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International Education Forum

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Ni Lan

An Empirical Study on the Influencing Mechanism of AIGC on the Cognitive Load of College Foreign Language Learners

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Abstract: In recent years, with the advent of the artificial intelligence era, AIGC technology has been widely applied in the field of education, and studying the influencing mechanism of cognitive load among college foreign language learners has gradually become an important topic at present. The application of AIGC technology in college foreign language teaching not only affects the cognitive load of foreign language learners but also changes the channels through which they process learning information and acquire foreign language knowledge. Furthermore, it can maximize the quality of college foreign language teaching and continuously improve learners' foreign language proficiency. Therefore, it is necessary to select representative research subjects, adopt scientific and reasonable research tools, comprehensively examine the impact of AIGC on the cognitive load of college foreign language learners, and deeply explore its internal laws. In this regard, this paper first conducts an empirical analysis on the influencing mechanism of AIGC on the cognitive load of college foreign language learners. Then it puts forward corresponding educational implications and suggestions, in order to provide certain references for relevant researchers.

Keywords: AIGC; College foreign language; Learners; Cognitive load; Influencing mechanism

Online publication: November 14, 2025

1. Empirical analysis of the influence mechanism of AIGC on the cognitive load of college foreign language learners

1.1. Research objects and instruments

1.1.1. Research objects

The research targets college English learners. During the group experiment, stratification will be conducted based on learners' majors, grades, or English proficiency to ensure that the ability levels and knowledge backgrounds of learners in each group are roughly equivalent, thereby controlling the differences in intrinsic load caused by prior knowledge.

1.1.2. Research methods

- (1) For questionnaire surveys: Design a questionnaire that includes a subjective cognitive load assessment scale (such as the validated Paas Load Scale) and a learning effect questionnaire to evaluate learners' intrinsic load, extraneous load, germane load, as well as learning effectiveness and satisfaction under different teaching scenarios. Quantitative data are collected using a Likert Scale, and reliability and validity tests are conducted.
- (2) For interview surveys: Conduct semi-structured interviews with some learners and English teachers to understand their subjective experiences and cognitive perceptions during the learning process using ChatGPT and DeepSeek, providing a qualitative perspective for questionnaire design and data interpretation.
- (3) For learning logs: Require participants to record their learning processes and cognitive experiences (such as problems encountered, tool feedback, and thinking processes) during the period of using AI tools for auxiliary learning, so as to supplement the understanding of changes in cognitive load.
- (4) For experimental controls: During the empirical research, an experimental group and a control group are set up respectively. The experimental group is allowed to use DeepSeek or ChatGPT when completing specific learning activities, while the control group is only allowed to use traditional resources such as class notes and dictionaries. Both groups complete learning tasks in the same environment, and after the tasks are completed, their learning effectiveness, cognitive load, and other indicators are immediately measured^[1].
- (5) For Structural Equation Modeling (SEM): This method verifies hypotheses based on the collected quantitative data. SEM can test more complex correlations between multiple variables, verify the relationships among AIGC application, learning effect influence paths, and cognitive load, and reveal the mediating effect generated thereby^[2].

1.2. Research data collection and analysis

In order to explore the influence mechanism of AIGC on the cognitive load of college English learners in depth, this study adopted a mixed research method. By integrating quantitative and qualitative data, it conducted a systematic comparison between the experimental group (which used AIGC for auxiliary learning) and the control group (which used traditional learning resources). Data collection included three aspects: the Subjective Cognitive Load Scale, academic performance in learning outcome tests, and learning satisfaction questionnaires. All data were analyzed using SPSS 26.0 for descriptive statistics, t-tests, and correlation analysis. Additionally, AMOS 24.0 was used to construct a structural equation model (SEM) to verify the path relationships between variables.

1.2.1. Descriptive statistics on cognitive load and learning outcomes

A total of 218 valid questionnaires were collected in this study (experimental group, $n = 112$; control group, $n = 106$). The Paas Cognitive Load Scale (a 9-point Likert scale) was used to measure learners' intrinsic load, extraneous load, and germane load. Learning outcomes were evaluated based on academic performance in uniformly designed reading comprehension and writing tasks (scored on a 100-point scale). The results are presented in **Table 1**.

Table 1. Comparison of cognitive load and learning outcomes between the two groups (mean \pm SD)

Variable	Experimental group ($n = 112$)	Control group ($n = 106$)	t -value	p -value
Intrinsic Cognitive Load	5.24 \pm 1.32	6.87 \pm 1.45	-7.893	0.000
Extraneous Cognitive Load	3.56 \pm 1.21	4.89 \pm 1.33	-7.211	0.000
Germane Cognitive Load	6.78 \pm 1.43	4.32 \pm 1.28	11.245	0.000
Total Cognitive Load	5.21 \pm 1.12	6.52 \pm 1.24	-7.654	0.000
Learning Outcome	82.45 \pm 8.76	70.33 \pm 9.54	9.876	0.000

Note: * $p < 0.05$ (statistically significant difference), ** $p < 0.01$ (highly statistically significant difference), *** $p < 0.001$ (extremely statistically significant difference).

Table 1 shows that the intrinsic cognitive load and extraneous cognitive load of the experimental group during the learning process were significantly lower than those of the control group ($p < 0.001$), while the germane cognitive load was significantly higher than that of the control group ($p < 0.001$). This indicates that AIGC assistance effectively reduces the ineffective cognitive burden and promotes meaningful cognitive processing. Meanwhile, the learning effect of the experimental group was significantly better than that of the control group ($t = 9.876$, $p < 0.001$), which preliminarily verifies that AIGC has a positive impact on learning effectiveness.

1.2.2. Path analysis of structural equation model (SEM)

To further explore the mechanism underlying the relationship between AIGC use, cognitive load, and learning effect, this study constructed a structural equation model (SEM), which includes four latent variables: “AIGC Usage Frequency,” “Intrinsic Cognitive Load,” “Germane Cognitive Load,” and “Learning Effect.” The model exhibits good fit indices ($\chi^2/df = 2.13$, CFI = 0.94, TLI = 0.92, RMSEA = 0.06), and the path coefficients are presented in **Table 2**.

Table 2. Path coefficients and significance test of the structural equation model

Path relationship	Standardized coefficient β	S.E.	C.R.	p -value
AIGC Use \rightarrow Intrinsic Cognitive Load	-0.38	0.06	-5.212	0.000
AIGC Use \rightarrow Germane Cognitive Load	0.42	0.07	5.876	0.000
Intrinsic Cognitive Load \rightarrow Learning Outcome	-0.31	0.05	-4.532	0.000
Germane Cognitive Load \rightarrow Learning Outcome	0.46	0.06	6.124	0.000
AIGC Use \rightarrow Learning Outcome	0.28	0.05	3.987	0.000

The model results show that AIGC use has a significant negative impact on intrinsic cognitive load ($\beta = -0.38$, $p < 0.001$) and a significant positive impact on germane cognitive load ($\beta = 0.42$, $p < 0.001$). Intrinsic cognitive load exerts a negative predictive effect on learning effect ($\beta = -0.31$), while germane cognitive load has a significant positive effect on learning effect ($\beta = 0.46$). In addition, AIGC use has a direct positive effect on learning effect ($\beta = 0.28$) as well as an indirect effect mediated by cognitive load, indicating that cognitive load plays a partial mediating role between AIGC and learning effect.

The above data results indicate that AIGC technology significantly improves the learning effect by

reducing learners' extraneous and intrinsic cognitive load and increasing their germane cognitive load. This finding is consistent with the Cognitive Load Theory proposed by Paas and Sweller, which states that effective instructional design should reduce irrelevant cognitive load and increase germane cognitive load. The personalized explanations, multimodal examples, and real-time feedback provided by AIGC help learners construct clearer mental representations and facilitate in-depth language processing. Furthermore, the SEM results further reveal the dual-path mechanism through which AIGC influences the learning effect via the mediation of cognitive load, providing theoretical support and practical guidance for the educational application of AIGC.

1.3. Research results and discussion

In the experimental group using AIGC technology, the mean score of learners' self-assessment of cognitive load was much lower than that of the control group. This proves that AIGC technology can effectively alleviate the pressure brought by learning complex materials. In addition, regarding germane load, the control group scored significantly lower than the experimental group. This indicates that AIGC can promote learners to enter a state of in-depth thinking, conduct in-depth processing of foreign language knowledge, and organically connect new and existing knowledge points. Furthermore, in the questionnaire survey on satisfaction and learning effects, the scores of the control group were lower than those of the experimental group, which fully shows that learners have a high degree of recognition for AIGC-assisted learning ^[3].

Learners mentioned that AIGC provides diverse explanations and examples, helping them better understand complex foreign language knowledge, especially in grammar and vocabulary learning. For instance, when encountering an incomprehensible grammatical structure, AIGC can provide easy-to-understand explanations and list multiple example sentences in different contexts, enabling them to draw inferences about other cases from one instance. Teachers, on the other hand, believe that AIGC can serve as an effective supplementary teaching resource, providing more ideas and creativity for teaching activities. However, they also worry that learners may develop over-reliance on AIGC, which would neglect the cultivation of their independent thinking ability ^[4].

2. Educational implications and suggestions on the mechanism of AIGC's impact on the cognitive load of college foreign language learners

2.1. Teaching content design: Personalized provision and cross-modal integration

In terms of the impact of learning load, it is particularly important to provide personalized foreign language teaching content based on AIGC. Teachers should leverage the advantages of AIGC technology in teaching and combine learners' interests, learning characteristics, and foreign language proficiency to customize personalized teaching content for them. For example, for learners with a weak foundation, teachers can provide basic grammar content and fundamental foreign language vocabulary, and use AIGC technology to automatically generate low-level exercises and explanations. For learners with a solid foundation, teachers can use AIGC technology to provide more in-depth learning materials, such as foreign language news reports and research papers, and guide learners to use AIGC technology to assist themselves in reading and understanding the linguistic structures and language contexts in the learning materials ^[5].

In addition, teachers can also use AIGC to analyze learners' learning data, understand their usage of learning resources in different modalities and their learning effects, and further adjust the provision and

integration methods of teaching content. By continuously optimizing the personalized provision and cross-modal integration of teaching content, it is possible to better adapt to learners' cognitive needs, give full play to the positive role of AIGC in college foreign language teaching, and promote learners' foreign language learning and cognitive development ^[6].

2.2. Optimization of teaching process: Human-machine collaboration and real-time feedback

Currently, to improve the effectiveness of college foreign language teaching, it is essential to recognize the importance of human-machine collaboration. AIGC will form a complementary relationship in terms of advantages with teachers, and teachers can leverage AIGC technology to continuously enhance their own capabilities, such as in professional knowledge, teaching experience, and learning guidance. Additionally, teachers can utilize AIGC's functions like rapid content generation, data analysis, and data processing to continuously improve the efficiency of foreign language teaching. For instance, in teaching practice, teachers explain grammatical knowledge systematically and provide example demonstrations. After learners fully understand and master the grammatical knowledge, teachers can use AIGC technology to automatically generate practice questions of varying difficulty levels, analyze learners' answer situations, weak learning areas, and other aspects in real time, and accurately push matching intensive training content ^[7].

Furthermore, real-time feedback is also a key link in optimizing the teaching process. AIGC can provide timely feedback on learners' learning performance. During oral practice, AIGC can evaluate aspects such as the accuracy of pronunciation, fluency, and intonation, and offer detailed improvement suggestions. For learners' writing assignments, AIGC can conduct quick grading. It not only identifies grammatical errors and spelling mistakes but also evaluates the assignments from multiple dimensions, including content structure, logical coherence, and vocabulary usage. This kind of real-time feedback enables learners to promptly understand their own learning status, adjust their learning strategies, and improve learning efficiency ^[8].

2.3. Innovation in learning evaluation: data-driven and competence diagnosis

- (1) The process-oriented evaluation system can continuously track learners' learning progress and dynamic changes

AIGC can instantly acquire and analyze various information, such as classroom performance, task completion status, and collaborative learning. For example, during oral training, AIGC can record details like pauses in learners' training and speech error rates in real time; during writing training, it can also collect information such as the evolution of learners' writing thinking and traces of writing revisions in real time. Based on this information, personalized learning profiles are established to intuitively present learners' shortcomings and strengths ^[9].

- (2) Regarding cognitive load diagnosis tools

Teachers can develop professional diagnosis tools using AIGC technology to accurately detect the cognitive load of foreign language learners and monitor the distribution of their cognitive resources and their foreign language learning status in real time. For example, during foreign language reading comprehension, the diagnosis tool will collect data such as learners' reading speed, accuracy in reading texts on different topics, and changes in reading attention, so as to accurately evaluate the cognitive load of learners during the reading comprehension process.

2.4. Cultivation of students' competencies: from technology dependence to in-depth learning

(1) Guide learners to develop a correct understanding of the role of AIGC in learning

Even though AIGC technology can provide learners with suggestions for writing, reading, and translation, it remains an auxiliary learning tool that cannot replace learners' independent learning and thinking processes. Therefore, teachers can use case studies, in-class activities, and other methods to clarify the negative effects of excessive reliance on AIGC technology on foreign language learning. For instance, in foreign language writing exercises, if learners fail to think independently or organize language on their own during the writing process and merely copy and paste content generated by AIGC technology, it will be difficult for them to truly improve their writing skills ^[10].

(2) It is essential to stimulate learners' awareness of independent learning

Teachers can design challenging learning tasks and encourage learners to complete them without the assistance of AIGC technology. For example, organizing foreign language debate activities, thematic speeches, and similar events allows learners to practice and enhance their language expression, logical thinking, and problem-solving abilities in practical scenarios. At the same time, teachers should guide learners to develop personalized study plans: based on their own learning goals and progress, learners can reasonably arrange study time and content, thereby gradually improving their independent learning capabilities.

3. Conclusion

In summary, the emergence of AIGC technology has brought brand-new challenges and opportunities to foreign language teaching. In empirical analyses, the multifaceted impacts of AIGC on the cognitive load of college foreign language learners can be clearly observed, which provides a solid theoretical basis for subsequent teaching practices. By implementing a series of measures, including developing scientific and reasonable teaching content, optimizing teaching processes, innovating learning assessment methods, and cultivating learners' competencies, teachers can effectively guide learners to make proper use of AIGC technology, reduce their dependence on the technology, achieve in-depth learning, and continuously improve their foreign language proficiency and comprehensive competencies.

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An Exploration of the Application of English Rhetorical Devices in College Students' Public Speech Competitions

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Abstract: Public speech demonstrates an individual's critical thinking ability, language expression skills, and, most importantly, the depth of thought. This is also true for college students. Using the public speech platform to showcase themselves and propagate their ideas is of profound significance for the cultivation of their comprehensive quality. Taking English as a requirement for public speeches can further enhance students' cross-cultural understanding and communication abilities. The use of various rhetorical devices to train and improve the appeal of language and the persuasiveness of speeches is worthy of in-depth discussion and practice. Therefore, combining the types of rhetorical devices with the actual situation of college students, this paper puts forward several feasible and effective suggestions and strategies, hoping to provide a reference for college students to improve the quality of their English speeches.

Keywords: College students; Public speech; Competition; English rhetorical devices

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1. Introduction

Against the background of globalization, college English public speech competitions are in full swing, such as the "FLTRP · Guocai Cup" English Public Speaking Contest, the National College Students English Speech Competition, and the "21st Century Cup" National English Speech Competition, which are widely popular. Many college student contestants want to demonstrate their personal charm and in-depth thinking in the competitions, and their application of rhetorical devices has reached a sophisticated level, which is also the key point discussed in this paper. From the perspective of speech theory, as early as Aristotle's Rhetoric, three major elements, logical appeal, emotional appeal, and ethical appeal, were proposed, and these elements are realized through the use of rhetorical devices, whose importance is self-evident. For college students, the rhetorical devices they use are nothing more than parallelism and rhetorical questions related to logic, metaphors and hyperbole related to emotion, as well as repetition and quotation, etc., through which they optimize language

expression and enhance the appeal and impact of language. The specific analysis is as follows:

2. The application and classification of rhetoric in speeches

2.1. Semantic rhetorical devices

As the name suggests, semantic rhetorical devices refer to the re-expression of language that deeply explores the depth and creativity of linguistic meaning. They can break through the conventional semantic associations of words, construct brand-new meaning connections, endow speeches with stronger imagery and associative space, and thus bring a better experience to the audience. The application of semantic rhetorical devices does not rely on sentence structures or phonetics; instead, they convey emotions and viewpoints solely through “ingenious ideas” at the semantic level. Common types include metaphor, personification, metonymy, hyperbole, etc.

For example, in a speech, the sentence “Ideal is a lighthouse that illuminates the path forward” transforms the abstract “ideal” into the concrete and perceptible “lighthouse”, allowing the audience to quickly understand the guiding role of ideals. In the first-prize work Youth and Global Citizenship of the 2023 “FLTRP · Guocai Cup” (National English-Speaking Competition), the contestant used the expression “Global challenges are like a jigsaw puzzle, each youth’s effort is a crucial piece”, which visualized abstract global challenges as a jigsaw puzzle, enabling the audience to intuitively grasp the importance of youth power^[1-3]. Semantic rhetorical devices can free speeches from plain and straightforward narration, move the audience with more vivid images, and deepen the memory points of the viewpoints expressed.

2.2. Syntactic figures of speech

Syntactic figures of speech also have their unique advantages. By adjusting sentence structures and optimizing sentence combinations, they make the rhythm of a speech more accurate and the logical hierarchy clearer; correspondingly, the language expression becomes highly powerful and expressive. They do not change the inherent semantic meaning of words themselves, but instead concentrate the audience’s attention and highlight key information through creative sentence design. Common types include parallelism, antithesis, repetition, rhetorical questions, and echo question (a figure of speech that uses a negative form to emphasize a positive meaning or vice versa). For instance, in Martin Luther King Jr.’s “I Have a Dream,” the continuous use of the parallel structure “I have a dream that one day...” creates a powerful rhythmic cadence. It progressively unfolds the ideal vision and strengthens the emotional impact. In the 2023 “FLTRP · Guocai Cup” second-prize work Cultural Heritage in the Digital Era, the contestant continuously used the structure “If we digitize folk songs, we preserve voices of the past; if...” This progressive expression demonstrates the significance of digitizing cultural heritage protection, with clear logic and strong appeal^[4]. There are many more examples like these, all of which require analysis based on specific contexts. However, it is undeniable that syntactic figures of speech make speeches more logical and ingenious.

