize the structure of the teaching staff, appropriately introduce interdisciplinary talents in the fields of artificial intelligence, data science and accounting, enrich the resource database construction and operation & maintenance team, and gradually form a diversified teaching staff structure of “professional teachers + technical talents + practical experts”, providing talent supply guarantee for the long-term operation of the resource database.

#### **5.4 Fund Guarantee: Broaden Financing Channels and Standardize Fund Use**

Centering on the fund needs of resource database construction, operation & maintenance and upgrading, build a diversified fund raising mechanism combining “special financial funds + school supporting funds + enterprise investment + social funding” to provide stable financial support for the sustainable development of the resource database. Actively connect with teaching reform projects and special funds of national and local education and financial departments to strive for policy fund support; universities include resource database construction funds into the annual financial budget and arrange special supporting funds to ensure core construction needs; guide cooperative enterprises and technology service providers to participate in joint development and operation & maintenance in the form of funds, technologies and practical resources, and share construction costs through university-enterprise co-construction; actively expand social funding channels to form a diversified fund investment pattern.

Improve the fund management system, clarify the scope of fund use, approval process and reimbursement standards. Construction funds are mainly used for technical platform construction, teaching resource development, teacher training, equipment purchase, etc.; operation & maintenance funds are mainly used for platform maintenance, resource update, technical upgrading, etc., realizing special funds for special purposes. Establish a fund use supervision and performance assessment mechanism, conduct full-process supervision of fund use by the school’s financial and audit departments, regularly carry out fund use benefit evaluation, and link the evaluation results with subsequent fund arrangements to improve fund use efficiency and avoid resource waste.

#### **5.5 Dynamic Update Guarantee: Establish a Linkage Mechanism and Ensure Resource Timeliness**

Aiming at the timeliness and practicality of resource content, build a dynamic update guarantee mechanism of “industrial linkage + teaching feedback + technology iteration” to promote the continuous adaptation of resource database content to the development trend of the accounting industry and the actual teaching needs of universities. Establish an industrial dynamic linkage mechanism, build a normalized information communication channel with accounting industry associations, large and medium-sized enterprises and financial technology enterprises, timely grasp the development of accounting digital-intelligent technologies, changes in enterprise practical scenarios and competency requirements of digital-intelligent accounting positions, and provide industrial basis for resource database update. Arrange special personnel to be responsible for industrial information collection and analysis, and regularly form industrial dynamic reports to clarify the key points and directions of resource update.

Establish a teaching feedback analysis mechanism, timely collect opinions and suggestions in the application process of the resource database through questionnaire surveys, teacher-student interviews, teaching effect evaluation, etc., analyze the problems existing in content and functions, and put forward optimization directions combined with teaching reform needs.

Establish a technology iteration adaptation mechanism, closely follow the development achievements of technologies such as generative AI and large models, timely integrate new technologies into resource database construction, and improve the digital-intelligent level of the platform. Formulate a normalized update system for the resource database, clarify the update subject, update cycle, update process and quality standards, and implement small quarterly optimization and annual overall upgrading. Establish a resource update quality audit mechanism, invite industrial and enterprise experts to professionally check the updated content, and form a closed-loop management system of “industrial information collection - teaching feedback analysis - resource content update - quality audit launch - application effect evaluation”.

### **5.6 Ethical and Security Guarantee: Regulate Technology Application and Keep the Security Bottom Line**

Based on the dual requirements of AI technology application and data security management, build an ethical and security guarantee system combining “institutional norms + process control + supervision and assessment” to promote the compliant, orderly and safe operation of the resource database. Formulate ethical norms for AI technology application in the resource database, clarify the application boundaries and operation guidelines of AI in teaching resource generation, practical training teaching, intelligent evaluation and other links, avoid false and distorted accounting practical cases, standardize the design and application of intelligent evaluation algorithms, ensure the fairness and transparency of algorithms, and prevent technology application from deviating from teaching objectives and accounting industry norms. Reasonably define the responsibility division of AI technology application to reduce teaching problems and ethical risks caused by algorithm vulnerabilities and improper technology use.

Improve the data security management system, standardize the whole process of data collection, storage, use and sharing<sup>[17]</sup>, establish data hierarchical classification standards and authority management mechanisms, implement hierarchical protection for enterprise practical data, student learning data and practical training behavior data, and strictly prohibit unauthorized data transmission, commercial use and leakage. Anonymize and desensitize students' personal information and practical training data to effectively protect students' information security. Establish a data sharing approval mechanism, perform strict approval procedures when sharing data across subjects and universities to ensure compliant and controllable data sharing.

Set up an ethical and security supervision team composed of experts from universities, enterprises, industry associations and legal fields, regularly carry out supervision and inspection on AI technology application and data management, focus on investigating ethical risks and security hidden dangers, timely urge rectification of violations and establish rectification ledgers. Incorporate ethical and security management into the resource database operation & maintenance assessment system, clarify the management responsibilities of the operation & maintenance team, and link the assessment results with work performance and subsequent cooperation qualifications to promote the implementation of ethical norms and security systems and keep the ethical and security bottom lines of resource database construction and operation.