2.3. Phonological figures of speech

Phonological figures of speech refer to techniques related to sound characteristics, specifically the varied combination of syllabic, rhythmic, and metrical elements. They make the content of a speech pleasant to the ear and easy to remember, enhance its auditory appeal, and help the audience deepen their impression of the content through the auditory experience. Such rhetorical devices rely on the physical properties of speech sounds, with common types including rhyme, reduplication, alliteration, assonance, and more. For example, at the end of a

speech, using a rhyming line like “In the name of youth, we answer the call of the times; with a striving posture, we create the beauty of the future” makes the sentence catchy due to the rhyme between “times” and “future,” facilitating audience memory and dissemination. The use of reduplication, such as “gentle wind, warm light,” creates a soft atmosphere through the repeated adjectives “gentle” and “warm,” narrowing the distance with the audience ^[5-7]. By adopting such techniques, public speeches become less rigid, instantly draw the audience closer, achieve “one-step perfection” in overall fluency and approachability, and are highly compatible with the temperament of college students.

3. Suggestions on the use of rhetorical devices in college students’ speeches

3.1. Grasp the correct semantic relationship

The prerequisite for using semantic rhetorical devices is to accurately grasp the semantic relationship. Otherwise, even the most exquisite rhetorical expressions will lose their value and may even mislead the audience and weaken the persuasiveness of the speech. When college students participate in public speech competitions and skillfully design and use rhetorical devices such as metaphor, personification, metonymy, and hyperbole, they must first ensure that there is a reasonable and close logical connection between the tenor and the vehicle (in metaphor), as well as between the original object and the personified object (in personification). This connection should not only conform to the laws of objective cognition but also align with the theme and contextual needs of the speech. For example, when elaborating on the theme of “persistence,” comparing “persistence” to “a kite with a broken string” violates semantic logic. A kite with a broken string will lose control and fall, which is contrary to the core connotation of “persistence leading to steady progress.” Such inappropriate metaphors will cause cognitive confusion among the audience. On the contrary, comparing “persistence” to “a hiking stick in hand when climbing a mountain” not only reflects the supporting role of persistence in moving forward but also highly fits the speech context of “overcoming difficulties and moving towards goals,” enabling the audience to quickly understand and agree with the viewpoint.

Secondly, the use of the above rhetorical devices should also be practical, avoiding distortion caused by excessive rhetoric, which would instead reduce the effectiveness of the speech ^[8]. The use of hyperbole is a typical example here. For instance, the statement “The efforts we make for our dreams can stop the earth from rotating” violates objective facts and is quite absurd. It will also affect the audience’s trust in the speech and the speaker themselves, leading to many doubts. In addition, some metonymic references between people and things should also conform to common social laws. For example, using “red scarf” to refer to “Young Pioneers” is a fixed association formed based on universal social cognition. However, if one uses “book” to refer to “diligent students” in a speech, it lacks sufficient semantic connection support, making it difficult for the audience to understand and hindering the transmission of information. In daily practice, college students should strengthen the analysis and judgment of semantic logic, improve the accuracy and rationality of using semantic rhetorical devices, and make semantic rhetoric truly serve the theme of the speech, thereby enhancing the appeal and credibility of the speech.

3.2. Choosing appropriate sentence structures

Choosing appropriate sentence structures is key to the effective application of syntactic figures of speech in college students’ English public speeches. Different sentence structures produce distinct expressive effects;

only when they align with the speech's theme, content logic, and emotional tone can the function of syntactic rhetoric be maximized, making the speech more logical and engaging. Therefore, when college students select sentence patterns for syntactic figures of speech, such as parallelism, antithesis, repetition, rhetorical questions, and echo questions, it is essential to consider the overall framework and structure of the speech and maintain a good balance. For instance, if the speech theme is "Youth and Responsibility," when using the parallel structure of "Youth is...; Youth is...; Youth is..." it is advisable to include 3 to 5 clauses. Each clause should be of similar length, with key words highlighted ^[9,10]. However, it is also important to avoid distracting the audience due to an excessive number of clauses or disorganized sentence patterns. When the theme is "Setbacks and Growth," employing the antithetical sentence "Setbacks are thorns, yet they sharpen the steps of progress; Growth is a rainbow, always shining after storms" can clearly convey the idea that "growth comes only through setbacks" by contrasting "setbacks" with "growth" and "thorns" with "rainbows."

Meanwhile, the concise and concise expression makes it easy for the audience to remember and spread. The selection of rhetorical questions and echo questions should be based on the speech's interactive needs and emotional intensity. Rhetorical questions are often used to introduce topics and inspire thinking. For example, opening a speech with the rhetorical question "What is true success? Is it the accumulation of wealth, or the realization of value?" can quickly capture the audience's attention and guide them to think deeply along the speech's train of thought. Echo questions are more suitable for strengthening emotions and intensifying tone. For example, ending a speech with the echo question "In the face of the call of the times, how can we hold back? How can we slack off?" can arouse the audience's emotional resonance and strengthen their determination to act ^[11,12]. All of these require repeated attempts to find suitable sentence structures and create innovative combinations (on the premise of conforming to objective facts) based on different thematic scenarios. College students are expected to keep practicing in daily speech training, analyze the differences between various expressive effects, and gradually master the rules of matching sentence structure selection with speech content and emotions, ultimately making syntactic figures of speech a powerful tool for organizing speech logic and enhancing expressive effects.

3.3. Mastering diverse phonetic features

Speech is an auditory art, and phonetic features directly influence the communication effect of figures of speech. When college students use figures of speech, integrating diverse phonetic features such as level and oblique tones (in Chinese), rhyme, and reduplication can endow rhetorical expressions with a "melodic beauty of sounds." This helps the audience deepen their understanding of the content through auditory memory and enhances the overall appeal of the speech. For college students participating in public speaking competitions, they must fully master the characteristics and application techniques of various phonetic figures of speech during pre-competition training, and apply them flexibly in combination with the speech scenario and their own expressive habits. Rhyme is the most commonly used type of phonetic figure of speech. Its core lies in maintaining the consistency and naturalness of rhymes, avoiding forced rhyming that undermines the fluency of the speech. In English speeches, common rhyming methods include end rhyme and alliteration. End rhyme is suitable for speech conclusions or paragraph summaries; for example, "Let's strive with passion, chase dreams with action, and build the future with dedication."

The repeated end rhymes of "passion," "action," and "dedication" make the sentence catchy, enhancing the speech's appeal and communicability. Alliteration, on the other hand, is ideal for emphasizing key words

and creating a specific atmosphere. When describing a striving scenario, phrases like “persistent pursuit, powerful progress” use alliteration of “persistent” and “powerful” (both starting with “p”) to highlight the determination and strength in striving, capturing the audience’s attention. Reduplication (or repeated syllable rhetoric) enhances the vividness and emotional color of language by repeating syllables. Its application must align with the characteristics of the described object and the emotional tone of the speech. When depicting a warm scene, reduplicative expressions such as “soft sunshine, gentle breeze” (with “soft” and “gentle” carrying a subtle repetitive rhythmic feel) create a mild and comfortable atmosphere, narrowing the distance with the audience ^[13–15].

When expressing strong emotions, phrases like “firm faith, endless courage” use reduplication to emphasize the steadfastness of faith and the boundlessness of courage, conveying a positive and uplifting force. Although alliteration (consonant repetition, note: differentiated from the above “alliteration” in a broader sense) and assonance (vowel repetition) are used relatively less frequently in English speeches, their proper application can enrich the layers of phonetic expression. Alliteration (consonant-focused) emphasizes the repetition of consonants; for example, “clear and concise” repeats the consonant “c,” making the expression more rhythmic. Assonance focuses on the repetition of vowels; for example, “bright and light” repeats the vowel “i,” rendering the pronunciation more harmonious and pleasant.

4. Conclusion

Rhetoric helps enhance the appeal of language expression, strengthens the persuasiveness and logic of viewpoints, and has always played a crucial role in various processes that require language expression and communication. In college students’ public speaking competitions, it is also necessary to learn and apply these techniques to materialize abstract viewpoints, popularize complex ideas, establish emotional resonance with the audience, and improve the quality and standard of speeches. Based on the above, from the language perspective, rhetorical devices can be divided into three categories: semantic rhetorical devices, syntactic rhetorical devices, and phonological rhetorical devices. These three categories optimize speech expression from different dimensions. Of course, college students should grasp correct semantic relationships, select appropriate syntactic structures, and master diverse phonological features when applying them. In the future, they will further deepen the application of these techniques to improve their speaking ability and overall quality.

Disclosure statement

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An Experimental Study on the Impact of Sports Dance Exercise on College Students' Mental Health

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Abstract: This study explores the impact of sports dance exercise on college students' mental health through a controlled experiment. Sixty non-physical education major students from a university were selected and randomly divided into an experimental group (30 students, receiving 12 weeks of sports dance training) and a control group (30 students, maintaining their original lifestyle). The Symptom Checklist-90 (SCL-90) was used to measure the mental health level of the two groups before and after the experiment. The results showed that after the experiment, the total score of SCL-90 and the scores of each factor (including somatization, obsession-compulsion, interpersonal sensitivity, depression, anxiety, hostility, phobic anxiety, paranoid ideation, and psychoticism) in the experimental group were significantly lower than those in the control group ($p < 0.05$), and there was also a significant decrease in the experimental group when comparing its own pre-experiment and post-experiment scores ($p < 0.01$). The conclusion indicates that regular sports dance exercise can effectively improve college students' mental health, alleviate various negative psychological symptoms, and is an effective means to promote college students' mental health. It is suggested that colleges and universities should widely promote sports dance courses.

Keywords: Sports dance; College students; Mental health; SCL-90; Experimental study

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1. Introduction

As a sports event with strong appreciation and high competitiveness, sports dance has been established as a compulsory course for dance majors in many institutions of higher education. College students are in a critical period of physical and mental development, and they face multiple pressures such as academic studies, employment, and interpersonal relationships, leading to increasingly prominent mental health issues^[1]. Seeking positive and effective psychological intervention approaches has thus become an important topic in higher

education. As a form of exercise that integrates artistic expressiveness and physical fitness functions, sports dance, with its rhythmic features, social attributes, and the characteristic of coordinating the body and mind, is believed to have unique value in emotional regulation ^[2]. This study aims to empirically test the effect of regular sports dance exercise on improving specific dimensions of college students' mental health through a rigorous controlled experimental design, thereby providing a scientific basis for mental health promotion work in colleges and universities.

2. Research objects and methods

2.1. Research objects

Sixty college students (aged 19–22 years old) were recruited from a university, who met the following criteria: non-physical education majors, no history of regular dance training, and voluntary participation. They were divided into two groups using the random number table method: Experimental group ($n = 30$): 12 males and 18 females; and Control group ($n = 30$): 14 males and 16 females.

There were no significant differences between the two groups in terms of gender, age, or baseline SCL-90 scores ($p > 0.05$), indicating comparability. No participants dropped out during the experiment.

2.2. Research methods

- (1) Experimental design: A randomized controlled trial (RCT) was adopted.
- (2) Intervention protocol:
 - (a) Experimental group: Received 12 weeks of sports dance training, with 3 sessions per week and 90 minutes per session. The training covered basic dance styles such as waltz, cha-cha-cha, and rumba, and included four phases: warm-up (15 minutes), technical teaching and practice (50 minutes), routine combination and expressiveness training (20 minutes), and cool-down (5 minutes). Professional sports dance teachers conducted the training, ensuring a moderate exercise intensity (heart rate controlled at 60–75% of the maximum heart rate).
 - (b) Control group: Maintained their original study and living habits, without any systematic dance training or additional exercise intervention.
- (3) Assessment tool: The widely used Symptom Checklist-90 (SCL-90) was employed. This scale consists of 90 items, covering 9 factors (somatization, obsessive-compulsive symptoms, interpersonal sensitivity, depression, anxiety, hostility, phobic anxiety, paranoid ideation, and psychoticism) and 1 general symptom index. A 5-point Likert scale was used for scoring (1 = “none” to 5 = “severe”), where higher scores indicate more severe mental health problems. The scale has good reliability and validity. All participants were assessed one week before the experiment (T0) and within one week after the experiment (T1).
- (4) Data processing: SPSS 26.0 software was used for statistical analysis. Measurement data were expressed as mean \pm standard deviation (SD). An independent samples t -test was used for inter-group comparisons, and a paired samples t -test was used for intra-group pre-post comparisons. The significance level was set at $\alpha = 0.05$.

3. Research results

3.1. Intra-group comparisons

Experimental group: After 12 weeks of sports dance exercise, the total score of SCL-90 and the scores of all 9 factors in the experimental group were significantly lower than those before the intervention ($p < 0.01$), indicating a comprehensive improvement in their mental health status (**Table 1**). Control group: There were no significant changes in the total SCL-90 score or the scores of each factor in the control group between the pre-test and post-test ($p > 0.05$).

3.2. Inter-group comparisons

(1) Pre-test (T0): There were no significant differences in the total SCL-90 score or the scores of each factor between the two groups ($p > 0.05$), indicating consistent baselines.

(2) Post-test (T1): The total SCL-90 score and the scores of all 9 factors in the experimental group were significantly lower than those in the control group ($p < 0.05$) (**Table 1**).

Among these, the improvement in the factors of depression, anxiety, and interpersonal sensitivity was particularly notable.

Table 1. Comparison of total SCL-90 score and scores of each factor between the two groups of college students (mean \pm SD)

Indicator	Group	Pre-test (T0)	Post-test (T1)	Intra-group comparison (T1 vs T0) p -value	Inter-group comparison (T1) p -value
Total score of SCL-90	Experimental group	145.83 \pm 20.76	118.27 \pm 15.42	0.000	0.001
	Control group	143.60 \pm 22.15	142.13 \pm 21.08	0.452	
Somatization	Experimental group	1.58 \pm 0.42	1.32 \pm 0.31	0.000	0.012
	Control group	1.55 \pm 0.38	1.54 \pm 0.37	0.802	
Obsessive-Compulsive	Experimental group	1.92 \pm 0.48	1.61 \pm 0.35	0.000	0.005
	Control group	1.90 \pm 0.45	1.88 \pm 0.44	0.678	
Interpersonal sensitivity	Experimental group	1.85 \pm 0.41	1.48 \pm 0.29	0.000	0.000
	Control group	1.83 \pm 0.39	1.81 \pm 0.38	0.735	
Depression	Experimental group	1.78 \pm 0.46	1.35 \pm 0.33	0.000	0.000
	Control group	1.76 \pm 0.42	1.74 \pm 0.41	0.715	
Anxiety	Experimental group	1.65 \pm 0.39	1.28 \pm 0.27	0.000	0.000
	Control group	1.63 \pm 0.36	1.62 \pm 0.35	0.826	
Hostility	Experimental group	1.53 \pm 0.35	1.26 \pm 0.28	0.000	0.008
	Control group	1.52 \pm 0.33	1.51 \pm 0.32	0.791	
Phobic anxiety	Experimental group	1.42 \pm 0.31	1.19 \pm 0.23	0.000	0.018
	Control group	1.40 \pm 0.30	1.39 \pm 0.29	0.855	
Paranoid ideation	Experimental group	1.48 \pm 0.34	1.24 \pm 0.26	0.000	0.010
	Control group	1.47 \pm 0.32	1.46 \pm 0.31	0.812	
Psychoticism	Experimental group	1.38 \pm 0.28	1.16 \pm 0.21	0.000	0.022
	Control group	1.36 \pm 0.27	1.35 \pm 0.26	0.781	

Note: Boldfaced p -values indicate that the differences are statistically significant ($p < 0.05$).

4. Discussion

This experimental study clearly confirms that 12 weeks of regular sports dance training exerts a significant and comprehensive positive effect on improving college students' mental health, and the results support the research hypothesis.

(1) The mind-body synergy effect is remarkable

Sports dance requires a high degree of coordination between body movements, musical rhythms, and emotional expression. This in-depth engagement of both mind and body can effectively divert individuals' excessive attention from negative thoughts and stress ^[3] and promote the release of neurotransmitters such as endorphins and serotonin in the brain ^[4], directly improving emotional states (e.g., significant reduction in depression and anxiety factors). Meanwhile, the moderate exercise intensity effectively alleviates somatization symptoms (e.g., feelings of fatigue, muscle tension, etc.).

(2) Social connection is strengthened

The inherent paired or group form of dance requires participants to engage in eye contact, physical coordination, and emotional interaction. The significant improvement in the "interpersonal sensitivity" factor among the experimental group confirms the unique value of sports dance as a form of "non-verbal social interaction" ^[5]. Such positive social interactions help college students establish a sense of belonging, reduce loneliness and social anxiety, and enhance social confidence.

(3) Self-efficacy is enhanced

The process of learning new dance steps, mastering complex routines, and completing elegant performances constitutes a continuous "challenge-success" cycle. The improvement in factors such as "obsession-compulsion," "hostility," and "paranoia" among the experimental group is partly attributed to the sense of control and accomplishment gained through skill mastery ^[6], which helps break the cycle of negative thinking and enhances psychological resilience in coping with stress.

(4) Emotional catharsis through artistic expression

Dance serves as a non-verbal channel for emotional expression and catharsis. Expressing inner emotions (especially those difficult to verbalize) through physical movements provides college students with a healthy outlet for emotions, helping to reduce the intensity of emotions such as anxiety and hostility (as reflected in the significant decrease in scores of relevant factors).

5. Conclusions and recommendations

5.1. Conclusions

Through a randomized controlled experiment, this study confirms that regular sports dance exercise (3 times a week, 90 minutes each time, lasting 12 weeks) can effectively and comprehensively promote the mental health of college students. The mechanism lies in the combined effects of the physical and mental benefits of exercise itself, the unique social interaction of dance, the sense of accomplishment brought by skill mastery, and the emotional catharsis of artistic expression. These factors significantly alleviate various psychological symptoms, including depression, anxiety, interpersonal sensitivity, and somatization.

5.2. Recommendations

- (1) Incorporate into the curriculum system: Colleges and universities should proactively offer sports dance as a public physical education elective course or a compulsory module, increase the supply of such

courses, and enable more students to benefit from them.

- (2) Enrich extracurricular activities: Support the establishment of sports and dance associations and clubs, regularly organize workshops, experience classes, dance parties, and on-campus competitions, and foster a campus dance culture atmosphere.
- (3) Integrate into psychological services: The psychological counseling centers of colleges and universities can recommend or use sports dance as an auxiliary method for group psychological counseling or stress management training.
- (4) Strengthen faculty development: Cultivate and introduce faculty members with dual competencies in sports and art to ensure the quality of teaching.
- (5) Deepen research and exploration: Future research may focus on the differences in intervention effects between different dance styles (e.g., Latin dance vs. ballroom dance), different exercise frequencies/durations, long-term effects, and interventions targeting specific psychological issues (e.g., social anxiety).

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Teaching Reform of the Course “Fundamentals of Mechanical Engineering Control” Based on the Theory of “Knowledge Visualization”

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Abstract: In recent years, with the proposal and implementation of the intelligent manufacturing strategy, mechanical engineering control theory has become the core support for the intelligent upgrading of equipment. However, as a core course for mechanical majors, “Fundamentals of Mechanical Engineering Control” features a strong theoretical and abstract nature. The traditional teaching mode easily leads to difficulties in students’ understanding and insufficient learning interest. “Knowledge visualization” can present the abstract knowledge in the course in visual forms such as graphics, images, and animations, helping students better understand and master the course content, thereby fully stimulating their learning interest, improving their learning effects, and effectively cultivating their innovative and practical abilities. In this regard, this paper first expounds on the significance of the teaching reform of the course “Fundamentals of Mechanical Engineering Control” based on the theory of “Knowledge Visualization”, and then proposes effective reform strategies, aiming to provide certain references for relevant researchers.

Keywords: Knowledge visualization; Fundamentals of mechanical engineering control; Teaching; Reform strategies

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1. Significance of teaching reform for the course “Fundamentals of Mechanical Engineering Control” based on the theory of “Knowledge Visualization”

1.1. Conducive to changing students’ cognitive attitudes

The teaching reform based on the “knowledge visualization” theory can transform abstract knowledge into vivid graphics, images, animations and other forms. This enables students to contact and understand the course content more intuitively, no longer feeling that knowledge is out of reach. When students can clearly see the operation process of the control system and the interaction between various links through visualization, they will gradually shift from passively accepting knowledge to actively exploring it ^[1]. This change in cognitive attitude will stimulate students’ learning enthusiasm and make them more willing to invest time and energy

in an in-depth study of the course content. In addition, this visual teaching method can also cultivate students' innovative thinking. When students can understand knowledge from a new perspective, they are more likely to find problems and put forward new ideas. In the process of observing visual models and animations, students may associate them with relevant phenomena in real life, thereby connecting theoretical knowledge with practical applications, which enables them to better adapt to the needs and changes of the industry ^[2].

1.2. Conducive to optimizing the presentation of course knowledge

Most traditional teaching models use texts and static pictures to teach knowledge, but it is difficult to comprehensively and intuitively present the complex knowledge points in the “Fundamentals of Mechanical Engineering Control” course to students. The “knowledge visualization” theory can transform complex and difficult-to-understand concepts and principles in the course into vivid visual models. For example, for the feedback link of the control system, the process of how the feedback signal changes the system output is drawn into an animation, allowing students to intuitively feel how the feedback principle works, thus breaking the dullness and incomprehensibility of textual narration in traditional teaching methods. In addition, knowledge visualization tools such as mind maps and concept maps can be used to sort out the knowledge points of the “Fundamentals of Mechanical Engineering Control” course. These visualization tools can help students clarify the connections and hierarchical structures between various knowledge points, assist them in building a more complete course framework, facilitate their understanding and memory of knowledge points, enable them to better accept and absorb knowledge points, and further enhance the teaching effectiveness of the “Fundamentals of Mechanical Engineering Control” course ^[3].

2. Teaching reform strategies for the course “Fundamentals of Mechanical Engineering Control” based on the “Knowledge Visualization” theory

2.1. Visual reconstruction of teaching content

(1) Systematically organize core knowledge

Teachers should sort out the key and difficult points in the course “Fundamentals of Mechanical Engineering Control”, such as system composition, transfer functions, and time-domain analysis methods, and classify and arrange each knowledge point according to difficulty level, logical relationship, etc. At the same time, combined with the abstraction level and comprehension difficulty of the involved content, they should identify the course knowledge that needs visualization processing, to improve learning efficiency ^[4].

(2) Adopt appropriate methods to visualize different types of knowledge points

For example, for abstract course knowledge such as the principle of feedback control, using visual flowcharts and dynamic videos to describe it can not only intuitively show the information transmission path and feedback part, but also dynamically display the operation of the system, allowing students to more intuitively perceive the control effect. For complex concepts and principles like Laplace transformation and transfer functions, graphical methods can also be used for explanation. For instance, drawing function curves to reflect the impact of various parameters on system performance helps students understand their corresponding physical connotations ^[5].

(3) Realize visual teaching through real engineering cases

Teachers should select highly representative mechanical engineering cases based on the course content,

such as robot mobile control systems and CNC machine tool propulsion control systems, and visually present their working principles and structures through real-scene pictures, videos, 3D models, etc., enabling students to flexibly apply control systems in practical work and learn how to use the acquired principles to analyze and design such systems. In addition, teachers should guide students to combine theoretical knowledge with practical cases to enhance their problem-solving abilities ^[6].

2.2. Digital transformation of teaching methods

(1) Introduce virtual simulation experiments

Teachers should make full use of virtual simulation technology to build an experimental platform for mechanical engineering control systems, allowing students to operate personally on the platform, change the experimental environment and the structure of the experimental system, and observe the results of system motion responses without worrying about equipment damage in the experimental environment or cost issues. For example, when analyzing the stability of control systems, simulation experiments can be used to intuitively observe changes in system stability under different parameter conditions, understand the concept of stability and its influencing factors, thereby improving students' practical operation efficiency ^[7].

(2) Use online teaching tools to carry out blended teaching

Online teaching tools have resources such as online exams, courseware resources, and electronic textbooks. Teachers can upload the basic knowledge points of mechanical engineering control to online platforms, so that students can preview independently before class and master basic theoretical knowledge and skills. In offline classes, teachers focus on solving the problems encountered by students during self-study and conduct further analysis and discussion, thereby improving the efficiency and quality of classroom learning. In addition, online learning platforms can also record students' learning processes and data materials. Teachers conduct accurate analysis and evaluation of their learning processes based on relevant information, and propose targeted learning plans based on the analysis and evaluation results ^[8].

(3) Use artificial intelligence technology to realize intelligent tutoring

Artificial intelligence technology can provide intelligent tutoring and feedback based on students' learning situations and problems. For example, an intelligent tutoring system can understand the questions raised by students through natural language processing technology and provide accurate answers and guidance. In addition, artificial intelligence can also conduct real-time monitoring and evaluation of students' learning processes. When it finds that students have learning difficulties or lag behind in learning progress, it promptly reminds teachers and students and provides corresponding learning strategies and suggestions ^[9].

2.3. Diversification of knowledge visualization tools

To facilitate the orderly implementation of the "Fundamentals of Mechanical Engineering Control" course, teachers can introduce diversified knowledge visualization tools.

(1) Concept mapping tools

This visual learning tool can show students the logical relationships between different course topics, enabling them to clarify the course framework. When teaching complex course knowledge, teachers

can use concept maps to intuitively describe theorems, formulas, and application backgrounds in the knowledge, allowing students to visually perceive the logical relationships between knowledge points, thereby helping them understand and memorize course knowledge efficiently ^[10].

(2) Animation demonstration tools are also very effective

For dynamic processes in mechanical engineering control, such as system response and signal transmission, animations can present abstract theories vividly and intuitively. Students can more directly observe the operation of the system under different conditions, thereby better understanding control principles. Teachers can use professional animation production software or search for relevant high-quality animation resources online to serve teaching ^[11].

(3) Adopt virtual reality (VR) technology, augmented reality (AR) technology, etc.

This is to present the teaching process digitally and intelligently. Using VR technology, teachers can enable students to experience the operation of mechanical control systems without leaving the classroom, entering an immersive learning state. At the same time, it can also map virtual information to the real environment; for example, in the laboratory, students can use VR technology to access the operation guidelines and data information of physical objects, thereby improving the accuracy and convenience of operational practice ^[12].

2.4. Diversified innovation in assessment methods

(1) Appropriately increase the proportion of usual grades and experiment report scores

Regular assignments can help students consolidate the knowledge learned in class and cultivate their autonomous learning and problem-solving abilities. Teachers should create real-world scenarios to enable students to flexibly apply the knowledge they have mastered to solve problems. Experiment reports can test students' practical operation ability and understanding of basic experimental knowledge. At the end of the experiment, students are required to sort out and analyze experimental data and write experiment reports, including the experimental purpose, process, results, as well as their own experiences and reflections ^[13].

(2) Introduce project-based evaluation methods

Teachers can set up questions related to actual engineering projects and guide students to complete them in groups, including project planning, model construction, model simulation, etc. This is of great help in cultivating students' cooperative communication ability and engineering practice ability, and can also stimulate their innovative awareness. After the project is completed, the project is evaluated through group reports and defenses, and other groups and teachers are invited to evaluate the project and put forward questions, which can enhance teacher-student interaction and learning effects ^[14].

(3) Introduce online quizzes, which are more real-time and flexible

Teachers can arrange exam times according to teaching needs and obtain students' score information on time. Moreover, the exam content can be set as multiple-choice questions, fill-in-the-blank questions, short-answer questions, etc., to test students' mastery and understanding of knowledge from various angles. The online quiz platform can automatically calculate exam scores and issue analysis reports, enabling teachers to accurately grasp students' learning status. Evaluating students through the above diversified evaluation methods can make teaching evaluation more comprehensive and objective, thereby promoting the all-round development of students ^[15].

3. Conclusion

In summary, the teaching reform of the “Fundamentals of Mechanical Engineering Control” course based on the “knowledge visualization” theory is of far-reaching significance. This reform not only helps to change students’ cognitive attitudes, enabling them to move from passive learning to active exploration, but also optimizes the way course knowledge is presented, breaking the limitations of traditional teaching, thereby comprehensively enhancing the effectiveness of course teaching. To this end, teachers can start with strategies such as the visual reconstruction of teaching content, the digital transformation of teaching methods, the diversification of knowledge visualization tools, and the diversified innovation of assessment methods, to cultivate more high-quality mechanical engineering professionals who meet the needs of the intelligent manufacturing era and inject strong impetus into the development of my country’s mechanical engineering field. In the future, teachers should also be encouraged to carry out relevant teaching research and practical exploration, share teaching reform experience, form a good teaching reform atmosphere, and promote the improvement of the teaching quality of the entire mechanical engineering major.

Disclosure statement

The authors declare no conflict of interest.

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Exploration of the Path of AI-Empowered Innovation and Entrepreneurship Education in Colleges and Universities

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Abstract: Currently, we have entered the AI era, against which college and university innovation and entrepreneurship education have also ushered in new opportunities for reform. In this regard, this paper conducts an in-depth analysis of AI-empowered innovation and entrepreneurship education in colleges and universities. By dissecting the internal mechanism of AI empowering college and university innovation and entrepreneurship education, it sorts out in detail the dilemmas faced in the previous process of college and university innovation and entrepreneurship education. Finally, it puts forward targeted and effective implementation paths, aiming to provide some references for the reform of college and university innovation and entrepreneurship education.

Keywords: Artificial intelligence (AI); Colleges and universities; Innovation and entrepreneurship education

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1. Introduction

Against the backdrop of the AI era, science and technology are developing at a rapid pace and penetrating various fields at an unprecedented speed, bringing profound changes to people's lifestyles and production methods^[1]. As an important base for cultivating professional talents in China, colleges and universities undertake the important task of providing innovative talents for society and the country. Nowadays, innovation and entrepreneurship education has become an important part of college and university teaching, playing a crucial role in cultivating students' innovative ability, practical ability, and entrepreneurial awareness. However, there are many problems in the previous innovation and entrepreneurship education in colleges and universities, which have seriously affected the improvement of students' innovative ability. In this regard, under the background of the AI era, colleges, universities, and teachers should keep up with the development trend of the times, make full use of the powerful functions of AI to improve the effect and quality of innovation and entrepreneurship education, and cultivate students into high-quality innovative talents needed for the

development of society and the country.

2. The internal mechanism of artificial intelligence empowering innovation and entrepreneurship education in universities

2.1. Data-driven precision education

Artificial intelligence (AI) possesses robust data collection and analysis capabilities, enabling the collection and analysis of various types of student data ^[2]. Based on this, teachers can accurately understand the diverse needs of students and provide them with targeted education and guidance, thereby laying a foundation for enhancing the effectiveness of innovation and entrepreneurship education.

2.2. Intelligent interactive immersive learning experience

AI encompasses technologies such as virtual reality (VR) and augmented reality (AR). When applied to innovation and entrepreneurship education, these technologies can create a variety of virtual learning environments for students, allowing them to gain a profound understanding of the innovation and entrepreneurship process and enrich their practical experience ^[3]. Meanwhile, intelligent interactive systems can also realize real-time interaction between students and virtual characters, bringing students an immersive learning experience. This effectively stimulates students' interest in participation and mobilizes their enthusiasm.

2.3. Intelligently assisted decision support

In the process of innovation and entrepreneurship, scientific and sound decision-making is crucial. Against the backdrop of the AI era, AI's powerful functions can be utilized to analyze and process large volumes of market data, industry trends, and practical cases, thereby providing guidance for entrepreneurs in making decisions ^[4]. Introducing AI decision-making systems into university innovation and entrepreneurship education can cultivate students' decision-making thinking, strengthen their innovation awareness, and improve their decision-making capabilities, laying a foundation for their future participation in innovation and entrepreneurship activities.

2.4. Optimization of resource integration and sharing

AI can also realize the integration and sharing of resources. Due to various factors such as geography, environment, transportation, and economy, there are certain disparities in innovation and entrepreneurship education resources among different universities, which leads to differences in the educational services available to students from different universities ^[5]. However, in the context of AI, an intelligent educational resource platform can be built to integrate and share internal and external innovation and entrepreneurship resources. This not only greatly improves resource utilization efficiency but also significantly enhances educational equity, laying a foundation for students' all-round development in the future.

3. Difficulties in innovation and entrepreneurship education in colleges and universities in the past

3.1. Unbalanced allocation of resources

Affected by various factors such as geography, economy, and environment, there exists a phenomenon of unbalanced allocation of innovation and entrepreneurship education resources among colleges and

universities of different levels and different majors ^[6]. Specifically, some key universities or “Double First-Class” universities are often able to obtain more resource support, such as financial appropriations, corporate sponsorships, and alumni donations. In contrast, ordinary undergraduate universities, especially newly established ones, often face problems such as insufficient funds, outdated equipment, and limited venues, which affect the improvement of the effectiveness of innovation and entrepreneurship education. This unbalanced resource allocation directly leads to inequality among students from different universities and majors in receiving innovation and entrepreneurship education, thereby affecting the enhancement of students’ innovation and entrepreneurship capabilities.

3.2. Monotonous teaching methods

At present, some colleges and universities still adopt traditional and monotonous teaching models for innovation and entrepreneurship education, focusing on classroom lectures. Under this teaching model, students often remain in a state of passive acceptance; their enthusiasm and initiative can hardly be fully aroused, and there is a lack of interaction between teachers and students. The classroom atmosphere is dull and oppressive, which seriously affects the improvement of the effectiveness and quality of innovation and entrepreneurship teaching. In this regard, in the era of artificial intelligence, colleges and universities should keep up with the development trend of the times, promptly optimize and innovate teaching models, and adopt various methods and means to stimulate students’ interest in learning and more effectively cultivate students’ innovation and entrepreneurship capabilities.

3.3. Lack of practical guidance

Essentially, innovation and entrepreneurship education is a highly practical and operational educational activity that requires providing students with sufficient practical platforms and opportunities ^[7]. However, in reality, some colleges and universities have the phenomenon of “emphasizing theory over practice” when carrying out innovation and entrepreneurship education. They do not attach importance to practical teaching and neglect the cultivation of students’ practical abilities. On the one hand, some teachers in colleges and universities lack entrepreneurial experience and cannot provide students with scientific and reasonable practical guidance; on the other hand, the construction of on-campus innovation and entrepreneurship practice bases is lagging, and university-enterprise cooperation remains superficial. This lack of practical guidance makes innovation and entrepreneurship education a mere formality, thus seriously affecting the improvement of students’ practical abilities and innovative capabilities.

3.4. Lagging development of faculty teams

Teachers are not only important participants and organizers of curriculum teaching but also key factors in ensuring the quality of innovation and entrepreneurship education ^[8]. However, the development of faculty teams in some colleges and universities is relatively lagging, which seriously affects the improvement of the quality of innovation and entrepreneurship education. First, the number of teachers specializing in innovation and entrepreneurship is insufficient, which cannot meet the needs of carrying out innovation and entrepreneurship education in colleges and universities. Second, teachers lack practical experience in innovation and entrepreneurship, and also lack access to specialized training opportunities, resulting in their low level of practical teaching and difficulty in effectively improving the effect of practical teaching. Finally, the structure of

the faculty team is unreasonable, with a low proportion of interdisciplinary and compound teachers. In addition, the incentive mechanism is imperfect, leading to low enthusiasm among teachers. This lag in the development of faculty teams directly affects the professional level and teaching quality of innovation and entrepreneurship education and has become a bottleneck restricting the development of innovation and entrepreneurship education.

4. Implementation paths for artificial intelligence empowering innovation and entrepreneurship education in universities

4.1. Building an intelligent education platform

4.1.1. Integrating educational resources

Against the backdrop of the artificial intelligence era, universities should fully leverage the advantages of AI to build an innovation and entrepreneurship education platform that integrates multiple functions such as curriculum teaching, case analysis, and practical guidance^[9]. By integrating and sharing high-quality internal and external innovation and entrepreneurship resources, the platform can provide teachers and students with high-quality and diverse learning resources, thereby laying a foundation for enhancing the effectiveness of innovation and entrepreneurship education. For instance, it can integrate innovation and entrepreneurship courses from well-known domestic and foreign universities, entrepreneurs' experience sharing on entrepreneurship, classic cases, and more. This allows students to access high-quality innovation and entrepreneurship education simply by logging into the platform, exposing themselves to cutting-edge knowledge and concepts, strengthening their cognition, and ultimately improving the effectiveness of innovation and entrepreneurship education.

4.1.2. Providing personalized services

Intelligent education platforms possess powerful data processing and analysis capabilities. They can comprehensively collect and analyze students' learning data, and provide personalized learning services based on the analysis results^[10]. The platform can intelligently push learning materials (such as teaching videos and cases) to students according to their interests, level of knowledge mastery, and aspirations. Meanwhile, the platform can also offer intelligent learning guidance and support to help students solve various problems encountered in the learning process.

4.1.3. Creating a virtual practical environment

Additionally, the powerful functions of the intelligent education platform can be utilized to create virtual practical scenarios. This enables students to conduct practical operations and training in virtual and realistic environments, thereby effectively cultivating their practical abilities. For example, students can carry out activities such as market research, product promotion, and business plan formulation in the virtual environment, which helps to effectively develop their innovation and entrepreneurship capabilities.

4.2. Innovating teaching models

Against the backdrop of the artificial intelligence era, traditional innovation and entrepreneurship education models can hardly meet the needs of students' development. In response, teachers need to innovate and optimize these models.