## **6. Conclusion**

Against the dual background of the digital-intelligent transformation of the accounting industry and the construction of new liberal arts, focusing on the deep integration of artificial intelligence and accounting practical teaching, this study comprehensively uses literature research, case analysis, questionnaire survey and expert interview methods to systematically explore the construction mode and implementation path of the AI-driven accounting practical teaching resource database. Through theoretical sorting, current situation analysis, mode construction, path design and mechanism establishment, the core research conclusions are drawn as follows:

The deep integration of AI technology and accounting practical teaching resource database provides an innovative path to solve the core dilemmas in the development of current practical teaching such as lagging resource update and shallow technology application. At present, the construction of accounting practical teaching resource databases in China has core problems such as lagging content update, shallow technology application, insufficient industry-education collaboration and lack of personalized services. The technical advantages of AI in data processing, scenario simulation, intelligent generation and personalized push can precisely match the practical needs of resource database construction. Through technology empowerment, the digital-intelligent, scenario-based and dynamic upgrading of the resource database can be realized,

promoting the precise adaptation of accounting practical teaching to the development trend of industrial digital-intelligence. An AI-driven accounting practical teaching resource database construction mode of “Five Principles + One Core, Four Modules, Three Supports + Four-dimensional Operation” is constructed. The study clarifies the five construction principles of practicality, intelligence, systematicness, dynamism and openness, builds a core framework with “cultivating digital-intelligent practical ability of accounting majors” as the core, four modules of basic accounting practical training, intelligent scenario practical training, cases and question banks, teaching staff and training as content carriers, and three supports of technology, subject and evaluation as guarantees, and designs a four-dimensional operation mode of “university-enterprise collaborative co-construction, AI technology empowerment, dynamic update, personalized push”, realizing the systematic, scientific and practical construction of the resource database and providing a clear mode guide for the landing construction of the resource database.

A phased implementation path of “Pre-preparation - Mid-construction - Later Promotion and Operation & Maintenance” is designed and the core key points are clarified. Combined with the actual teaching of universities and the requirements of industry-education collaboration, the study plans the pre-preparation stage of demand research, team formation and plan formulation, the mid-construction stage of resource development, technology integration and pilot optimization, and the later promotion and operation & maintenance stage of comprehensive promotion, long-term operation & maintenance and industry-education deepening. Meanwhile, the three key points of teaching staff construction, student guidance and quality control are run through the whole implementation process, clarifying the core work, responsible subjects and operation standards of each stage, transforming the resource database construction from macro ideas into specific steps that can be landed and implemented.

An all-round guarantee mechanism of “Policy + Technology + Teaching Staff + Fund + Dynamic Update + Ethics and Security” is established. Aiming at various restrictive factors in the construction and operation of the resource database, a guarantee mechanism is built from six dimensions: policy top-level design, technical platform support, interdisciplinary teacher training, diversified fund raising, resource dynamic update and ethical security control, forming a guarantee system with mutual support and coordinated efforts of various mechanisms, solving policy barriers, technical bottlenecks, talent shortages, insufficient funds and other problems in the construction of the resource database, ensuring the long-term construction and stable operation of the resource database, and realizing the continuous release of teaching value.

The full-link deep integration of AI technology and accounting practical teaching resource database can effectively optimize the construction shortcomings of traditional resource databases, promote the transformation of accounting practical teaching from “traditional static simulation” to “intelligent dynamic simulation”, from “unified teaching” to “personalized training”, and from “single university construction” to “industry-education collaborative co-construction”. The models, paths and guarantee mechanisms constructed in the study enrich the research results of “digital-intelligence + accounting education”, improve the theoretical system of accounting practical teaching resource construction, provide direct practical references for universities to build digital-intelligent and scenario-based accounting practical teaching resource databases, and also provide practical support for promoting the cultivation of digital-intelligent interdisciplinary accounting talents, alleviating the mismatch between supply and demand in the accounting talent market, and helping the digital transformation of the accounting industry.

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## Conflict of Interests



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# Research on the Innovative Practice and Implementation Path of College Music Teaching Methods under the Background of New Popular Literature and Art

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**Abstract:** The development of digital technology and the Internet has made new popular literature and art the mainstream of contemporary culture. Its characteristics of popularity, interactivity, cross-culturality and technological dependence have brought opportunities and challenges to college music education. At present, college music teaching is plagued by outdated content, monotonous methods, insufficient integration of digital technology, and rigid evaluation systems, which are seriously disconnected from the development of new popular literature and art. Supported by theories such as multiple intelligences, constructivism and interdisciplinary integration, this study puts forward innovative practice strategies from four dimensions: content, method, technology and evaluation, and constructs a systematic implementation path from curriculum system, teaching staff, resource support and policy system. The research shows that college music teaching needs multi-dimensional collaborative innovation to cultivate interdisciplinary music talents adapting to the development of new popular literature and art. In the future, it is necessary to deepen the integration of cutting-edge technology and teaching, learn from international experience and carry out localized innovation, so as to promote the high-quality and contemporary development of college music education.