4.2.1. Blended teaching

Teachers can closely integrate information technology with innovation and entrepreneurship education, and adopt a blended teaching model to stimulate students' interest in learning and enhance the effectiveness of innovation and entrepreneurship education. In online teaching, teachers can leverage the advantages of intelligent education platforms to provide students with rich learning resources, enabling them to conduct independent learning and preview. In the offline phase, teachers can use methods such as group cooperation and case analysis to help students understand and master knowledge more deeply, and promote the development of their innovative awareness.

4.2.2. Project-based teaching

Teachers can also apply the project-based teaching method to innovation and entrepreneurship education. Based on students' academic performance and combined with teaching content, they can design challenging and practical project tasks (e.g., analyzing the flower market) to cultivate students' innovation and entrepreneurship capabilities. In specific practice, teachers can guide students to conduct on-site research in the flower market, communicate in-depth with market owners to obtain first-hand information, and analyze flower sales data from various sales platforms, thereby formulating more feasible business plans for flower-related entrepreneurship. The application of this teaching model can effectively cultivate students' practical abilities and their ability to solve problems independently, laying a solid foundation for their all-around development in the future.

4.3. Strengthening practical guidance

4.3.1. Building a practical mentor database

Colleges and universities can carry out in-depth cooperation with enterprises, industries, and social organizations, and invite outstanding entrepreneurs and industry elites to serve as practical guidance teachers in the schools, thereby building a practical mentor database. With rich practical experience, these practical mentors can provide students with comprehensive and realistic entrepreneurship guidance, helping them solve various problems encountered in the entrepreneurial process.

4.3.2. Conducting innovation and entrepreneurship practical activities

Colleges and universities can cooperate in-depth with enterprises and industrial parks to organize and carry out various types of entrepreneurial practical activities, and guide students to participate in them to cultivate their practical abilities. For example, they can organize students to participate in entrepreneurship competitions, entrepreneurial internships, and entrepreneurship incubation camps, providing sufficient opportunities for students to practice. During practice, students can apply the knowledge and skills they have learned to real scenarios, accumulate entrepreneurial experience, and effectively improve their own innovation and entrepreneurship capabilities.

4.3.3. Establishing entrepreneurship incubation bases

In addition, colleges and universities can integrate resources and actively establish entrepreneurship incubation bases to provide sufficient platforms and opportunities for students' practice. These incubation bases can offer students one-stop services such as facilities and equipment, financial support, and office spaces, helping them reduce entrepreneurial costs and improve the success rate of entrepreneurship. At the same time, the incubation bases can introduce professional entrepreneurial service institutions to provide students with services in aspects

such as law, finance, and marketing, thereby supporting students' successful entrepreneurship.

4.4. Strengthening faculty team development

4.4.1. Improving the faculty training mechanism

Colleges and universities should keep pace with the times and continuously improve their faculty training mechanisms. They can regularly organize teachers to participate in specialized training programs on innovation and entrepreneurship education. The training content includes, but is not limited to, teaching methods, theoretical knowledge of innovation and entrepreneurship, and practical guidance. Through such initiatives, teachers' concepts can be updated and their practical teaching capabilities enhanced.

4.4.2. Refining the incentive mechanism

Colleges and universities should also establish and improve an incentive mechanism to motivate teachers to actively participate in innovation and entrepreneurship education activities. For example, appropriate rewards (such as bonuses and certificates) can be given to teachers who have achieved certain results in innovation and entrepreneurship education; policy preferences can be provided in aspects like award selection and evaluation, as well as professional title assessment; and more support for scientific research and project funds can be offered to teachers.

4.4.3. Enhancing talent recruitment efforts

Colleges and universities should also formulate and improve talent recruitment plans, and actively introduce outstanding talents with rich entrepreneurial experience and profound industry backgrounds to serve as teachers in innovation and entrepreneurship education. This will help optimize the structure of the faculty team and elevate the overall quality of the teaching staff.

5. Conclusion

In summary, against the backdrop of the artificial intelligence era, innovation and entrepreneurship education in colleges and universities has also ushered in new opportunities for reform. In this context, colleges and universities should conduct an in-depth analysis of the internal mechanisms through which artificial intelligence empowers innovation and entrepreneurship education. Based on their actual conditions and in alignment with future development goals, they should adopt various methods and measures to improve the effectiveness of innovation and entrepreneurship education, cultivate students' innovative capabilities and adaptability, and enable them to become interdisciplinary talents who meet the needs of social and national development in the future.

Disclosure statement

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Exploration and Reflection on Cross-Culturally Oriented Integration of Ideological and Political Elements into German Language Teaching: Evidence from the Sino-German Cooperative Mechanical Engineering Program

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Abstract: *Objective:* Against the backdrop of advancing Sino-foreign cooperative education and national “Curriculum Ideology and Politics” initiatives, this study explores the integration of ideological and political elements into German language teaching in Sino-German cooperative mechanical engineering programs. The paper framework covers three core parts: analyzing the necessity (aligning with the “Manufacturing Power” strategy and addressing students’ cross-cultural value challenges) and advantages (German original textbooks, multi-cultural foreign faculty) of the integration; presenting two practical teaching cases (a textbook-based craftsmanship seminar and a cross-cultural interview activity); and summarizing outcomes and proposing future optimization directions. *Methods:* It adopts a case study approach, taking the Sino-German Cooperative Program in Mechanical Design, Manufacturing, and Automation at Qilu University of Technology (Shandong Academy of Sciences) as the research object, combining qualitative analysis (textbook element extraction, interview content analysis) and practical teaching verification (activity design, student feedback collection). *Results:* Major findings show that the integration enriches German teaching content, enhances students’ cultural identity, national confidence, and intercultural communication skills, and provides a replicable paradigm for foreign language Curriculum Ideology and Politics in educational opening-up contexts.

Keywords: Sino-German cooperative education programs; German language teaching; Curriculum ideology and politics; Cross-cultural integration

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1. Introduction

In recent years, as a crucial component of educational philosophy, “Curriculum Ideology and Politics” (a

concept referring to the integration of ideological and political education into professional courses) has been gradually integrated into the teaching systems of various disciplines, emerging as a key direction in higher education reform. In 2020, the Ministry of Education of the People's Republic of China issued the Guidelines for the Construction of Curriculum Ideology and Politics in Institutions of Higher Education (hereinafter referred to as the "Guidelines"). The document explicitly states that comprehensively advancing the construction of Curriculum Ideology and Politics is a strategic measure to implement the fundamental task of "fostering virtue through education," the core goal of China's education system, which prioritizes moral cultivation alongside knowledge impartment ^[1].

The Guidelines not only highlight the importance of ideological and political education but also stress the need to promote the organic integration of Curriculum Ideology and Politics with professional courses, while fully reflecting the characteristics of specific disciplines. The implementation of Curriculum Ideology and Politics is not merely a supplement to educational content, but an in-depth reflection on and expansion of educational objectives. This process requires university teachers to proactively adjust their educational concepts, to continuously innovate teaching methods, and to integrate the elements of Curriculum Ideology and Politics into classroom teaching naturally and effectively ^[2]. By doing so, it aims to enhance students' cultural identity and national self-confidence, help them establish a correct worldview, outlook on life, and values, and comprehensively improve their overall quality.

With the deepening of international exchanges and cooperation, there is a growing demand for high-quality, globally competent foreign language professionals. Against this backdrop, Sino-foreign cooperative education programs in Chinese universities have rapidly developed and expanded in recent years. As a compulsory component of cooperative programs between Chinese and German universities, German language courses directly influence students' prospects for further study abroad and career development. Therefore, the implementation of ideological and political education through German courses in Sino-German cooperative programs bears significant meaning and unique advantages.

The Sino-German Cooperative Program in Mechanical Design, Manufacturing and Automation at Qilu University of Technology (Shandong Academy of Sciences) (hereinafter the Sino-German Program in Mechanical Engineering) has admitted students since 2014. Over more than a decade of development, it has sent over a hundred students to Germany for further studies. Taking this program as a case study, this study systematically explores concrete pathways and practical strategies for the integration of ideological and political elements into German language teaching within Sino-German cooperative education programs.

2. Analysis of the necessity for the implementation of ideological and political education in Sino-foreign cooperative education programs

2.1. The practical need for strengthening ideological and political education in mechanical engineering programs

The Guidelines provide clear directives for the ideological and political development of various specialized programs. For mechanical engineering programs, the focus of Curriculum Ideology and Politics should be on the following dimensions: fostering education on socialism with Chinese characteristics and the Chinese Dream of national rejuvenation, cultivating core socialist values, enhancing awareness of engineering ethics and social responsibility, promoting the excellence-driven "craftsmanship spirit," and inspiring a sense of mission to serve the nation through science and technology and strengthen the country through manufacturing.

Against the backdrop of the national “Manufacturing Power” strategy, mechanical engineering professionals have become core drivers of high-quality development in the manufacturing industry. The quality of their training directly affects the development level and international competitiveness of the country’s modern industrial system. Therefore, the systematic integration of ideological and political elements into professional education, specifically guiding students to align personal development goals with national strategic needs and cultivating interdisciplinary talents equipped with advanced technical expertise, national identity awareness, and professional ethics, has become an imperative requirement for the teaching reform of mechanical engineering programs. The infusion of ideological and political education can effectively awaken students’ sense of mission within the industry and their social responsibility, motivating them to actively contribute to the construction and development of China’s modern industrial system.

2.2. The special significance of strengthening ideological and political education in Sino-foreign cooperative programs

As an important vehicle for the internationalization of higher education, Sino-foreign cooperative programs possess distinct particularities and complexities in their talent development processes, making ideological and political education especially urgent and critical in such programs. Taking the Sino-German Program in Mechanical Engineering as an example, this program is built on an international vision and aims to cultivate high-quality engineering talents who are equipped with both Chinese and German cultural backgrounds and are prepared to meet the demands of multinational enterprises. The program adopts a “3+1” training model (three years of domestic study followed by a fourth year of study in Germany for eligible students), which requires students to not only undergo professional education in China but also complete their studies in Germany, earning bachelor’s degrees from both institutions upon graduation. The vast majority of undergraduate graduates choose to pursue master’s degrees in Germany, remaining in a cross-cultural environment for an extended period.

This educational path poses two major challenges: First, during their studies, students are extensively exposed to Western cultures, modes of thinking, and values, which may lead to cultural shocks and value conflicts, thereby increasing their susceptibility to the influence of certain Western ideologies^[3]. Second, as envoys of Sino-foreign exchanges and future international talents in the engineering field, students’ political stance, cultural identity, and value orientation directly influence the international image of “Made in China” and the depth and quality of long-term technological cooperation between China and Germany. Therefore, compared to regular majors, Sino-foreign cooperative programs have a greater need to firmly implement ideological and political education, strengthening ideological guidance and value shaping for students. This is not only vital for the healthy development of individual students but also a strategic educational project. Through the targeted integration of ideological and political elements, students can enhance their ability to discern ideologies, maintain a Chinese cultural stance while embracing multiculturalism, and strengthen their confidence in the path, theory, system, and culture of socialism with Chinese characteristics while broadening their international perspectives. This enables them to become outstanding engineers with both global competitiveness and a profound sense of national commitment^[4].

3. Analysis of the advantages of implementing ideological and political education in Sino-foreign cooperative programs

The Sino-foreign cooperative education model infuses international elements into professional talent

development while simultaneously creating significant advantages for the implementation of ideological and political education through its unique cross-cultural resources. In-depth exploration and effective utilization of these resources can make ideological and political education more dynamic, multi-dimensional and profound.

3.1. Expanding the scope of curriculum ideology and politics materials through foreign teaching resources

Sino-foreign cooperative programs typically incorporate original professional textbooks from partner institutions abroad, providing a rich and unique repository for ideological and political education. For example, the Sino-German Program in Mechanical Engineering utilizes German original textbooks such as “Konstruktionselemente,” “Sensorik_und_Aktorik,” and “Grundlagen_Messtechnik.” These texts not only complement domestic textbooks in their knowledge systems but also exhibit distinct cultural differences and regional characteristics in their pedagogical approach, case selection, and value orientation.

These imported textbooks serve not only as carriers of specialized knowledge but also as reflections of German engineering culture and professional ethos. Their content often embodies a rigorous and practical scientific attitude, a craftsmanship spirit committed to excellence, a strong sense of professional ethics, and a focus on environmental protection and social responsibility. Chinese German language teachers can actively collaborate with specialized course teachers to extract materials that combine authentic language use with ideological and political educational value. For instance, in the teaching of technical documentation writing, instructors may emphasize the professional integrity reflected in its standardization and precision. When analyzing engineering cases, students can be guided to compare similarities and differences between Chinese and German approaches to standard setting, quality management, and engineering ethics, thereby enhancing their understanding and identification with China’s efforts to promote high-quality development in manufacturing. By transforming original textbooks into high-quality resources for ideological and political education, values-based guidance can be naturally integrated into professional German language teaching, thus realizing the organic unity of knowledge acquisition, language skills enhancement, and values cultivation ^[5].

3.2. Deepening the educational dimensions of curriculum ideology and politics via foreign teachers’ strengths

Rooted in deep collaboration between partner institutions, Sino-foreign cooperative programs typically maintain a regular and high-quality foreign faculty team, which brings multi-faceted perspectives and practical case studies to ideological and political education. Each semester, several full-time German faculty members teach specialized courses in the Sino-German Program in Mechanical Engineering. They serve not only as bridges for students to access cutting-edge professional knowledge but also as windows through which students gain direct exposure to German engineering culture, academic ethos, professional attitudes, and encounters between Chinese and foreign cultures.

Chinese and German language teachers can collaborate with international faculty to integrate their diverse educational backgrounds, professional experiences, and personal narratives into interactive activities. This provides students with authentic scenarios for cross-cultural communication and enables the systematic exploration of ideological and political elements from the following aspects:

- (1) Foreign teachers may be invited to share inspirational stories from their personal growth, academic pursuits, or technical problem-solving, highlighting qualities such as perseverance and innovative courage.
- (2) They can be encouraged to discuss their collaborative experiences with China or personal insights from

working and living in the country, guiding students to perceive China's developmental achievements from an external perspective and enhancing national pride.

- (3) Seminars, debates, or project presentations on topics such as “technology ethics,” “global sustainable development,” or “comparative analysis of Sino-German manufacturing cultures” may be organized in conjunction with current affairs and foreign faculty expertise.

These activities enable students to engage critically with diverse perspectives, consolidate their own viewpoints, and foster enhanced cultural confidence and critical thinking abilities through international dialogue. By effectively integrating foreign faculty resources, Curriculum Ideology and Politics transcends the traditional one-way indoctrination model and transforms into an open value dialogue with the joint participation of multiple subjects, significantly expanding the dimensions of ideological and political education.

4. Teaching practice cases: Integrating ideological and political elements into the basic German course

The Basic German course, offered to first and second-year students in the Sino-German Program in Mechanical Engineering, is designed to systematically develop students' comprehensive German language skills, aiming to achieve levels A1 to B1 of the Common European Framework of Reference for Languages (CEFR). With its extended duration, broad coverage, and frequent teacher-student interaction, the course provides ample opportunity for the organic integration of ideological and political elements. The following two typical teaching activity cases illustrate how the advantages of Sino-foreign cooperative education can be leveraged to achieve value guidance in language teaching.

4.1. Case 1: Themed seminar on “The Spirit of Craftsmanship in Professional Textbooks”

4.1.1. Activity design and implementation

This case was implemented in the second semester of the sophomore year, synchronized with the course Mechanical Design Methods taught by a German faculty member. The selected German original textbook “Konstruktionstechnik - Ausgewählte Maschinen- und Konstruktionselemente III” is not only highly specialized but also reflects the pursuit of precision and standardization inherent in German engineering culture through its content structure and presentation.

The Chinese German language teacher posted a thematic discussion task on the Superstar Learning Platform: “Welche Inhalte im Lehrbuch spiegeln die strenge Arbeitsweise deutscher Ingenieure und ihr höchstes Streben nach Perfektion in den Details wider?” (Which contents in the textbook reflect the rigorous working methods of German engineers and their utmost pursuit of perfection in detail?). The task lasted two weeks, aligning with the teaching period of the international faculty member's module on Mechanical Design Methods. Students were required to identify typical examples embodying German engineering ethics and professional spirit from the textbook while studying Mechanical Design Methods and submit their responses in German via the platform. The task explicitly encouraged students to focus not only on technical content but also on reflecting on the underlying attitudes, standards, and cultural connotations.

In the subsequent Basic German course, the Chinese German language teacher guided students to conduct in-depth discussions around the submitted examples. Students used German to exchange opinions and summarize the professional values embodied in the teaching materials. At the appropriate time, the teacher introduced a clip from The Great Craftsman (a documentary produced by China Central Television,

CCTV), specifically the segment titled Excellence in Craftsmanship. By presenting examples of Chinese craftsmen who also refused to compromise on a 0.01-millimeter error, the Chinese German language teacher facilitated students' dialogue and comparison between Chinese and German engineering cultures. This helped students recognize that “striving for perfection and pursuing excellence“ is a quality shared by outstanding engineers across national borders, thereby strengthening their recognition of and confidence in the high-quality development of “Made in China.“ At the end of the activity, excellent expressions were selected through teacher comments and student mutual evaluation, with incentives provided to the winners.

4.1.2. Outcomes and reflection

During the two-week task period, over thirty valid responses were collected on the platform. Beyond rigorous attitudes, some students identified additional ideological and political elements reflected in the textbook, such as normative awareness and environmental responsibility, demonstrating an enhanced ability to recognize values (Table 1). Classroom discussions were lively, with students not only deepening their understanding of professional German expressions but also strengthening their appreciation of the craftsmanship spirit through cross-cultural comparison.