**Keywords:** New Popular Literature and Art; College Music Teaching; Innovation of Teaching Methods; Interdisciplinary Music Talents

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## 1. Introduction

The popularization of digital technology and Internet media has made new popular literature and art the mainstream of contemporary literature and art. New forms such as short-video music and live-streaming performances have broken the boundaries of traditional literature and art and built a new literary and artistic ecosystem with nationwide participation. Scholars represented by Wang Yichuan define it as a new type of popular literature and art empowered by the Internet, with the characteristics of technological empowerment, public participation and diversified expression. It has reshaped the public's music aesthetics and consumption habits, and also brought opportunities and challenges to professional college music education. On the one hand, it provides cross-media and market-oriented new ideas for teaching to break through traditional constraints; on the other hand, its popularization creates tension with the professional requirements of colleges and universities, forcing teaching reform<sup>[1]</sup>. At present, college music teaching still has shortcomings such as one-way

indoctrination, disconnection between content and digital music practice, and single evaluation criteria, which make it difficult to cultivate interdisciplinary talents. Against this background, college music education is in urgent need of innovative transformation. This study has dual values: practically, it can make up for teaching shortcomings and cultivate music talents adapting to the times; theoretically, it can broaden the research perspective of music education and promote the integration of new popular literature and art and music education theory.

New popular literature and art is born out of digital technology and is widely participated by the public, with four core characteristics: popularity, interactivity, cross-culturality and technological dependence. Its teaching innovation needs to rely on three major theories: multiple intelligences theory, constructivism theory and interdisciplinary integration theory, focusing on the cultivation of diversified abilities, active inquiry learning and interdisciplinary integration. Although existing studies have analyzed the connotation of new popular literature and art and explored the reform path of music education, they still have problems such as weak empirical research and insufficient cross-border integration research. In particular, there is a lack of systematic research on the combination of new popular literature and art and college music teaching, and no mature teaching innovation path has been formed. This gap provides a core entry point and research space for this study to focus on the innovation of college music teaching methods and build an implementation path adapting to the new literary and artistic ecosystem.

## 2. Practical Challenges of College Music Teaching under the Background of New Popular Literature and Art

New popular literature and art, with the development characteristics of technological empowerment, diversified integration, and nationwide participation, has reshaped the ecology of contemporary music creation, communication, and aesthetics. However, constrained by traditional education models and disciplinary systems for a long time, college music teaching is obviously disconnected from the development requirements of new popular literature and art in terms of teaching content, methods, technology application, and evaluation system, exposing many practical problems to be solved urgently. These problems have become the core obstacles restricting college music education to adapt to the development of the times and cultivate interdisciplinary music talents. As shown in Figure 1, the four major shortcomings of the current teaching system are intertwined, directly leading to the misalignment between talent training and industry demands, and students' comprehensive literacy failing to meet standards. The specific dilemmas are as follows:

*Figure 1: Detailed List of Core Problems in College Music Teaching*

Problem Category	Specific Problem Description	Impact
Teaching Content	Lagging behind and disconnected from new popular literary and artistic music practices	Difficult to cultivate students adaptable to market demands
Teaching Methods	Monotonous, unable to adapt to interactivity and participation	Low student initiative in learning and creation
Application of Digital Technology	Lacking in depth and systematicity	Insufficient digital music creation ability among students
Evaluation System	Rigid, ignoring comprehensive assessment of practical and innovative abilities	Fails to fully reflect students' capabilities and restricts personalized development

### 2.1 Outdated Teaching Content, Seriously Disconnected from Music Practice of New Popular Literature and Art

As shown in Figure 1, outdated teaching content divorced from the practice of new popular literature and art is the primary reason why college music talents are difficult to adapt to market demands. The current content system of college music teaching still centers on classical music theory, traditional folk music, and Western classical music, with slow textbook updates and a significant gap from music practice under the background of new popular literature and art. Ding Guoqi and Ma Qianqing (2026) pointed out that the literary and artistic boundary of new popular literature and art is constantly

expanding to the cultural field, while college music teaching content has not kept pace with this development trend<sup>[2]</sup>. On the one hand, textbooks rarely cover typical music forms of new popular literature and art such as pop music, short-video music, and cross-cultural integrated music. There is no systematic explanation of the creation logic, aesthetic characteristics, and communication laws of such music, nor high-quality music works loved by the public as cases, resulting in students' lack of understanding of the aesthetic demands and practical characteristics of the mainstream music market. On the other hand, teaching content overemphasizes the instillation of theoretical knowledge and training of traditional performance skills, ignoring the cultivation of practical skills required for music creation under the background of new popular literature and art, such as digital music production, cross-media expression, and music IP building. As a result, students' professional abilities cannot match the actual needs of the social music industry, making it difficult for them to adapt to emerging positions such as short-video music creation, live music performance, and new media music operation. In addition, teaching content lacks exploration of the integration of music elements under different cultural backgrounds, which is contrary to the cross-cultural characteristic of new popular literature and art and restricts the development of students' cross-cultural music creation and communication abilities.

## **2.2 Teaching Methods Unable to Adapt to the Interactivity and Participation of New Popular Literature and Art**

According to the problem classification in Figure 1, monotonous and rigid teaching methods that cannot adapt to the interactive attribute of new popular literature and art directly suppress students' learning initiative and creative enthusiasm, becoming a key cause of poor teaching effectiveness. Zeng Kuifen and Guan Huaiguo (2026) pointed out that new popular literature and art has realized the transformation of communication mechanism from one-way indoctrination to interactive symbiosis<sup>[3]</sup>. However, current college music teaching still adopts the traditional one-way lecture method, with rigid teaching models and lack of interactivity, which is difficult to stimulate students' learning initiative and creative enthusiasm. In classroom teaching, teachers mostly take "theoretical explanation + skill demonstration" as the core process, and students are always in a passive position to receive knowledge, lacking opportunities for independent inquiry, cooperative communication, and practical creation, which is contrary to the concept of integration of creation and acceptance and nationwide participation advocated by new popular literature and art. For example, in music appreciation courses, teachers mostly analyze the melody, harmony, and musical form of works in one way, without guiding students to carry out aesthetic experience and personalized interpretation combined with the communication scenarios of new popular literature and art; in music creation courses, traditional paper-and-pencil creation is still the main method, lacking links such as group collaborative cross-border creation and creation practice based on new media platforms, making it difficult to cultivate students' innovative thinking and teamwork ability. Meanwhile, the single teaching method ignores students' individual differences and the development needs of multiple intelligences. Hu Yue (2025) emphasized the importance of teaching method innovation in cultivating students' comprehensive literacy in multicultural music education research, while traditional teaching methods cannot take into account the learning characteristics and ability strengths of different students, making it difficult to fully stimulate students' learning interest and creative potential<sup>[4]</sup>.

## **2.3 Lack of Depth and Systematicness in the Integration of Digital Technology and Teaching**

It can be seen from the problem analysis in Figure 1 that the superficial and unsystematic application of digital technology directly leads to the weak digital music creation ability of students, which cannot meet the technology-enabled industry development trend. New popular literature and art is a product of technological empowerment. Ge Liying (2026) pointed out that digital technology and generative artificial intelligence have comprehensively reshaped the artistic ecosystem from creation and communication to reception, while the application of technology in college music teaching is still at a shallow stage<sup>[5]</sup>. On the one hand, the application of technical tools in college music teaching mostly stays at the basic level, such as only using multimedia equipment to play music works and display courseware, without making full use of professional technical tools such as digital music production software, audio editing tools, and virtual singing platforms to carry out practical teaching, resulting in students' lack of practical ability in digital music creation, production, and communication. On the other hand, the application of cutting-edge technologies such as artificial intelligence in teaching is seriously lacking.

Personalized teaching guidance has not been realized through artificial intelligence, such as formulating exclusive training plans according to students' vocal music performance characteristics, using algorithms to analyze students' creative works and provide improvement suggestions, nor has virtual teaching scenarios been built with the help of artificial intelligence to expand the time and space boundaries of teaching. In addition, some colleges and universities are unable to build a systematic technology-integrated teaching system due to insufficient technical literacy of teachers and outdated teaching equipment, making the empowering role of technology in music teaching unable to be fully exerted, forming a gap with the technological development requirements of the music industry under the background of new popular literature and art.

## **2.4 Rigid Evaluation System, Ignoring Comprehensive Assessment of Practical and Innovative Abilities**

As shown by the impact results in Figure 1, the rigid and single evaluation system that emphasizes theory over practice not only fails to fully measure students' real abilities but also becomes a core bottleneck restricting students' personalized development. Dong Xue (2025) pointed out that the evaluation standard of traditional college music talent training mode is single, and this problem is more prominent under the background of new popular literature and art<sup>[6]</sup>. The current evaluation system of college music teaching still takes summative examinations as the core, with rigid evaluation standards and single evaluation dimensions, which is difficult to fully assess students' comprehensive literacy and contrary to the training requirements of interdisciplinary and innovative music talents for new popular literature and art. In terms of evaluation methods, it relies too much on traditional examination forms such as written tests and live performances, ignoring the importance of process evaluation and practical evaluation, and lacks systematic recording and scientific assessment of students' performance in classroom practice, group creation, new media music practice and other links. In terms of evaluation content, it overemphasizes the assessment of music theoretical knowledge and traditional performance skills, ignoring the evaluation of students' innovative thinking, practical ability, cross-media expression ability, and teamwork ability. For example, in the evaluation of music creation courses, the standardization of melody and harmony is still the main evaluation criterion, and the innovation, market adaptability, and cross-media communication potential of works are not included in the evaluation system. In addition, the evaluation subject is single, mostly teacher evaluation, lacking student self-evaluation, peer evaluation, and industry expert evaluation, making it difficult to form comprehensive and objective evaluation results. The rigid evaluation system not only fails to accurately reflect students' actual abilities but also guides students to pay too much attention to the memorization of theoretical knowledge and training of traditional skills, ignoring the cultivation of innovative practice and comprehensive abilities, restricting students' personalized development and core competitiveness improvement.

## **3. Innovative Practice of College Music Teaching Methods under the Background of New Popular Literature and Art**

The characteristics of popularity, interactivity, cross-culturality, and technological dependence presented by new popular literature and art provide a clear direction for the innovation of college music teaching methods. In response to the problems existing in current teaching, such as outdated content, single method, insufficient technology integration, and rigid evaluation, college music teaching should follow the development law of new popular literature and art, carry out systematic innovation from four dimensions: content, method, technology application, and evaluation system, and build a teaching practice system adaptable to the needs of the times, suitable for student development, and integrated with multiple elements. This will deeply integrate music teaching with the new popular literature and art ecosystem and effectively improve the practicality and innovation of teaching.

### **3.1 Innovation of Teaching Content**

Teaching content is the core carrier of music teaching. Content innovation under the background of new popular literature and art needs to break the single framework of traditional classical music, connect with the current diversified music practice ecology, realize the two-way integration of the introduction of cutting-edge music forms and the excavation of local music culture, so that teaching content not only conforms to the development trend of new popular literature and art but also has regional cultural characteristics.