Table 1. Examples of ideological and political elements identified by students from the German textbook “Konstruktionstechnik - Ausgewählte Maschinen- und Konstruktionselemente III”

Element	Original content	Chapter & page
Precise calculation	Die Größe der Reibungskraft hängt ab von Umschlingungswinkel β und Reibungszahl μ : $F_1 = F_2 \cdot e^{(\mu\beta)}$. To ensure transmission efficiency and prevent slippage in belt drives, engineers must precisely calculate parameters such as wrap angle, coefficient of friction, and tension. To this end, the textbook equips engineers with exact formulas and standards for geometric, mechanical, and kinematic parameters across various transmission components, reflecting its rigorous pursuit of “quantitative design.” The textbook specifies exact formulas and standards for the geometric, mechanical, and kinematic parameters of various transmission components (e.g., belt, chain, and gear drives), thus reflecting a rigorous pursuit of “quantitative design.”	1.1.3 Berechnung der kraftschlüssigen Übertragung, p. 11–14
Scientific and rigorous material selection	Man verwendet: -Grauguss und Temperguss für leichte Beanspruchung, -Stahlguss und unlegierten Stahl für mittlere Beanspruchung, -Vergütungs- und Einsatzstähle für hohe Beanspruchung... The textbook establishes its material selection criteria on the operating conditions (load, speed, environment) of transmission components, embodying the rigorous principle of “adaptive design.”	2.3 Zahnradwerkstoffe, p. 79–80
Standardization and norm awareness	Normalkeilriemen sind nach DIN 2216, Schmalkeilriemen nach DIN 7753 genormt. Rollenkette DIN 8187 – 10 B – 2 × 100 The textbook extensively references DIN (German Industrial Standards) and other international standards, integrating the design process into a standardized framework. This demonstrates a paramount emphasis on “consistency” and “reliability,” thereby ensuring the interchangeability and compatibility of components produced by different engineers and factories.	1.1.2 Riemenarten/ Werkstoffe, p. 11; p. 34, etc.
Environmental responsibility	The textbook promotes sustainability by promoting three key strategies: scientific material selection to prevent over-engineering and conserve resources; high-efficiency transmissions to mitigate energy loss; and component standardization (e.g., DIN norms) to enable part replacement, thus reducing machine scrapping and electronic waste.	2.3 Zahnradwerkstoffe, etc.

The successful implementation of this case demonstrates that language tasks deeply integrated with professional contexts can effectively stimulate students' learning motivation and value-based reflection. It should be noted that imported professional teaching materials focus primarily on theoretical principles and technical descriptions, with relatively few explicit ideological and political elements. Therefore, task design must be well-targeted and supported with clear examples. By focusing on a "rigorous working attitude," this activity reduced the students' identification difficulty and primed them to engage with more complex ideological and political topics later. In the future, the resource pool can be further expanded by incorporating authentic materials such as German-language corporate case studies and industry standards, gradually building a multi-level teaching resource system for Curriculum Ideology and Politics.

4.2. Case 2: Themed interview activity "China and the World from a Cross-Cultural Perspective"

4.2.1. Activity design and implementation

This case was implemented in November 2024 during the teaching period when the international faculty member was on campus. The faculty member, a German national born in Peru, a key cooperative country under the Belt and Road Initiative, has a multicultural background, which provided a unique opportunity for cross-cultural ideological and political education. Coincidentally, this period overlapped with President Xi Jinping's attendance at the 31st APEC Economic Leaders' Meeting and his state visit to Peru; this major diplomatic event offered abundant current affairs materials and discussion space for the interview activity.

Following consent from the international faculty member, the Chinese German language teacher assigned a cross-cultural interview task titled "Ein Interview mit Herrn Dr. Zárate Moya" in the Basic German course. The activity was first launched via the Chaoxing Learning Platform as a group task, requiring each team to draft a German interview outline comprising 5-8 questions centered on the theme of "China-Peru Friendly Relations" within two days. The outline could cover multiple dimensions such as politics, economy, and culture. Subsequently, through peer evaluation, instructor feedback, and AI-assisted assessment, the most insightful and creative interview proposal was selected. The chosen team, under the guidance of the instructor, integrated the strengths of various proposals to formulate the final interview script and collaboratively carried out the on-site interview and video recording.

4.2.2. Outcomes and reflections

The edited interview video was publicly screened in class, followed by a German-language thematic discussion centered on the interview content. All students participated in group efforts to complete the translation and proofreading of the video subtitles in German, further enhancing language learning outcomes (**Table 2**).

Table 2. Compiled excerpts from students' interview with the international faculty member

Person	Response
Interviewer	Der Präsident von China, Xi Jinping, hat die Republik Peru, Ihr Heimatland, vor zwei Wochen besucht. Haben Sie etwas über das gewusst?
Dr. Zárate Moya	Ja, diese Nachricht war sehr populär in internationalen Zeitungen. Also in Peru und überall in Europa. Ich habe diese Nachrichten in Deutschland, in der deutschen Zeitung gelesen. Das war sehr interessant. Im Prinzip ist es nur zu geben eine starke Doppelkooperation zwischen Peru und China. Eine interessante Nachricht war die Straße, die ganze Straße in der Altstadt, im Zentrum von Peru, in Lima. Das alles dekoriert mit Flaggen für Peru und China. So sagt er willkommen für die Präsidentin von China, Xi Jinping.
Interviewer	Peru ist eines der ersten lateinamerikanischen Länder, das mit der Volksrepublik China diplomatische Beziehungen aufgenommen hat, ist eines der ersten, das eine umfassende strategische Partnerschaft mit China eingerichtet hat, und ist eines der ersten, das ein Paket abgeschlossener Freihandelsabkommen mit China unterzeichnet hat. Seit der Unterzeichnung des Memorandums des Verständnisses über die gemeinsame Kooperation im Rahmen von "Belt and Road" zwischen China und Peru im Jahr 2019 sind beide Länder gute Partner auf dem Weg der Entwicklung von "Belt and Road". Können Sie uns einige Beispiele über die Zusammenarbeit und gemeinsame Entwicklung zwischen China und Peru nennen?
Dr. Zárate Moya	Ja, natürlich. Also für die Nachricht, die ich vorher gesagt habe, die Besuche für den Präsidenten aus China, das war für die große Infrastruktur, das Peru und China zusammengearbeitet haben. Es gibt ein besonderes Hafen, das ist der Chancay Hafen, das ist in Nord - Lima. Und das ist ein großer Hafen, der importiert und exportiert Produkte aus China und Peru. Das war die interessanteste Kooperation zusammen. Seit 2010 haben wir diese Doppelkooperation angefangen. Diese Kooperation hat Produkte wie Zink, Kupfer und andere Waren importiert und exportiert.
Interviewer	Ich habe gehört, dass in Peru das chinesische Essen oft als "Chifa" bezeichnet wird, stimmt das? Auf Chinesisch hört sich das sehr ähnlich wie "Chi Fan" an, und bedeutet "Essen". Gibt es in Peru viele chinesische Restaurants? Haben Sie in Peru schon mal chinesisch gegessen?
Dr. Zárate Moya	Ja, natürlich. Wie gesagt, wenn die erste chinesische Gruppe nach Peru kam, gab es so viel Arbeit von diesen chinesischen Leuten. Danach hat diese Gruppe in der Landwirtschaft gearbeitet, in Zucker und Baumwolle. Alles, was die chinesischen Leute kochen in Peru, heißt Chifa. Ja, in Peru gibt es viele chinesische Restaurants. Mein Lieblingsgericht ist Arroz Chaufa. Das ist ein Gewürz in Reis, mit Fleisch oder Hähnchen. Das schmeckt wirklich sehr gut.
Interviewer	In Berichten habe ich erfahren, dass die Ergebnisse einer von chinesischen und peruanischen Institutionen gemeinsam durchgeführten Umfrage über die positive Einstellung der Peruaner gegenüber China zeigen, dass 91.5 % der Befragten China für ein attraktives Land halten und 86.3 % der Befragten China als Partner von Peru betrachten. Was halten Sie von diesem Ergebnis?
Dr. Zárate Moya	Das Ergebnis zeigt die starke Beziehung und das Vertrauen zwischen beiden Ländern. Die Peruaner sehen China als wichtigen Partner für die Zukunft, insbesondere in Handel, Bildung und Technologie.
Interviewer	Was erwarten Sie sich von der zukünftigen Entwicklung der Beziehungen zwischen China und Peru, oder haben Sie irgendwelche Vorschläge?
Dr. Zárate Moya	Ja, natürlich. Im Prinzip gibt es eine große Zukunft zwischen China und Peru. Es gibt verschiedene Produkte und Kenntnisse, die geteilt werden können, um die Wirtschaft zu stärken. Beide Kulturen, Peru und China, haben starke Disziplin und Wissenschaft. Ich glaube, dass wir in Zukunft sicherlich mehr Möglichkeiten haben werden, gemeinsam die Initiative "Belt and Road" auszubauen und Kooperationen zum Vorteil aller Seiten zu fördern.

This activity provided students with multifaceted gains.

- (1) Taking General Secretary Xi Jinping's recent state visit to Peru as a timely entry point, students and the international faculty members engaged in in-depth exchanges on the historical origins, economic and trade cooperation, and cultural interactions between China and Peru, thereby enhancing their intercultural communication skills through practical engagement.
- (2) Through the first-hand accounts of the international faculty member, students gained a direct

understanding of how the principle of “extensive consultation, joint contribution and shared benefits” is implemented in international cooperation, and thus strengthened their confidence in China’s approach to participation in global governance.

- (3) During the preparation phase, students significantly enhanced their information literacy and collaborative skills through literature consultation, data collection, and teamwork. The students in the interview group, in particular, demonstrated exceptional organizational and coordination abilities through task allocation, on-site execution, and post-production work.

Although this activity achieved certain positive outcomes, it also revealed several areas for improvement.

- (1) Due to course time constraints, students’ language expression still needs optimization, with specific issues in pronunciation accuracy and grammatical correctness requiring further attention.
- (2) Nervousness during the on-site interview affected some students’ on-the-spot performance.
- (3) Such activities demand significant extracurricular time investment, limiting the frequency of implementation per semester.

In future teaching, targeted optimization measures could be adopted, such as adding mock interview sessions to enhance students’ language fluency and adaptability through role-playing; incorporating AI speech recognition tools to assist students in pronunciation correction and expression refinement; and breaking down the interview project into smaller tasks distributed throughout the semester to reduce student workload while maintaining instructional continuity.

5. Conclusion and future prospects

This study verifies via practical teaching cases that integrating ideological and political elements into German courses in Sino-foreign cooperative education enriches language teaching content and enhances students’ cultural identity, national confidence, and patriotism. Essentially, this integration is a strategic measure to implement the “fostering virtue through education” task and a key way to cultivate high-quality international talents—those with national belonging, global perspective, and balanced moral integrity and professional competence. It leverages cooperative education’s unique resource platforms and cross-cultural arenas, offering targeted support for Curriculum Ideology and Politics amid educational opening-up.

To advance Curriculum Ideology and Politics and boost moral education effectiveness, four focused directions are proposed:

- (1) Optimize evaluation mechanisms: Build a multi-dimensional formative system for cooperative education’s cross-cultural context. Involve instructors, foreign experts, corporate mentors, and students; include ideological and political elements (value shaping, cross-cultural communication, national awareness) in indicators; and use process-oriented methods (project demonstrations, practical reports) to “promote development and education through evaluation.”
- (2) Strengthen teacher collaboration: Encourage Chinese German teachers and international faculty to conduct regular joint lesson preparation and thematic Curriculum Ideology and Politics research. Focus on Sino-German engineering culture and scientific ethics to co-identify teaching entry points, build a shared material library, and improve teachers’ instructional design and implementation capabilities.
- (3) Develop characteristic resources: Leverage the “Belt and Road” Initiative, Sino-German manufacturing cooperation, and sustainable development to create bilingual/German ideological and political

resources (case collections, digital modules) that integrate language training, professional context, and value guidance.

- (4) Expand overseas pathways: Design practical tasks for students studying in Germany, such as “Telling ‘Made in China’ Stories in German” and “Sino-German Technology Research.” Encourage students to share China’s development concepts and technologies with the German public, enabling them to advocate for China’s national image and spread Chinese stories, thus deepening cultural confidence.

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Research on the Construction of Curriculum Teaching System in Higher Vocational Colleges from the Perspective of “Integration of Posts and Courses”: A Case Study of the Course Intelligent Tax Declaration and Management

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Abstract: With the rapid development of social economy and the continuous adjustment of industrial structure, higher vocational colleges, as an important base for cultivating high-quality technical and skilled talents, have attracted increasing attention to the alignment between their talent cultivation quality and social needs. As a key measure for higher vocational colleges to deepen the integration of industry and education as well as school-enterprise cooperation, “integration of posts and courses” can effectively realize the seamless connection between curriculum teaching and post requirements. Taking the course Intelligent Tax Declaration and Management as an example, this paper explores the construction path of the curriculum teaching system in higher vocational colleges from the perspective of “integration of posts and courses”. The purpose is to provide references for improving the teaching quality of this course and cultivating technical and skilled talents in the field of intelligent taxation that meet the needs of industries and enterprises, and also to offer insights for the optimization of the teaching system of other similar professional courses.

Keywords: Higher vocational colleges; Integration of posts and courses; Intelligent Tax Declaration and Management; Construction path

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1. Introduction

As a core course for finance and economics majors in higher vocational colleges, the scientific validity of the teaching quality system setup of the course Intelligent Tax Declaration and Management is closely related to the effectiveness of professional talent cultivation. “Integration of post and curriculum” refers to the educational

approach that takes work as the carrier, integrates work tasks and professional competence requirements throughout the entire course teaching process, and ultimately achieves the educational effect of mutual integration and connection between courses and posts, teaching and work, as well as training objectives and post demands ^[1]. With the accelerated advancement of higher vocational education reform, designing the teaching system of the Intelligent Tax Declaration and Management course from the perspective of “integration of post and curriculum” not only meets the development needs of the tax industry, but also conforms to the requirement for upgrading the training objectives of higher vocational education teaching.

2. Value of constructing a curriculum teaching system in higher vocational colleges from the perspective of “Integration of Posts and Courses”

2.1. Enhancing the degree of alignment between talent cultivation and social needs

The “integration of posts and courses” model enables higher vocational colleges to organize teaching activities based on the actual job demands of industries and enterprises. Taking the course Intelligent Tax Declaration and Management as an example, by cooperating with tax authorities, accounting firms, corporate finance departments, and other relevant entities, colleges can keep track of the dynamic changes in job requirements within the field of intelligent taxation. They integrate the latest job skill requirements and social information into classroom teaching, so that the cultivated students can meet the needs of practical work. This helps fulfill the demand of industries and enterprises for intelligent taxation talents and realizes a sound connection between talent cultivation and social needs ^[2].

2.2. Strengthening students’ professional competitiveness

This model emphasizes post-oriented practice. Students’ practical courses are not mere theoretical exercises. In the teaching of Intelligent Tax Declaration and Management, work tasks are introduced into specific posts and completed at these posts; students receive training in a simulated real tax work environment, or colleges carry out practical operation projects through the integration of industry and education with enterprises. These measures allow students to apply theoretical knowledge in real-world scenarios, enabling them to meet the basic requirements of job positions. By transforming knowledge into practical capabilities, students are more likely to secure employment quickly after graduation. Moreover, after taking up positions in enterprises or companies, they can better demonstrate their practical value ^[3].

2.3. Promoting the teaching reform of higher vocational education

The so-called “integration of posts and courses” means that higher vocational education must break the barriers of traditional teaching through this model, and comprehensively eliminate traditional drawbacks in teaching, such as those existing in curriculum design, course content, teaching methods, and assessment and evaluation ^[4]. From the exploration of the course Intelligent Tax Declaration and Management in higher vocational colleges, the construction of the curriculum teaching system from the perspective of “integration of posts and courses” provides practical experience and reference for the teaching reform of other professional courses in higher vocational education. This further drives the improvement of the overall teaching quality of higher vocational education, and provides strong talent support and intellectual guarantee for regional economic development and industrial transformation and upgrading ^[5].

3. Analysis of the current situation of the curriculum teaching system for Intelligent Tax Declaration and Management

3.1. Disconnect between course objectives and job requirements

When formulating the course objectives for Intelligent Tax Declaration and Management, some higher vocational colleges overemphasize the teaching of theoretical knowledge while paying insufficient attention to cultivating the practical skills and professional literacy required by actual jobs. These course objectives do not align with the real needs of intelligent tax-related positions. As a result, the theoretical knowledge students gain after completing the course leaves graduates “at a loss” in the workplace, they are unable to perform practical tasks, such as completing tax declarations or processing tax data promptly. For example, some course objectives only mention that students need to master the basic content of tax laws/regulations and basic tax calculation methods, but fail to explicitly specify the operational skills for intelligent tax systems. Consequently, graduates require a long learning period to adapt to their positions and master the effective operation of intelligent tax systems on the job^[6].

3.2. Mismatch between course content and job tasks

Course content is the core of the curriculum teaching system, and the rationality of such content has a direct impact on the quality of course teaching. Currently, the content of some courses on Intelligent Tax Declaration and Management still has the problem of failing to integrate with the work tasks of actual positions. First, course content updates lag behind, failing to promptly incorporate new information in the intelligent taxation field, such as updated policies and regulations, technical methods, and industry trends. For example, with the digital transformation of tax collection and administration, tax authorities have launched several intelligent tax service functions; however, the content of some courses remains limited to traditional tax declaration methods and procedures, lacking introductions to the functions of intelligent tax handling tools and corresponding teaching content. Second, the compilation form of course content is relatively traditional: most of it is divided according to chapters of theoretical knowledge, rather than being organized in accordance with the logic of job tasks. This makes it difficult for students to connect their learning of course content with their future job tasks in a coherent way, which leads to low targeted nature and applicability of their learning.

3.3. Inconsistency between teaching methods and the requirements of “Integration of Jobs and Courses”

From the perspective of “Integration of Jobs and Courses” (a concept emphasizing alignment between academic teaching and workplace needs), course teaching should be student-centered, adopting methods that simulate real job tasks and cultivate students’ practical work capabilities^[7]. However, the teaching methods for Intelligent Tax Declaration and Management in some colleges do not closely link to job practice:

The classroom lecture-based method remains dominant, while after-class practical teaching is underdeveloped. Although some schools offer experimental or practical training courses, the content is overly simplistic, often limited to basic simulated operations, which are far from matching the complexity and comprehensiveness of real job tasks. There is a lack of in-depth cooperation with industries and enterprises. These colleges do not use real job projects from enterprises for teaching, so students cannot access authentic tax work content or business processes. This ultimately constrains the cultivation of students’ practical abilities and professional quality^[8].

4. Paths for constructing the teaching system of the course Intelligent Tax Declaration and Management from the perspective of “Integration of Positions and Courses”

4.1. Clarify course objectives based on job requirements

4.1.1. Knowledge objectives

Enable students to possess basic theoretical knowledge of intelligent taxation, master the latest tax laws and regulations (such as the administration and collection provisions for value-added tax, consumption tax, corporate income tax, and personal income tax), basic principles and methods of tax calculation, as well as the principles and basic operations of intelligent tax systems; help students understand the latest developments and trends in the development of intelligent taxation, such as the application of tax big data and artificial intelligence in tax collection and administration.

4.1.2. Skill objectives

Cultivate talents proficient in intelligent tax operation skills, who can independently complete job tasks including registration and login operations on the electronic tax bureau, filling and submitting of tax declaration forms, issuance and authentication of value-added tax invoices, and collection and analysis of tax data; develop students' ability to solve practical tax problems, enabling them to use the knowledge and skills they have mastered to address common issues encountered in the tax declaration process (e.g., correction of erroneous declaration data and application of preferential tax policies); foster students' initial assisting ability in tax planning, allowing them to initially design simple tax planning schemes for enterprises and reduce enterprises' tax risks.