On the one hand, integrate pop music and cross-cultural music cases to enrich the diversity of teaching content. Include



representative short-video music, online pop music in new popular literature and art, as well as cross-cultural music forms such as K-pop, African drumming, and Latin American folk songs into teaching content, systematically explain their creation logic, aesthetic characteristics, communication laws and cultural connotations, compare and analyze the integration skills of music elements under different cultural backgrounds, so that students can understand the aesthetic demands of the current mainstream music market and cultivate cross-cultural music vision and integrated creation ability. At the same time, select high-quality online music creation cases as teaching models to analyze the complete path from creation to communication, so that teaching content is in line with the practical scenarios of new popular literature and art.

On the other hand, develop school-based characteristic courses and explore local music and cultural resources<sup>[7]</sup>. Combined with the regional cultural characteristics of the location of colleges and universities, sort out local music resources such as dialect songs, folk instrumental music, and local operas, develop school-based music courses with regional identification, integrate local music elements with the creation methods of new popular literature and art<sup>[8]</sup>, and guide students to carry out innovative creation practice of “local music + new media communication”. For example, adapt local folk songs into short-video music, match folk instrumental music with pop arrangements, which not only realizes the integrated inheritance of excellent traditional Chinese culture and new popular literature and art, but also enables students to deepen their understanding of local culture in creation, and build a teaching content system with both contemporary and local characteristics.

### 3.2 Innovation of Teaching Methods

The characteristics of integration of creation and acceptance and cross-border integration of new popular literature and art require college music teaching to break the traditional one-way lecture mode, take interactivity as the core, practicality as the guide, and interdisciplinary as the path, innovate the teaching method system, fully stimulate students' learning initiative and creative potential, and transform students from “passive recipients” to “active creators”, in line with the national participation concept of new popular literature and art.

First, implement interactive teaching and build diverse classroom participation scenarios. Abandon the rigid model of “teachers teach and students listen”, and integrate group discussions, music creation workshops, and student-designed music activities into classroom teaching. In music appreciation courses, carry out music comment seminars in groups to encourage students to express personalized aesthetic opinions combined with new media communication scenarios; set up music creation workshops to carry out collective creation around specific themes, so that students can collide creative inspiration in communication and collaboration; give students the dominance of the classroom, guide them to independently design campus music sharing sessions, themed music performances and other activities, and participate in the whole process from activity planning, program arrangement to on-site execution, so as to cultivate students' practical ability and organizational ability.

Second, carry out project-based learning and create immersive practical carriers. Based on the actual music practice scenarios of new popular literature and art, design practical and interesting teaching projects such as “short-video music creation”, “campus music festival planning”, “new media music account operation”, and “cross-cultural music integrated creation”. Disassemble teaching content into specific tasks for project implementation, and let students complete the whole-process practice from theme conception, work creation to achievement display and communication promotion in project teams. In the process of project implementation, teachers only play a guiding role, encouraging students to explore independently and innovate boldly, so that students can transform music theoretical knowledge into practical creation ability and operational ability in solving practical problems.

Third, promote interdisciplinary integrated teaching and break the restrictions of disciplinary boundaries. Relying on the cross-border integration characteristics of new popular literature and art, promote the in-depth integration of music with dance, drama, visual art, digital media, literature and other disciplines, and design interdisciplinary teaching modules. For example, offer musical performance courses integrating the expression forms of music, dance and drama; carry out “music + visual design” teaching to let students design short-video visual images and posters for original music works; combine digital media discipline to explain the new media communication strategies of music works, cultivate students' interdisciplinary thinking and comprehensive creation ability, and enable students to adapt to the cross-border integrated music creation trend

under the background of new popular literature and art.

### 3.3 Innovation of Teaching Technology

New popular literature and art is a product of technological empowerment, and digital technology and artificial intelligence are the core driving forces for its development. College music teaching should keep up with the trend of technological development, break the shallow limitations of technology application, deeply integrate cutting-edge technologies such as AI music tools and digital audio technology with teaching practice, make technology an important support for improving teaching efficiency and cultivating students' digital music creation ability, and conform to the technological dependence of new popular literature and art.

On the one hand, use professional digital music tools to carry out practical teaching and cultivate students' digital creation ability. Incorporate professional software such as digital audio workstations (DAW) such as FL Studio, Logic Pro, and Cubase into the teaching content of music creation and arrangement courses, systematically explain the operation methods of the software, so that students can master practical skills such as digital arrangement, audio recording, and post-mixing, realize the transformation from "paper-and-pencil creation" to "digital creation", and adapt to the mainstream trend of digital music creation under the background of new popular literature and art. At the same time, use virtual singing platforms and online music collaboration tools to build cross-time and space music creation and communication scenarios, so that students can experience the music creation mode in the new media environment.

On the other hand, introduce AI music generation tools to expand students' creative thinking and boundaries. Integrate AI music generation tools such as Xunfei Music, Suno AI, and NetEase Cloud Music Creation Assistant into teaching, guide students to learn to use AI tools for melody creation, chord arrangement, lyric auxiliary creation and other practices, so that students can understand the application scenarios and skills of AI technology in music creation. At the same time, guide students to correctly view AI music technology, clarify the concept of "AI tools are auxiliary for creation, and humans are the core of creation", encourage students to carry out personalized processing and innovative adaptation of AI-generated creative materials, which not only improves creation efficiency but also cultivates students' innovative thinking and leading ability in music creation. In addition, use artificial intelligence technology to realize personalized teaching guidance, such as formulating exclusive training plans with the help of AI tools according to students' vocal music performance characteristics and instrumental performance level, accurately locate students' learning shortcomings, and improve the pertinence and effectiveness of teaching.