4.1.3. Literacy objectives

Cultivate students' rigorous and conscientious work attitude to ensure the accuracy and timeliness of tax declaration data, and avoid enterprise tax-related risks caused by work errors; develop students' integrity-based professional ethics, enabling them to abide by laws and regulations, strictly comply with tax professional ethics and norms, and effectively safeguard the tax interests of both enterprises and the state; enhance students' good interpersonal communication and collaborative cooperation abilities, allowing them to communicate with tax authorities and various departments of enterprises, and coordinate the handling of tax issues; cultivate students' lifelong learning ability, encouraging them to proactively pay attention to policy and information technology changes in the field of intelligent taxation, and update and strengthen their professional and job-related capabilities.

4.2. Establish a curriculum content system based on post-work tasks

4.2.1. Research post-work tasks

Visit tax authorities, accounting firms, and finance departments of large and medium-sized enterprises, and conduct in-depth interviews with frontline tax specialists and corporate finance supervisors. The goal is to understand the work tasks, work processes, skill requirements, and quality requirements of positions related to smart tax administration (such as tax accountants, tax declaration specialists, and tax consulting assistants). Collect materials used in post-work, including forms, cases, and operation guides, to provide practical resources for the development of curriculum content.

4.2.2. Integrate curriculum content modules

Based on the research on post-work tasks, decompose the content of the course Smart Tax Declaration and Management into several work task modules. Each work task module corresponds to one or more post-work tasks. Guided by job responsibilities, the course content can be divided into modules such as “Understanding and Application of Smart Tax Systems,” “VAT Declaration and Management,” “Consumption Tax Declaration and Management,” “Corporate Income Tax Declaration and Management,” “Individual Income Tax Declaration and Management,” “Collection and Analysis of Tax Data,” and “Prevention and Handling of Tax Risks.” Then, each module organizes specific teaching content in accordance with the logical post-work process. For example, the module “VAT Declaration and Management” is divided into work tasks, including “Management of VAT Invoices,” “Confirmation of VAT Sales Revenue,” “Deduction of Input VAT,” “Filling out VAT Return Forms,” and “VAT Declaration and Payment,” so that the curriculum content corresponds to specific work tasks ^[9].

4.2.3. Update curriculum content in a timely manner

Establish a dynamic update mechanism for curriculum content. Pay close attention to revisions to national tax policies and regulations, upgrades of smart tax systems, and changes in post requirements of industry enterprises. Incorporate the latest policies and regulations, system operation methods, and industry cases into the curriculum content. For instance, adjust the teaching content of curriculum modules when there are new adjustments to national tax policies or revisions to the Tax Collection and Administration Law; update the practical training content on system operations when the system adds new functions or optimizes business processes. This ensures that the most timely and practical resources are provided for the curriculum content.

4.3. Adoption of teaching methods aligning with the “Integration of Job and Curriculum”

4.3.1. Project-based teaching method

With real job-related work projects as the career, this method integrates course teaching content into the project implementation process. For example, taking the tax declaration work of an enterprise during a tax period as a project, students are asked to play the role of tax accountants and complete the entire process from tax data collection, tax calculation, smart tax system operation, to tax declaration submission. During project implementation, teachers guide students to analyze project tasks, formulate work plans, and solve problems encountered. Through independent inquiry and team collaboration, students complete project tasks, thereby mastering the knowledge and skills required for the job. In project-based teaching, students can be divided into several groups according to the complexity of the project, with each group undertaking different subtasks to cultivate students’ team collaboration and communication abilities.

4.3.2. Case-based teaching method

Typical cases in the field of smart tax (such as cases of enterprise tax declaration errors, cases of applying tax preferential policies, and successful tax planning cases) are selected for students to analyze and discuss. In case analysis, teachers first explain the relevant background and information of the case, put forward thinking questions, and then organize students to discuss the problems and answers of the case in groups, as well as reflect on the knowledge and skill-related issues contained in the case. Through case analysis, students can connect the theoretical knowledge they have learned with the actual job work of their major and improve their ability to analyze and solve problems. In addition, experts from industries and enterprises can be invited to participate in case teaching to share case experiences from practical work, making case teaching more authentic

and practical.

4.3.3. Simulation training teaching method

Simulated tax work scenarios are established, and smart tax simulation teaching software (such as the electronic tax bureau simulation system and the value-added tax invoice simulation management system) is used for training. In simulation training teaching, students are provided with operating environments and data that are close to real job work, allowing them to conduct job skill training such as tax declaration, invoice management, and tax data operation. Teachers use the training platform to monitor students' operation process, timely identify problems in students' work results, and provide targeted guidance. The simulation training teaching method can provide students with a safe and controllable practice environment, enabling students to practice job skills repeatedly, understand and master the work process of the job, and strengthen their practical operation capabilities. At the same time, cooperation with enterprises can be carried out to establish off-campus training bases, and students can be arranged to conduct on-the-job internships in enterprises. By practicing in a real job environment, students can further improve their job adaptability^[10].

5. Conclusion

From the above, it can be seen that in the design of the teaching system for the course Intelligent Tax Declaration and Management, guided by the reform concept of "integration of posts and courses" in higher vocational colleges, efforts should be made to closely focus on post needs to establish the three-dimensional curriculum objectives of "knowledge-skill-literacy," coordinate the curriculum content guided by post tasks, and adopt diversified practical teaching methods. By doing so, we can break through the misunderstandings existing in the three aspects of traditional teaching (i.e., teaching objectives, content, and methods) under the "separation of posts and courses," enhance the targeting and adaptability of the teaching of this course, ensure that students master the key skills required for intelligent tax posts, and achieve seamless connection between "courses" and "posts". Meanwhile, this provides a "model" for the implementation of the "integration of posts and courses" reform in other finance and economics courses in higher vocational colleges, so as to cultivate more high-quality technical and skilled talents for all walks of life and better serve the high-quality development of the tax industry in the digital economy era.

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Research on the Innovation and Entrepreneurship Education Model of Local Agricultural Colleges under the Background of Rural Revitalization: A Case Study of Anhui Agricultural University

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Abstract: Under the background of the in-depth advancement of the rural revitalization strategy, local agricultural colleges bear the core mission of cultivating innovative talents who understand and love agriculture. Taking Anhui Agricultural University as the research object, this paper analyzes the “five-level platform, four-dimensional system, and three-party collaboration” innovation and entrepreneurship education model constructed by the university. Through approaches such as competition incubation, integration of industry and education, and mutual promotion of ideological and innovative education, the model provides talent support for agricultural modernization. The research shows that this model has effectively addressed the pain points in agricultural education, such as the shortage of practical platforms, the disconnection between industry and education, and the weak sense of innovation, through mechanisms including maker space incubation projects, the extension of scientific and technological services to rural areas, and the feedback of discipline competitions to teaching.

Keywords: Rural revitalization; Innovation and entrepreneurship education; Agricultural colleges; Integration of industry and education

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1. Introduction

The core driving force of rural revitalization lies in the dual-wheel drive of talents and technology. With the acceleration of the agricultural modernization process, problems in the “micro-fields” of agricultural production (such as the research and development of special agricultural machinery, the cultivation of characteristic crops,

and the operation of small-scale cooperatives) have become increasingly prominent, and there is an urgent need for high-quality talents with “micro-innovation” capabilities. As the main base for outputting agriculture-related talents, local agricultural colleges need to integrate innovation and entrepreneurship education into the entire talent cultivation chain to break through the bottlenecks in traditional agricultural education, such as the shortage of practical platforms, the weak integration of industry and education, and the insufficient innovative literacy. Based on the school-running tradition of the “Dabie Mountain Road” and guided by serving the regional rural revitalization, Anhui Agricultural University has constructed a distinctive innovation and entrepreneurship education system. In the past five years, its students have won 10 national gold awards in national competitions such as the “Challenge Cup” and “Internet Plus,” incubated 35 start-up enterprises, and its technical services have covered 24 counties and districts in Anhui Province, becoming a typical model of innovation and entrepreneurship education in agricultural and forestry universities. By deconstructing the model logic and practical paths of Anhui Agricultural University, this paper provides a reference for similar colleges and universities ^[1].

2. The practical framework of innovation and entrepreneurship education Model at Anhui Agricultural University

Anhui Agricultural University, guided by the concept of “integration of thinking and innovation, collaboration between professionalism and innovation, and linkage between industry and education”, has constructed a three-dimensional support model of “platform – system – mechanism” (**Table 1**).

Table 1. Three dimensions of the innovation and entrepreneurship education model at Anhui Agricultural University

Dimension		Specific Measures	Implementation Carriers
Platform Level		Five-level Progressive Practical Platform	Maker Space + Science and Technology Courtyard + Enterprise Base
System Level		Four-dimensional Integration of Curriculum-Competition-Incubation-Service	“Xingnong Cup” Competition + Farming and Reading Education
Mechanism Level		Tripartite Collaborative Education among University-Enterprise-Locality	Government Projects + Enterprise Topics + Rural Practice

2.1. Building a five-level practical platform to connect the “Classroom-Farmland” chain

2.1.1. Maker space drives technology marketization

A 2,000-square-meter maker space for college students has been built, providing full-chain services including “entrepreneurship training, project incubation, and market connection.” For example, relying on this space, the team led by Wu Fei from the innovative experimental class of biology transformed the technology of “termite symbiotic bacteria microbial fungicide” into a startup project. This project won the national special prize in the “Challenge Cup” competition, was promoted to more than 200 cooperatives, and realized green prevention and control of plant diseases. The space has incubated 60 projects in total, among which 35 have registered companies, and agricultural-related projects account for over 80%.

2.1.2. Science and technology courtyards promote localized services

Drawing on the experience of the “Farmer Academician Science and Technology Service Station” of Yunnan Agricultural University, science and technology courtyards have been set up in the major wheat-producing areas of northern Anhui and the tea-growing areas of southern Anhui. Teachers and students reside there to carry out “field classrooms.” For instance, the team from the School of Resources and Environment developed a “straw returning corn seeder” at the Fuyang Science and Technology Courtyard, which solved the seeding problem caused by straw returning. This technology has been promoted to 13.44 million mu of farmland, helping farmers increase their income by 1.071 billion yuan^[2].

2.2. Four-dimensional integration to cultivate “Innovation and Entrepreneurship-Oriented” new agricultural talents

2.2.1. Integrating “Micro-Innovation” literacy courses

Courses such as Agricultural Micro-Technology Innovation and Entrepreneurship Training have been offered. These courses strengthen the teaching design of technologies in “micro-fields” such as the transformation of characteristic agricultural machinery and organic planting, to meet the literacy needs of agricultural makers as “micro-innovation developers and popularizers.” At the same time, the ideological and political element of “Red Dream-Building” is integrated into the courses. For example, Zhou Guo’an, a volunteer of the Western Program, investigated the pain points of farmers during his teaching support in Guizhou. After returning to school, he developed agricultural machinery and won the gold award in the “Internet Plus” competition.

2.2.2. Promoting innovation and incubating projects through competitions

A four-level competition mechanism covering “college-university-province-nation” has been established. High-quality projects are selected through competitions such as the “Xingnong Cup” and “Challenge Cup.” In the 2022 “Challenge Cup” Anhui Provincial Competition, 5 projects won the gold award, including Guardian in Fungi and Colorful Agriculture for Prosperity, both of which focus on the resource utilization of agricultural waste. The competition projects are deeply connected to the needs of rural areas, and 90% of the winning teams have settled in the maker space for continuous incubation^[3].

2.3. Building an education ecosystem through university-enterprise-government collaboration

2.3.1. Interdisciplinary integration

Jointly with the School of Economics and Management, the School of Agriculture, and other institutions, interdisciplinary courses such as “Agricultural Big Data” and “Rural Brand Design” have been launched to meet the demand for interdisciplinary talents in rural revitalization. For example, the Yan Jiaxian Class of Fujian Agriculture and Forestry University has set up 10 interdisciplinary courses, including “Rural Aesthetics” and “Cooperative Economy.” This model is borrowed to enhance students’ ability in multi-functional agricultural development.

2.3.2. Sinking of industry-education resources

Enterprise collaboration: Jointly build practical bases with such enterprises as Quanyin Hi-Tech, Wanken Group, and Laoxiangji, and invite corporate mentors to guide the digital upgrading of agricultural machinery. Government linkage: Undertake county-level rural revitalization planning projects. For instance, the team of the

Tourism Management major designed a “tea-tourism integration” route for Jinzhai County, driving an average annual increase of 24,000 yuan in farmers’ income.

3. Practical framework of innovation and entrepreneurship education model of Anhui Agricultural University

3.1. Significant improvement in the quality of talent supply

In the past three years, the participation rate of students in innovation and entrepreneurship has increased from 32% to 78%, and the proportion of graduates employed in agriculture-related enterprises has exceeded 50%. In 2025, the university won 2 national special awards in the “Three Innovations Competition” (National College Students’ Innovation and Entrepreneurship Competition), setting a new historical record. A group of “rural makers” has emerged among graduates. For example, Zhao Zongxiang, an inheritor of intangible cultural heritage (flower arrangement), founded Hefei Qialiu Branch Flower Art Co., Ltd., serving more than 1,500 farmer households.

3.2. Sustained release of the effectiveness of technology-assisted agriculture

A closed loop of “technological services – standard output – talent supply” has been formed. In terms of technology transformation, 20 patents for new pesticides, intelligent agricultural machinery and other products have been developed and promoted to 5 provinces. In terms of standard formulation, 3 provincial local standards, such as the Technical Regulations for the Production and Processing of Ecological Pu’er Tea, have been jointly formulated with tea enterprises to help improve the quality of agricultural products. In terms of on-site talent placement, an average of 200 students are stationed at the base to provide services each year; for example, the Tea College of Yunnan Agricultural University has trained 890 tea farmers in Fengqing County^[4].

3.3. Model innovation points

The “maker space + ideological and political integration” dual-drive model integrates farming culture and the spirit of scientists into maker salons (such as “The Three Rural Issues of a Major Country” and “Shennong Lecture Hall”), fostering students’ sentiment of “understanding agriculture, loving rural areas, and caring for farmers.” The mutually promoting path of “micro-innovation – large industry” focuses on small cutting-edge technologies (such as transgenic cultivation of ornamental plants and intercropping management of organic tea), and amplifies benefits through the industrial chain^[5].

4. Suggestions for deepening the reform of innovation and entrepreneurship education

Although the model of Anhui Agricultural University has achieved remarkable results, it still faces challenges such as insufficient interdisciplinary curriculum integration, limited coverage of county-level practice bases, and weak sustainability of “micro-innovation” projects. Offer courses such as Development of Agricultural Micro-technologies and Operation of Small-scale Cooperatives, compile micro-technology books on “transformation of characteristic agricultural machinery” and “management of organic tea gardens”, and incorporate them into the credit system. Establish “agricultural maker workshops,” invite students of the “Leading Geese” project and rural pacesetters in getting rich to serve as mentors, and strengthen practical capabilities. Draw on the network

model of “Science and Technology Courtyard – Rural Revitalization Research Institute” of Fujian Agriculture and Forestry University, and set up workstations in 16 cities of Anhui Province to promote long-term resident practice of students. Cooperate with local governments to establish a “Rural Revitalization Venture Capital Fund,” provide financial support to high-quality projects, and introduce “AI + Agriculture” practical training projects to improve smart agriculture skills. Collaborate with leading enterprises to formulate group standards for “ecological tea gardens” and “green grain and oil,” and promote industrial upgrading through technology standardization ^[6].

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A Study on the Teaching Practice of English Continuation Writing from the Perspective of Discourse Analysis

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Abstract: With the continuous deepening of the new curriculum reform, the goal of cultivating core competencies in English has become more explicit, and senior high school English teaching is undergoing a transformation from traditional knowledge-based instruction to the enhancement of comprehensive language application ability. As a new English writing type that integrates reading and writing, continuation writing has been officially incorporated into the National College Entrance Examination (Gaokao) English test in recent years, becoming a crucial indicator for measuring students' language proficiency. This question type requires students to have a solid foundation of basic language knowledge and strong innovative thinking ability, as it is a comprehensive assessment of students' overall English application skills. This paper analyzes and studies continuation writing based on the genre, cohesion, coherence of the continuation text and senior high school English continuation writing, and explores practical strategies for continuation writing grounded in discourse analysis.

Keywords: Continuation writing; Discourse analysis; Coherence; Cohesion

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1. Introduction

In the National College Entrance Examination English Test Syllabus (2015) issued by the Examination Center of the Ministry of Education, it was clearly stated that a new continuation writing section would be added to the writing part of the Gaokao English test. This question type was first adopted in the 2016 Gaokao English test in Zhejiang Province. General Senior High School English Curriculum Standards (2017 Edition, Revised in 2020) elaborates on core competencies and methods for their cultivation. Senior high school students are in a critical period for the development of key learning abilities; proper guidance during this stage helps them master essential knowledge and develop sound qualities. In the new curriculum standards, continuation writing has become an important means to assess students' language proficiency and thinking quality^[1].

Continuation writing requires candidates to, based on understanding the original text, develop reasonable imagination within a specified time and complete a continuation of approximately 150 words using the English knowledge they have learned. However, in actual teaching, students' continuations are often disconnected from the original text and lack plot coherence. This paper applies discourse analysis theory to explore how to conduct discourse analysis, accurately grasp the theme and characters of the text, and naturally and effectively use inter-paragraph and inter-sentence cohesive devices in continuation writing, to help students construct continuations with clear structure, tight contextual cohesion, and coherence.

2. Teaching value of post-reading continuation writing under the guidance of core literacy

Fundamental changes have taken place in senior high school English teaching under the guidance of core literacy, and the new college entrance examination places greater emphasis on assessing the educational effects of core literacy. Post-reading continuation writing serves as a crucial means to evaluate students' English learning abilities and the development of their core literacy; it is also a key approach to fostering students' core literacy, setting higher requirements for their subject-specific literacy. Post-reading continuation writing holds significant value in cultivating students' core literacy and demonstrates strong compatibility. Through systematic training, students can integrate all knowledge points into a coherent whole in a short period, thereby forming a comprehensive knowledge system ^[2]. This not only helps improve students' learning efficiency but also enhances the quality of their learning. During the senior high school years, many students maintain a positive learning attitude and strive to master English knowledge. However, they often achieve unsatisfactory learning results and struggle to make effective progress in their grades. An investigation reveals that most students fail to integrate different components, such as reading and writing. As a result, although they can memorize a large number of words, they find it difficult to accurately understand the connotation of materials and produce high-quality compositions in writing. In contrast, the implementation of post-reading continuation writing helps establish connections between vocabulary, phrases, and grammar, thereby enhancing students' comprehensive literacy and abilities ^[3].