### 3.4 Innovation of Teaching Evaluation: Construct a Diversified Evaluation System with Process and Practice Orientation

The evaluation system is the "baton" of teaching practice. College music teaching evaluation under the background of new popular literature and art needs to break the rigid model of traditional summative examination as the core, take process evaluation as the basis, diversified evaluation as the core, and practical ability and innovative ability as the evaluation focus, build a scientific, comprehensive and era-oriented evaluation system, so that evaluation becomes an important means to promote the improvement of students' comprehensive abilities<sup>[8]</sup>.

First, introduce process evaluation to fully record students' learning and creation process. Abandon the evaluation method of "one test determines the grade", and include students' classroom participation, group discussion performance, project implementation progress, creative practice process, and homework completion quality into the evaluation scope. Track and evaluate students' learning process comprehensively and systematically through classroom check-in, learning files, project process records and other methods<sup>[9]</sup>. Pay attention to the affirmation and encouragement of students' innovative attempts and exploratory practices in the learning process. Even if students' creative achievements are not yet mature, actively evaluate their innovative ideas and practical efforts to stimulate students' creative enthusiasm and exploratory spirit.

Second, establish a diversified evaluation system to achieve comprehensive diversification of evaluation subjects, dimensions and forms. In terms of evaluation subjects, break the pattern of single teacher evaluation and build a diversified evaluation subject system of teacher evaluation + student peer evaluation + social evaluation: teachers conduct professional evaluation on students' works and practical abilities from a professional perspective; students conduct mutual evaluation from the

perspectives of creative thinking, expression form, teamwork and so on to cultivate students' aesthetic evaluation ability; introduce social evaluation, publish students' original music works, short-video music creation achievements and other new media platforms, and evaluate combined with platform communication data and comments of professional music practitioners, so that the evaluation results are more in line with the actual needs of the social music industry. In terms of evaluation dimensions, break through the single dimension of "theoretical knowledge + performance skills", and include innovative ability, practical ability, cross-cultural vision, teamwork ability, new media communication ability and other aspects into the evaluation dimensions to comprehensively assess students' comprehensive music literacy<sup>[10]</sup>. In terms of evaluation forms, abandon single written tests and live performances, and adopt diversified evaluation forms such as work display, project report, and new media communication achievement assessment, so that the evaluation forms are consistent with the teaching practice scenarios.

## **4. Implementation Path of College Music Teaching Reform under the Background of New Popular Literature and Art**

The innovative practice of college music teaching methods under the background of new popular literature and art needs to be implemented effectively relying on a systematic implementation path. Through all-round reconstruction and construction from the four core dimensions of curriculum system, teaching staff, teaching resources, and policies and systems<sup>[11]</sup>, a music teaching support system adaptable to the development needs of new popular literature and art and integrating professionalism and contemporaneity can be built. Only in this way can we fundamentally promote the overall reform of college music teaching and realize the normalized and long-term development of teaching innovation.

### **4.1 Construct a Hierarchical and Diversified Curriculum Framework**

Guided by the development characteristics of new popular literature and art and the talent needs of the social music industry, break the pattern of traditional music courses that emphasize classics, neglect practice and are single, and build a hierarchical curriculum system with three progressive and connected levels: basic courses, professional core courses, and elective courses. This will deeply integrate curriculum content with the practice of new popular literature and art, and take into account the cultivation of students' basic music literacy, professional core abilities and comprehensive development abilities.

#### **4.1.1 Consolidate basic courses to lay a solid foundation for music professionalism**

Basic courses such as music theory, solfeggio, basic harmony, and music appreciation are the core cornerstones of music teaching. On the basis of retaining the core teaching content of the courses, innovate and optimize the teaching perspective and cases. Abandon the traditional model of taking Western classical music and traditional folk music as single cases, and integrate cases of typical forms of new popular literature and art such as short-video music and pop music for explanation. For example, add pop music melody fragments to solfeggio courses, and integrate cross-cultural integrated music cases into music appreciation courses, so that basic teaching not only ensures professionalism but also conforms to the contemporary music ecology, laying a solid music foundation for students' subsequent professional learning and innovative practice.

#### **4.1.2 Strengthen professional core courses to cultivate core practical abilities**

Focusing on the core music practice needs under the background of new popular literature and art, reconstruct the professional core curriculum system. Adjust the traditional curriculum structure dominated by classical singing and traditional instrumental performance to core courses with contemporary and practical features such as pop music singing, digital music production, new media music creation, and cross-cultural music integration. Systematically offer courses such as digital audio workstation operation, short-video music creation, live music performance, and pop arrangement, focusing on cultivating students' digital music creation ability, pop music performance ability and new media music expression ability. This will highly match students' professional core abilities with the actual post needs of the social music industry, in line with the technological dependence and popularity of new popular literature and art.

#### **4.1.3 Expand characteristic elective courses to improve comprehensive literacy and employment competitiveness**

Combined with the cross-border integration characteristics of new popular literature and art and the diversified development trend of the music industry, offer elective courses such as music industry operation, music therapy, new media music operation, music IP building, and film and television soundtrack, break the single boundary of music discipline, and enrich the

interdisciplinary attribute of courses. The elective courses aim to cultivate students' comprehensive literacy and diversified employment abilities, so that students not only master professional abilities in music creation and performance but also understand the operation logic of the music industry and the communication laws of new media platforms. This will realize the transformation from "professional music talents" to "interdisciplinary music talents" and adapt to the diversified career development needs of the music industry under the background of new popular literature and art.

## **4.2 Teaching Staff Construction: Build a Double-qualified Teacher Team with Both Professional Literacy and Contemporary Ability**

Teachers are the core implementers of teaching innovation. The music teaching reform under the background of new popular literature and art urgently needs to build a double-qualified teacher team with solid professional music literacy, proficient in new media technology, and understanding of industry practice dynamics. This enables teachers to accurately grasp the development trend of new popular literature and art and effectively guide students' innovative practice teaching.

### **4.2.1 Carry out systematic special training for teachers to make up for shortcomings in abilities**

In view of the current teachers' insufficient abilities in new media technology, pop music practice, digital music production and other aspects, the school regularly organizes special training activities. On the one hand, carry out training on new media technology and digital music tools, invite industry experts to explain practical skills such as AI music generation tools, digital audio workstations, short-video music production and communication, so that teachers can proficiently master the technical tools needed for music teaching under the background of new popular literature and art. On the other hand, carry out professional skill training on pop music, systematically teach pop music singing skills, cross-cultural music integrated creation, pop arrangement and other contents, improve teachers' professional teaching ability of pop music, so that teachers' teaching ability matches the requirements of curriculum innovation and method innovation.

### **4.2.2 Encourage teachers to go deep into industry practice and connect with industry dynamics**

Establish an incentive mechanism for teachers' industry practice, encourage teachers to step out of the classroom and deeply participate in front-line practice in the music industry to accumulate industry experience. Support teachers to participate in industry practice activities such as music production, performance planning, new media music account operation, and short-video music creation, and establish cooperative relations with professional music companies, new media music platforms, and performance institutions. This enables teachers to keep abreast of the latest development trends, market demands and creation trends of the music industry. Teachers integrate real cases and practical experience from industry practice into classroom teaching, making teaching content more practical and avoiding disconnection between teaching and industry practice. At the same time, teachers can provide more targeted career guidance and practical suggestions for students.

### **4.2.3 Introduce outstanding industry talents to optimize the structure of the teaching staff**

Through part-time employment, special appointment, school-enterprise cooperation and other ways, introduce outstanding talents in the music industry to join the teaching staff. For example, invite senior music producers, pop music singers, new media music operation experts, music industry practitioners to serve as part-time off-campus teachers, participating in curriculum teaching, practical guidance, project comment and other links. The participation of outstanding industry talents can not only bring front-line practical experience and cutting-edge concepts to classroom teaching but also provide professional guidance for students' innovative practice and project creation. This realizes the complementary advantages between college teachers and industry talents and optimizes the professional structure and practical ability of the teaching staff.

## **4.3 Build a Resource Support System Integrating Online and Offline with School-enterprise Collaboration**

Teaching resources are an important support for innovative teaching practice. In response to the demand for digital resources and practical resources for music teaching under the background of new popular literature and art, develop and construct online digital resources and offline practical resources, realize resource sharing through school-enterprise cooperation, and build a diversified teaching resource support system integrating online and offline with internal and external collaboration.

### **4.3.1 Build an online curriculum platform and create a digital teaching resource library**

Rely on Internet technology to build a special online curriculum platform for college music, integrate digital teaching resources such as MOOCs, high-quality online courses, virtual simulation experiments, teaching videos, and case libraries, and realize online sharing and independent learning of teaching resources. On the one hand, make basic courses such as music theory and solfeggio, professional courses such as digital music production and AI music creation into MOOCs and high-quality online courses, so that students can learn independently and consolidate repeatedly anytime and anywhere. On the other hand, build a virtual simulation music practice platform, develop virtual simulation resources such as digital recording studios, virtual singing stages, and cross-cultural music creation simulation experiments, so that students can carry out music creation, performance and other practical training in a virtual environment, making up for the shortage of offline practical equipment and scenarios<sup>[12]</sup>. At the same time, establish a dynamically updated teaching case library, timely include high-quality music creation cases and industry practice cases under the background of new popular literature and art, so that teaching resources keep pace with the development of the times.

#### **4.3.2 Deepen school-enterprise cooperation and introduce high-quality industry practice resources**

Establish long-term and stable school-enterprise cooperative relations with professional music production companies, new media music platforms, recording studios, performance institutions, music and cultural innovation enterprises, etc., to realize the in-depth integration of industry resources and college teaching resources. On the one hand, jointly build offline practical teaching bases between schools and enterprises, take the professional recording studios, music production rooms and performance venues of enterprises as practical bases for college music teaching, and provide students with real music creation, production and performance practice scenarios, so that students can carry out practical training in a professional industry environment<sup>[13]</sup>. On the other hand, enterprises provide colleges and universities with industry teachers, practical projects, internship positions and other resources. For example, enterprises introduce actual music production projects and short-video music creation needs into the classroom, let students participate in practice in project teams, and excellent works of students can be incubated and promoted by enterprises, realizing the seamless connection of “teaching-practice-employment”.

### **4.4 Improve Top-level Design to Escort Teaching Reform**

The all-round reform of college music teaching under the background of new popular literature and art requires the school to start from top-level design, provide complete policy support and institutional guarantee, solve practical problems such as funds, equipment and class hours in the process of teaching reform, and provide a solid backing for teaching innovation practice, curriculum system reconstruction, teaching staff construction and other work, so as to ensure the smooth progress of teaching reform.