3. Research on discourse analysis and post-reading continuation writing teaching

In the 1970s, linguist Halliday (1970) proposed that language possesses three metafunctions: (1) the interpersonal function, (2) the ideational function, and (3) the textual function. The core content of discourse analysis lies in studying continuous language and its relationship with context. Since language consists of both meaning and form, discourse can also be structured through two types of relationships: cohesion and coherence. Discourse analysis refers to the analysis of discourse structure, which is generally divided into two major categories: macro-structural research and micro-structural research. Macro-structural research primarily focuses on exploring the in-depth meaning and organizational framework of discourse, while micro-structural research centers on the study of sentences. From the perspective of cohesion and coherence, discourse analysis theory emphasizes revealing the internal relationships between various parts of a text and explaining how to achieve clearer and more logical expression through cohesive and coherent devices.

3.1. Clarifying discourse structure and grasping the overall content

Senior high school English involves a wealth of theoretical knowledge, and students need to possess certain logical thinking abilities when engaging in post-reading continuation writing, learning and practice. Therefore, teachers should consciously guide students to analyze from the overall perspective of discourse, enabling them to deeply understand the structure and context of the article and better ensure the fluency of the written continuation. In the process of guiding students to carry out continuation writing, teachers should encourage them to analyze based on the overall structure of the article rather than confining their focus to a single paragraph or sentence. This mode of continuation writing is conducive to improving students' reading abilities, thereby helping them develop comprehensive language expression skills ^[4].

Taking the theme “from problems to solutions” as an example, teachers can guide students to conduct an in-depth analysis of the article and reflect on how the global community provides solutions to address problems. Teachers can also encourage students to use their imagination to think about issues, explore solutions applicable to different problems, and thereby complete the continuation writing.

In addition, teachers can provide writing ideas and frameworks to help students express their thoughts and viewpoints, thereby achieving effective teaching guidance. This teaching method is beneficial for the development of students' comprehensive abilities and the cultivation of their innovative capabilities.

3.2. Analyze the meaning of the original text and ensure coherent continuation

When high school English involves challenging writing tasks (specifically continuation writing), teachers can help students gain a deep understanding of the detailed requirements of the task by creating outlines. They can also list cohesive devices in the form of the shortest discourse units according to the development of the story. After students complete the continuation task, they can optimize and integrate their writing content to ensure that the continued work is coherent and natural with the original text. For the entire article, cohesive devices are particularly important. The coherence of the continued text is ensured through the use of references and pronouns, conjunctions, and transitional language. Therefore, to ensure that the style and quality of students' continued works are consistent with the original text, teachers can guide students to learn and use cohesive devices and creatively develop the story content.

For example, after reading a text themed “Mother's Day” and completing the continuation task, students should be guided to deeply analyze the continuation mode and language style of the text, to integrate the original text with their own writing. Teachers should encourage students to engage in extensive reading in their spare time, extract sentence patterns and structures from the texts they read, and then flexibly incorporate phrases and sentence patterns into the plot of their stories during the learning process. This model also helps arousing students' interest in learning, allowing them to give full play to their imagination to complete writing tasks through continuation or adaptation of structures, and select sentence patterns from their knowledge reserve. This is a key way to cultivate good thinking qualities and helps students develop strong writing skills.

3.3. Explore textbook discourses and build a corpus

To ensure the quality and effectiveness of teaching, teachers should deeply explore the reading discourses in textbooks, establish a corresponding corpus, and conduct multi-perspective analysis of the stories in the discourses. This enables students to analyze and think about problems from different angles, record and summarize the insights they gain during the learning process, and build their own corresponding corpus. Only

in this way can students deeply understand the content and structural characteristics of the text, master key language knowledge, and improve their personal reading and writing abilities.

For instance, in the teaching of the “Reading and Thinking” unit in textbooks, teachers can select representative article content based on the unit’s theme, and choose article structures of different genres, including news reports, popular science articles, novels, etc. Students are then guided to conduct an in-depth analysis of these articles from aspects such as theme and structure. During the analysis process, teachers should ask students to pay attention to important sentence patterns and vocabulary in the articles and record them. These records will also be helpful for students in their subsequent reading and writing. When reading news reports, students can record the article’s theme, main content, and conclusion, as well as important vocabulary and phrases. In this way, when writing, students can select appropriate vocabulary and sentence patterns from the corpus to accurately express their views and opinions, making the writing content more interesting. The establishment of a corpus also helps to enrich teaching materials and provide support for teaching work ^[5].

3.4. Imitate discourse style and continue the story plot

For continuation writing, it is of great importance for students to fully understand the linguistic characteristics and writing style of a work. Otherwise, there will be discrepancies in the style of the continuation, making it difficult to convey the emotions intended by the original text. If the original text of an article is relatively simple, students also need to express themselves using simple and clear sentence patterns. If the structure of the original text is complex, teachers should guide students to analyze the characteristics and structure of the original text, and then use different descriptive techniques to complete the continuation. This ensures the continuity of the work and avoids inconsistencies with the original style caused by ambiguous expression methods.

Take the textbook text “Mother of Ten Thousand Babies” as an example, teachers first guide students to analyze the writing style and linguistic characteristics of the original text, so as to understand the ideas and attitudes the author intends to convey. During the reading and writing process, students can also imitate the expressive features of the original text to present a consistent style and complete the continuation task. This kind of learning and practice activity helps students master more diverse writing skills, thereby improving their expressive abilities. In the writing process, students can add some detailed elements to further enrich the content of the article and ensure the rigor of the content, which also helps to enhance their writing skills ^[6].

4. Conclusion

To sum up, the combination of discourse analysis theory and continuation writing provides important theoretical support for the practice of continuation writing, a key learning activity in senior high school. It is of great guiding significance for constructing continued texts with coordinated context, reasonable cohesion, and coherent plots. Under the background of the new curriculum reform, teachers should guide students to practice continuation writing based on discourse, develop key discourse analysis abilities, and improve their personal writing skills. In teaching, teachers should focus on cultivating students’ “discourse analysis” ability, consciously guide them to master key methods of cohesion and coherence, and complete high-quality continuous texts.

Disclosure statement

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Research on the Integration Path of Artificial Intelligence and Humanistic Spirit in English Education

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Abstract: Based on the background of globalization, English education needs not only language skills training, but also the transmission and practice of the humanistic spirit. As the frontier of technological innovation, artificial intelligence, through its application in teaching, provides a brand-new perspective and tool for college English teaching, so as to ensure the development of teaching activities and formulate personalized teaching programs, so as to meet students' diverse learning needs and realize the cultivation of a humanistic spirit. Personalized learning supported by artificial intelligence can provide one-to-one customized learning content for students with different levels and learning styles, and narrow individual differences. This study will explore how to effectively integrate artificial intelligence and humanistic spirit, so as to enhance the interest and depth of English learning and further transport talents with an international vision and humanistic care for society.

Keywords: Artificial intelligence; Humanistic spirit; College English; Educational integration

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1. Introduction

With the continuous development of information technology, the advent of the 5G era has brought innovative changes to education. With the continuous rise of emerging technologies such as artificial intelligence, big data, and cloud computing, the contents, methods, and means of education have been innovated and changed. Among them, the "artificial intelligence+education" mode makes learning personalized and ensures a higher quality of teaching, which not only improves the teaching quality but also enables students to enhance their language ability in a real context. However, this transformation will also lead to thinking about the teaching quality and the inheritance of the humanistic spirit. In this context, people should use artificial intelligence technology to promote the development of education reasonably and integrate a humanistic spirit, hoping to provide new ideas for the reform of English teaching in colleges and universities, so as to cultivate all-round talents with both

language ability and humanistic quality.

2. The connotation and development of artificial intelligence

Artificial intelligence technology is actually an important branch of computer science. Since 1956, it was first proposed at Dartmouth University in the United States, and it has developed rapidly ^[1]. Its core is mainly to simulate and expand human intelligence, and its practical application scenarios are very extensive, mainly including language learning, image recognition, autonomous driving, and other fields. In college English teaching, the development of artificial intelligence technology has gradually advanced towards practicality, including text recognition, voice recognition, image recognition, natural language understanding, and other forms, which brings infinite possibilities in the development of personalized education.

In 2016, the MOOC Buddy teaching robot designed and developed by Holotescu mainly uses big data of courses to provide learners with more personalized learning advice guidance, which can not only recommend resources according to students' actual situation, but also accurately evaluate students' learning status, so as to ensure that each student can adjust his/her learning plan and further demonstrate the educational concept of teaching students in accordance with their aptitude ^[2]. In 2017, the State Council released the "New Generation Artificial Intelligence Development Plan", which clearly emphasized that the use of artificial intelligence technology can achieve educational reform. It is pointed out in this plan that a brand-new education system should be established, which involves intelligent schools and an interactive learning environment, effectively transforming the traditional single teaching mode into a relatively flexible and diverse method, so that teachers are no longer the only ones imparting knowledge, but the guides during students' actual learning. In addition, AI-assisted instruction can make it possible to learn anytime and anywhere. This technology mainly provides students with teaching content that adapts to their learning level and needs according to their mastery of knowledge, thus greatly enhancing their sense of participation and autonomy. Teachers can conduct accurate analysis and feedback through students' actual performance, and give appropriate guidance to students, so as to check and fill in the gaps in knowledge and further show a more personalized and efficient learning model ^[3]. Moreover, artificial intelligence technology can also provide rich resources for education, such as various video micro-courses, online English training, interactive exercises, etc., to ensure that the teaching content is not always limited to the acquisition of previous textbooks, but through the Internet, so that high-quality resources can contribute. In this new mode, no matter how time and space change, students can learn independently conveniently, thus cultivating their ability to think and solve problems independently.

3. The concrete application of artificial intelligence in the cultivation of college English humanistic spirit

In today's education field, the rapid development of artificial intelligence technology provides new impetus for the reform of college English teaching. Colleges and universities, as the main bases for cultivating applied talents, should especially integrate a humanistic spirit into English teaching. Artificial intelligence can not only break the previous single teaching mode, but also solve the difficulties and problems existing in English teaching.

3.1. The introduction of an intelligent learning platform

With the continuous development of big data analysis and artificial intelligence technology, the intelligent learning platform came into being. Through comprehensive analysis and tracking of students' learning data, the platform can generate a more detailed analysis report of the learning situation, thus providing good data support for teachers and ensuring an accurate understanding of students, so as to adjust the teaching plan according to each student's learning situation and the overall performance of the class ^[4]. This data-driven teaching mode enables teachers to devote more time and energy to more valuable teaching content and students' personalized guidance. For example, in order to meet the practical needs of "telling China stories in English" in college English courses, teachers can use the intelligent learning platform to provide students with rich English materials suitable for their actual ability level, thus alleviating the burden of teachers' preparation before class and ensuring the promotion of students' writing speeches and oral expression under this theme.

3.2. Listening training and intelligent matching

Listening is a key part of English teaching in colleges and universities. In the past listening training, students' enthusiasm for English learning was often low because of the lack of attractive training. However, the artificial intelligence platform based on the corpus can proceed from many aspects, such as students' majors, English learning level, and students' learning styles, so as to match the appropriate resources ^[5]. For example, in the "Daily English Listening" App, students can be provided with listening materials in different directions and at different levels through a modular design. This personalized recommendation system can steadily improve the effect of listening training and further stimulate students' interest in language learning. In addition, through different types of news, songs, films, and television dramas and other materials, the platform can provide real-time English subtitles, so as to achieve targeted autonomous learning assistance according to the function of word search and single sentence loop playback, and ensure that students can achieve information acquisition and stable improvement of language use ability in a relatively relaxed environment.

3.3. The promotion of oral expression ability

Oral English is the key to English teaching, but it is a severe challenge for many college students. With the help of artificial intelligence applications such as "English Fluency" in teaching practice, and according to the voice recognition technology and professional databases, the platform can grade users, so as to formulate more personalized practice content according to users' previous data, and further help students overcome the tension in one-on-one communication. By implementing the companion interactive mode, it is convenient for users to practice in real scenes and further meet the goal of fluent expression in English teaching. Moreover, this kind of application can also encourage users to establish their own communication environment, so that they can make oral expression, thus fundamentally enhancing their self-confidence in expressing in English and ensuring that they can successfully complete the expression of "China Story."

3.4. writing assistance and feedback mechanism

During the writing period, the intelligent writing platform of "Correction Network" under artificial intelligence plays an important role ^[6]. The traditional marking method is not only time-consuming but also inefficient. However, the platform mainly uses artificial intelligence for composition marking. On the one hand, it can provide feedback on students' scores in time; on the other hand, it can also make detailed suggestions for

revision, such as sentence structure, vocabulary collocation, and so on. This kind of immediate feedback mechanism enables students to make repeated corrections against their own mistakes, thus significantly improving their writing ability. In addition, the system also has a good peer review function, which is convenient for students to comment on each other, and helps to form a good interactive learning environment, so that students can practice their scoring skills, so as to find inspiration in other people's works and absorb the advantages of others, which affects the whole class and makes the writing course more lively and interesting.

3.5. The development of translation skills

During the translation period, the products of Iflytek and other companies can fully demonstrate the practical potential of artificial intelligence technology in language conversion. Through high-speed and accurate information processing technology, the language and text can be transformed into the target language based on translation tools. Compared with traditional translation methods, this model can steadily improve the overall efficiency of translation and save more time for students to understand the content more deeply, so as to imitate and use it. At the same time, the tool also has the functions of offline translation and scene translation, which can meet the students' language use requirements in different scenarios and improve their business communication skills. It can be seen that the introduction of artificial intelligence technology in college English teaching can not only show the modern education direction, but also provide a new direction for the education of artificial spirit ^[7]. During the practical application, students can get support from information processing to practical application during the autonomous learning stage of artificial intelligence tools, so as to realize the leap of time and space, avoid restrictions, and make the overall knowledge acquisition more flexible.

4. The teaching mode of “point-line-face” in college English humanistic spirit education

In the humanistic spirit of education of English in colleges and universities, by adopting the teaching mode of “point-line-surface”, the problems of “lack of effective input and difficulty in speaking” faced by students during their study can be effectively solved. This model is mainly based on the theory of the “output-oriented approach” and combined with the ideological and political status of English courses in higher vocational colleges, thus creating a brand-new English teaching system.

4.1. Points

“Point” emphasizes the setting of the “theme center point” in each unit in humanistic spirit teaching. Teachers should determine the theme of each unit according to the actual content of the syllabus and teaching materials, so as to ensure that humanistic spirit teaching has a clear direction and structure. The first layer means that each unit needs to carry out in-depth exploration and discussion around the “theme center” at all times, thus forming a more systematic and holistic curriculum system. By setting practical themes in teaching practice, teachers can guide students to clearly understand the humanistic spirit related to learning and further enhance their absorption and understanding of cultural knowledge. The second meaning is that in the early stage of classroom learning, teachers need to distribute relevant video resources to students to promote students' autonomous learning. By reading and watching the learning content before class, students can always take themselves as the center to perceive and absorb the initial knowledge, further stimulate students' enthusiasm for autonomous learning, and let students discuss with their personal understanding in class discussion, which is helpful to promote the

formation of a good learning atmosphere.

4.2. Line

In the “line” stage, the students in the class are mainly divided into different study groups, and the guidance group focuses on the reading materials, so as to conduct in-depth discussions and ensure that each student can elaborate and publish his personal views in the set “theme center”, which is not only a further extension of the personal knowledge system, but also the key to the ideological collision between groups. In the primary school discussion stage, let students share their different understandings of the “theme center” through communication, so that the vague cognition becomes clearer. Obviously, the discussion in groups can make students not only focus on the “dots” generated by their own reading, but also effectively connect the “dots” into “lines” in collective discussion. This structured, systematic, and interactive group discussion can help students form a deep understanding of what they have learned, and further promote students’ English communication and the stable promotion of a humanistic spirit.

4.3. Face-to-face

In the “face-to-face” stage, it is actually a video recording of each group’s speeches in groups to ensure that they can be displayed as works. This process can train students’ ability to tell Chinese stories in English, and it is more suitable for students’ preference for surfing the Internet and watching short videos in the new era. Through the video evaluation within the class, students’ interest in participating in activities can be promoted steadily, and further opportunities for students to compare and improve their works can be provided ^[8]. If educators choose excellent works, they can let students participate in the competition between classes, which can provide cross-class communication and enable excellent works to be shared on a wider platform. Excellent video works are uploaded to the public platform after being recommended by teachers and reviewed by the Youth League Committee, so as to promote the issue of influence and ensure that more teenagers can be exposed to positive cultural stories in China. During the specific application period, educators should also watch the “China Cultural English Speaking” short video contest and school-level English speech contest organized by the department, clearly recognize the feedback of humanistic spirit teaching assisted by artificial intelligence technology, ensure that students are more willing to participate in it, and further stimulate students’ strong desire and enthusiasm for knowledge. Therefore, artificial intelligence needs to be deeply integrated with educational concepts, so as to improve efficiency while retaining the cultural temperature and humanistic value of language learning.

5. Conclusion

In short, through the integration of artificial intelligence and humanistic spirit in English, it is found that the integration and development of the two can realize the stable improvement of teaching effect, which can not only provide students with a personalized learning experience, but also help teachers pay more attention to the cultivation of students’ emotions and values. In the future educational practice, educators need to comprehensively promote this integration mode, so as to ensure the creation of a personalized learning environment and help students master language skills accurately, thus realizing the establishment of correct values and world outlook, and further laying the foundation for the cultivation of compound talents with both professional ability and humanistic quality.

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Exploration on the Curriculum Reform of Medical Microbiology in Colleges and Universities under the Pattern of “Great Ideological and Political Education”

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Abstract: With the implementation of the fundamental task of “establishing morality and cultivating people”, the construction of the pattern of “Great Ideological and Political Education” has become an important measure for colleges and universities to promote the concept of “all-round education, whole-process education, and all-staff education” at present. In this process, teachers should deeply grasp the characteristics and advantages of ideological and political education in courses, realize the goal of ideological and political guidance through the integration of ideological and political elements with professional courses, and gradually build a pattern of “Great Ideological and Political Education” featuring “full participation, whole-process implementation, and all-aspect fulfillment.” This paper explores the course of Medical Microbiology, expounds the problems faced by the teaching of Medical Microbiology in colleges and universities under the pattern of “Great Ideological and Political Education”, and then puts forward the paths and strategies for the curriculum reform of Medical Microbiology in colleges and universities under this pattern. In this way, it organically integrates value shaping, knowledge impartment, and ability cultivation, realizes the parallel development of the Medical Microbiology course and ideological and political education, and provides strong support for cultivating outstanding medical talents with both virtue and ability, as well as noble medical ethics in the new era.