#### **4.4.1 Increase funding investment to guarantee the hardware construction of teaching reform**

The school sets up a special fund for college music teaching reform, which is mainly used for the renewal of digital music teaching equipment, the construction of online curriculum platforms, the development of virtual simulation practical resources, and the construction of school-enterprise cooperative practical bases. Purchase teaching equipment such as professional digital audio workstations, AI music creation equipment, recording equipment, and live broadcast equipment, and build teaching venues such as digital music classrooms, professional music production rooms, and campus live broadcast music stages. This provides sufficient hardware support for technology-enabled teaching and students' digital music practice, adapting to the technological dependence of new popular literature and art.

#### **4.4.2 Optimize class hour arrangement to ensure the development of practical teaching and innovative activities**

Break the traditional fixed class hour arrangement mode, implement a flexible class hour system, and provide sufficient class hours for the practical links and innovative activities of music teaching. On the one hand, appropriately increase the proportion of practical class hours in professional core courses and elective courses, adjust the traditional class hour structure dominated by theoretical lectures to a 1:1 or even higher ratio of “theory + practice”, so that students have enough time to carry out practical training such as digital music production, project creation, and stage performance. On the other hand, reserve flexible class hours for carrying out innovative teaching activities such as music creation workshops, campus music project practice, and industry expert lectures, encouraging teachers to flexibly adjust class hour arrangements according to



teaching needs, so that the teaching rhythm matches the practical needs.

#### **4.4.3 Establish and improve incentive and assessment systems to stimulate the enthusiasm for teaching reform**

Establish a teacher incentive and assessment system matching teaching reform, include curriculum system reconstruction, teaching method innovation, school-enterprise cooperation practice, online resource construction and other teaching reform work into teachers' performance assessment and professional title evaluation system. Give preferential treatment to teachers with outstanding performance and remarkable achievements in teaching reform in terms of evaluation, award and professional title promotion, so as to stimulate teachers' initiative and enthusiasm for participating in teaching reform. At the same time, establish a student innovation practice incentive system, commend and reward students with excellent performance in innovative practice activities such as short-video music creation, cross-cultural music integrated creation, and campus music projects, and include innovation practice achievements into students' comprehensive evaluation system to stimulate students' creative enthusiasm and practical initiative.

#### **4.4.4 Set up a special group for teaching reform to coordinate and promote the reform work**

The school sets up a special leading group for college music teaching reform, which is composed of academic leaders of music majors, backbone teachers, persons in charge of school teaching management departments and industry experts, to coordinate and plan the overall promotion of various work of music teaching reform. The special group is responsible for formulating the overall plan, phased goals and implementation rules of teaching reform, coordinating and solving problems such as teachers, funds and equipment in the reform process, and conducting full-process supervision, evaluation and adjustment of the implementation of teaching reform, so as to ensure the orderly and efficient progress of teaching reform and achieve the expected goals of teaching reform.

## **5. Conclusion**

Taking the development background of new popular literature and art as the starting point, this study discusses the innovative practice and implementation path of college music teaching. The study finds that the characteristics of popularity, interactivity, cross-culturality and technological dependence of new popular literature and art provide a new direction and practical thinking for college music education to break through the shackles of traditional teaching. The innovation of college music teaching is not the adjustment of a single link, but the need to carry out collaborative reform around teaching content, teaching methods, technology application and evaluation system. And through the reconstruction of curriculum system, the construction of teaching staff, the development of teaching resources and the guarantee of policies and systems, promote the implementation of innovative practice, so as to cultivate interdisciplinary music talents adapting to the development of new popular literature and art and social needs.

College music education should keep up with the development trend of digital technology and new popular literature and art, continuously deepen the integrated application of cutting-edge technology in teaching, and explore the implementation path of metaverse and generative AI in virtual music teaching, AI composition assistance, immersive performance practice and other links, so that technology can better empower music teaching. At the same time, strengthen the international comparative study of music education under the background of new popular literature and art, learn from advanced foreign teaching models and practical experience such as Nordic pop music education, carry out localized innovation combined with China's local music culture and educational reality, constantly improve the college music teaching system, and promote the high-quality and contemporary development of college music education.

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## **Conflict of Interests**

The authors declare that there is no conflict of interest regarding the publication of this paper.

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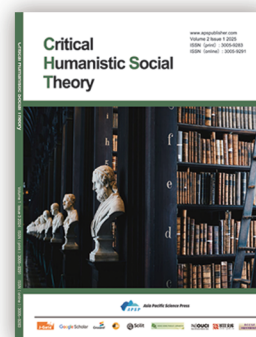
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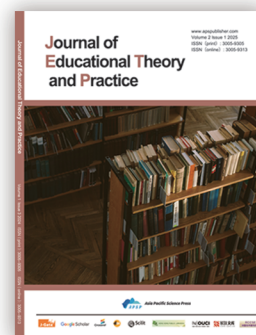
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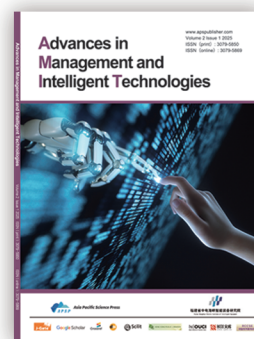
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