Keywords: Colleges and universities; Medical microbiology; Pattern of “Great Ideological and Political Education”; Curriculum reform

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1. Introduction

The pattern of “Great Ideological and Political Education” is an educational concept that runs through the whole process of education. Under this background, the reform of the Microbiology course should be based

on the fundamental task of “establishing morality and cultivating people.” It is not only necessary to fulfill the important mission of imparting professional knowledge such as the biological characteristics of pathogens, pathogenic mechanisms, diagnosis and prevention, but also to explore and utilize rich ideological and political education resources in this process, so as to cultivate students’ ideological and political literacy such as cultural confidence, scientific spirit, professional ethics, feelings for the country and care for humanity. This paper explores the basic paths and methods of constructing the pattern of “Great Ideological and Political Education” in the curriculum reform of Medical Microbiology in colleges and universities, aiming to provide a reference model for the ideological and political construction of medical professional courses.

2. Problems faced by the teaching of medical microbiology in colleges and universities under the grand ideological and political pattern

2.1. Weak awareness of curriculum ideological and political education, and top-level design

First, there is a deviation in teachers’ cognition. Some professional teachers have a wrong understanding of ideological and political education, mistakenly believing that ideological and political work is the responsibility of ideological and political teachers and counselors. They neither have the awareness to take the initiative to undertake the infiltration of ideological and political education nor conduct in-depth learning of the methods and techniques of curriculum ideological and political education, which makes it difficult for them to implement ideological and political education at the cognitive level.

Second, the curriculum teaching objectives are separated from the ideological and political education objectives. In the current teaching of the Medical Microbiology course, teachers have a clearer goal for cultivating students’ professional knowledge and abilities, but the setting of ideological and political education objectives is relatively general and vague, and they even fail to combine the knowledge of the Medical Microbiology course, thus failing to form measurable and implementable objectives and evaluation mechanisms ^[1].

Third, there is a lack of systematic guidance and planning. At this stage, in the ideological and political teaching of the Medical Microbiology course, most teachers present the ideological and political elements in a fragmented way, and even mainly carry out infiltration randomly based on their own ideas. They fail to conduct systematic planning and design from the perspective of the curriculum system, resulting in the lack of continuity and depth in curriculum ideological and political education.

2.2. The excavation and integration of ideological and political elements are rigid

First, the integration method is rigid, and the integration effect remains superficial. Some teachers have insufficient awareness and understanding of the integration of ideological and political elements, which leads to a “for-the-sake-of-integration” purpose in their infiltrative teaching design. They rigidly insert ideological and political elements into classroom teaching, resulting in the ideological and political education effect remaining on the surface. For example, after teaching knowledge related to virus structure, teachers suddenly shift to the content of patriotic education without establishing carriers such as scenarios, contexts, characters, or stories, which causes students to feel resentful during the infiltration of ideological and political elements ^[2].

Second, the excavation of resources is insufficient, and the integration into teaching applications is not in-depth. On the one hand, most teachers of the Medical Microbiology course lack experience in ideological

and political education and a profound understanding of ideological and political elements. Therefore, when excavating ideological and political elements, they mainly focus on aspects such as scientists' stories and the country's great achievements, and fail to design details in combination with the specific content of the Medical Microbiology course. On the other hand, when integrating and applying ideological and political resources, teachers are also accustomed to presenting them through oral narration, rather than using forms such as videos, stories, historical materials, or statistical data, which results in poor integration effects.

Third, there is a lack of medical professional characteristics. In the ideological and political teaching of the Medical Microbiology course, teachers still lack the concept and awareness of infiltrating ideological and political elements from a professional perspective. They neither introduce ideological and political cases in the medical field nor focus on cultivating students' literacy in medical ethics, biosafety, and public health awareness, which weakens the appeal of ideological and political education.

2.3. Outdated and unitary teaching methods and carriers

First, the ideological and political teaching methods for the course are backward, with a lack of interest-building links. In the current ideological and political teaching of the Medical Microbiology course in colleges and universities, most teachers still adopt the "cramming" method of teaching. During this process, they fail to design teacher-student interaction activities, resulting in a poor learning experience for students. Some students even remain in a passive learning state, making it difficult for them to proactively accept the course knowledge and ideological and political content, let alone develop profound emotional resonance and ideological identification ^[3].

Second, the application of information technology is insufficient, and the development of information-based teaching models lags behind. Teachers of the Medical Microbiology course fail to leverage the advantages of information technology in the design of ideological and political infiltration. They do not use online courses, case databases, virtual simulation technology, etc., for auxiliary teaching, nor do they establish a multi-modal, multi-platform, and diversified teaching system. This leads to teaching formats that fail to attract students' attention and interest ^[4].

Third, the integration of practical teaching activities with ideological and political education is inadequate. In practical teaching sessions of the Medical Microbiology course, such as experimental courses and clinical internships, teachers only focus on students' operational skills and experimental results. Therefore, they rarely integrate ideological and political elements into these processes, failing to cultivate students' scientific attitude, team spirit, awareness of biosafety, and the concept of reverence for life.

2.4. Lack of teaching evaluation and feedback mechanisms

First, the evaluation dimensions are set in a unitary manner. The current teaching evaluation system for the Medical Microbiology course in colleges and universities mainly focuses on students' mastery of theoretical knowledge and their experimental operation skills, and conducts evaluation through means such as exam scores and experimental reports. It fails to evaluate students' comprehensive qualities such as values, professional ethics, and scientific spirit.

Second, there is a lack of evaluation methods. The evaluation of the Medical Microbiology course mainly relies on exams and experiments as assessment approaches, and no evaluation system integrating quantitative and qualitative methods has been established. In particular, it fails to include classroom observation, group

performance, reflection journals, case analysis reports, and other forms in the evaluation criteria.

Third, there is a lack of feedback and adjustment mechanisms. The purpose of teaching evaluation is not just to evaluate; instead, it is to identify students' shortcomings and problems based on the evaluation results, and then provide targeted teaching guidance and improvement plans. However, the current teaching evaluation of the Medical Microbiology course has not set up corresponding feedback and adjustment mechanisms, nor has it established a cyclic system of "teaching-evaluation-feedback-improvement", which significantly reduces the practical value of evaluation ^[5].

3. Reform paths and strategies of medical microbiology curriculum in colleges and universities under the grand ideological and political pattern

3.1. Reconstructing curriculum objectives and content system, and strengthening top-level design

First, establish three-dimensionally integrated curriculum objectives. For the Medical Microbiology curriculum, the construction of its ideological and political elements should start with top-level design. Then, under the guidance of curriculum objectives, teachers and students are guided to pay attention to the integration, infiltration, and teaching application of ideological and political elements, so as to achieve the goal and effect of implementing the fundamental task of fostering virtue through education. To this end, teachers should design the teaching objectives in a detailed, concrete, and precise manner to ensure the operability and identifiability of the objectives. For example, in the teaching of the curriculum module related to "bacterial drug resistance mechanisms", the knowledge module should focus on "understanding and explaining bacterial drug resistance mechanisms"; the competency objective should be oriented towards "possessing the ability to design drug sensitivity tests"; and the ideological and political objective should be refined based on "the social responsibility of rational use of antibiotics" ^[6]. This not only elaborates the knowledge and skills that students need to master in a progressive manner, but also achieves the goal of infiltrating ideological and political elements through prior guidance.

Second, systematically explore and integrate ideological and political elements. In the construction of ideological and political elements in the Medical Microbiology curriculum, colleges and universities should set up a special teaching team for curriculum-based ideological and political education. Through collective lesson preparation and other methods, the team should deeply explore the content of ideological and political elements related to this curriculum, and then classify them into four modules ^[7]: "scientific spirit and innovation, professional ethics and responsibility, patriotism and self-confidence, and global perspective and care." At the same time, teachers should also systematically sort out the chapter structure and development process of the Medical Microbiology curriculum, and then match and connect the ideological and political elements of different modules with the curriculum knowledge points. In this way, a systematic ideological and political resource system is established, and a mapping relationship between knowledge points and ideological and political points is formed.

Third, revise the syllabus and teaching plans. After the establishment of the mapping relationship between knowledge points and ideological and political points, teachers should further improve the syllabus and teaching plan design of the Medical Microbiology curriculum. On the one hand, it is necessary to clarify the ways and expected effects of integrating different types of ideological and political elements into each chapter; on the other hand, it is necessary to optimize the design of teaching plans and establish a teaching paradigm that is fully covered, multi-carrier, and hierarchical.

3.2. Innovating teaching methods and carriers to promote in-depth integration

First, apply the case teaching method and the project-based teaching method. The construction of curriculum-based ideological and political education should aim to serve curriculum teaching. It is necessary not only to give play to its advantages of stimulating interest and being problem-oriented, but also to avoid ideological and political elements overshadowing the main content of the curriculum, which would adversely affect students' curriculum learning efficiency. To this end, teachers can create ideological and political carriers through cases or projects related to Medical Microbiology knowledge. While explaining, presenting, and elaborating on curriculum knowledge, they can explore the ideological and political elements contained therein, so as to achieve better teaching effects. For example, when learning the curriculum module related to "pathogen investigation", teachers can create a case of "MRSA infection outbreak" and organize students to carry out a simulated pathogen investigation project. This can not only help students master the knowledge points and skills of this course, but also help them develop ideological and political literacy, such as public health safety, doctor-patient communication, and ethical decision-making, thus achieving the teaching effect of in-depth integration ^[8].

Second, adopt situational simulation and role-playing teaching methods. In addition to case and project carriers, teachers can also use situational and role-playing activities as carriers for the integrated teaching of ideological and political elements in the Medical Microbiology curriculum. For example, in the teaching activities of the course related to "response to public health emergencies", teachers can create a live scene of a "press conference" and require students to play the role of the person in charge. While communicating with the news media, students explain the causes of the incident and the countermeasures. They can even use a simulation system to simulate the transmission of pathogens, so as to enhance students' communication and expression skills, sense of social responsibility, and ability to respond to emergencies.

Third, build an online-offline collaborative education platform. Teachers can also infiltrate ideological and political elements through online platforms. For instance, they can offer special micro-courses to tell students about content related to "medical history stories" and "cutting-edge Medical Microbiology technologies." They can also set up new media platforms and expand the scope of ideological and political education by producing videos such as "biographies of Medical Microbiology scientists" and "daily popular science on Medical Microbiology" ^[9].

3.3. Expanding the dimensions of practical teaching to achieve the unity of knowledge and practice

First, enhancing the ideological and political education effect of experimental courses. In the experimental courses of Medical Microbiology, teachers should not only emphasize the culture of "seeking truth" and require students to use real experimental data, but also strictly standardize students' experimental operation methods and procedures. Through this, students' awareness of biosafety can be infiltrated, and their respect for life and professional ethics can be gradually improved ^[10]. In addition, teachers should also use methods such as demonstration experiments and video demonstrations of common mistakes in experimental operations to help students further understand the importance of experimental safety. In this process, students' teamwork and communication skills are strengthened, enabling them to complete experimental tasks together with mutual assistance.

Second, launching the second classroom and social practice activities. For the construction of ideological and political elements in the Medical Microbiology curriculum, on the one hand, teachers can establish a

second classroom. Through activities such as campus student clubs, visits and studies at centers for disease control and prevention, and exchanges with vaccine research institutes, students can gain knowledge and literacy related to Medical Microbiology outside the classroom. On the other hand, project activities such as “investigation of microbial distribution on campus”, “survey on the awareness of antibiotic use”, and “promotion of infectious disease prevention and control” can be carried out on campus. These activities guide students to acquire knowledge, develop abilities, and make contributions in practice, thereby internalizing their sense of professional mission ^[11].

3.4. Constructing a diversified evaluation system to ensure the effectiveness of reform

First, adding ideological and political evaluation dimensions. Teachers should incorporate the performance and development of students’ ideological and political literacy into the evaluation system of the Medical Microbiology curriculum. They can assess students’ ideological and political literacy through indicators such as their performance in classroom learning, participation in team activity discussions, perspectives in case analysis, scientific attitudes reflected in experimental reports, and enthusiasm for participating in social practices.

Second, adopting diversified evaluation tools and carriers. In addition to examinations and experiments, teachers can also conduct evaluations through forms such as classroom observation records, students’ reflection journals, group review results, project research reports, and students’ defense conclusions, so as to objectively present students’ values, emotional attitudes, and levels of knowledge and skills ^[12].

Third, establishing a feedback and continuous improvement mechanism. Teachers can also regularly collect the teaching effects of ideological and political elements in the Medical Microbiology curriculum and students’ feedback through methods such as questionnaires, student interviews, and teaching supervision observations. Based on relevant data, they can identify practical problems and then establish a high-quality curriculum-based ideological and political teaching paradigm with continuous improvement by adjusting teaching strategies and methods.

4. Conclusion

To sum up, promoting the reform of the Medical Microbiology curriculum under the “grand ideological and political” pattern is an important measure for colleges and universities to implement the fundamental task of fostering virtue through education. This reform not only requires teachers to change their own concepts and cognitions, but also needs to deepen the reform from four dimensions: objective reconstruction, content integration, method innovation, and evaluation guarantee. By doing so, it can solve the problem of “separation between ideological and political education and professional education”, fully integrate ideological and political education into the whole process of medical professional education, and realize the mutual promotion and complementarity of “fostering virtue” and “cultivating people.”

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The Confucian Concept of “Harmony without Uniformity” and Its Implications for the Paradigm Shift in China-ASEAN Intercultural Communication Competence Theory

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Abstract: Deepening regional cooperation between China and ASEAN urgently requires innovative paradigms for intercultural communication competence. This study focuses on the implications of the Confucian concept of “harmony without uniformity” for constructing a China-ASEAN-specific theoretical framework of intercultural communication. By reinterpreting classical texts and reconstructing the philosophical meaning of this concept, the study reveals its core value: the dynamic unity of embracing differences while fostering consensus. The current dominant Western paradigms guiding China-ASEAN intercultural communication practices exhibit structural limitations in both respecting cultural heterogeneity and seeking common values. The concept of “harmony without uniformity” thus offers a valuable indigenous theoretical resource. It suggests a shift from mere transplantation of foreign models to the development of a more inclusive and effective theoretical framework centered on cultural symbiosis. This new framework advocates for constructive dialogue to identify shared interests and cooperative opportunities, while fully acknowledging and respecting cultural diversity, thereby achieving harmonious coexistence and mutual development. Based on these insights, the study proposes practical pathways for theoretical transformation, including reshaping intercultural education concepts, enhancing adaptability in multicultural contexts, and strengthening policy coordination. The goal is to provide theoretical support and practical guidance for the steady and long-term development of China-ASEAN relations.

Keywords: Confucian concept of “harmony without uniformity”; China-ASEAN; Intercultural communication; Theoretical paradigm; Intercultural ethics

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1. Introduction

The establishment of a comprehensive strategic partnership between China and ASEAN—aimed at peace, security, prosperity, and sustainable development—relies not only on close economic and trade ties, but also on deep cultural understanding and value communication. In this process, an effective paradigm shift in intercultural communication competence theory has become a key theoretical support for deepening regional cooperation. Rooted in the fertile soil of Chinese civilization, the Confucian concept of “harmony without uniformity” embodies profound wisdom in managing intercultural relations. It emphasizes the pursuit of value consensus and harmonious coexistence through constructive dialogue, on the premise of fully respecting cultural heterogeneity. This offers an important indigenous philosophical resource for rethinking and reconstructing contemporary intercultural communication theory ^[1]. The core of this concept resonates strongly with the goals of critical cultural relativism, particularly in the pursuit of cultural equality and reciprocity. It also provides a distinct Eastern perspective for overcoming the limitations of cultural centrism embedded in Western intercultural communication paradigms. In coping with ASEAN’s highly heterogeneous and pluralistic cultural ecology, the inclusive dialogue and consensus-building model advocated by “harmony without uniformity” demonstrates significant theoretical compatibility and practical potential.

Currently, global intercultural communication theory is undergoing a profound paradigm shift—from emphasizing unidirectional “cultural adaptation” to stressing bidirectional “cultural co-construction.” Traditional models either focus on static comparisons of cultural differences or demand that weaker cultures adjust unilaterally to dominant ones. Such approaches often fail to respond effectively to complex, dynamic intercultural interaction contexts. The Confucian idea of *he* (harmony), embedded in “harmony without uniformity”, inherently calls for the creative transformation and mutual empowerment of different cultural actors through equal interaction, ultimately guiding them toward dynamic balance and symbiotic development based on mutual understanding ^[2]. This paradigm shift poses a dual challenge for theoretical construction: on one hand, it must break free from long-dominant Western discourse frameworks to avoid falling into the trap of simplistic “theoretical transplantation”; on the other, it must guard against tendencies toward “cultural essentialism”, which risk solidifying differences into unbridgeable and static divides. Against this backdrop, drawing from indigenous intellectual traditions to construct a theoretical system with regional characteristics and cultural subjectivity becomes particularly important.

This study aims to systematically elucidate the theoretical insights offered by the Confucian concept of “harmony without uniformity” for promoting the paradigm shift in China-ASEAN intercultural communication. By deeply deconstructing its threefold logical dimensions—acknowledgment of difference, dialogic rationality, and ethics of coexistence—the study seeks to lay a solid philosophical foundation for building a regionally tailored intercultural competence assessment framework, negotiation mechanisms, and conflict transformation strategies.

2. The ontological implications and contemporary transformation of “harmony without uniformity”

2.1. Philosophical foundations of traditional meanings

The Confucian concept of “harmony without uniformity” (from *The Analects*, “Zi Lu” chapter) reveals at the ontological level a fundamental law of existence: “harmony” refers to a state of dynamic unity achieved through diversity, while “difference” points to the inherent uniqueness and heterogeneity of all things ^[3]. These

two aspects form an inseparable dialectical unity. Traditional commentaries emphasize that harmony is not homogenization that erases differences, but rather an organic integrity and balanced state formed through the interaction of diverse elements—an embodiment of the Way of Heaven. Neo-Confucianism in the Song-Ming period, especially Zhu Xi's theory of li (principle) and qi (vital force), elevated this notion to an ontological height. Li is immanent in all qi, and the diversity of qi is a necessary condition for the manifestation and fulfillment of li, jointly forming the ontological structure of all existence.

This ontological awareness profoundly shaped Confucian practical philosophy, whose core affirms that difference is the premise—rather than an obstacle—to generating harmony. Guo Xiang's "Theory of Individual Transformation" in the metaphysical tradition explains how individuals, while maintaining self-sufficiency, naturally integrate into the cosmic whole through mutual interdependence (xiang yin) ^[4]. Traditional political-ethical practices also reflect this structure by unifying respect for individual difference with the pursuit of collective harmony. The ultimate goal is to achieve a higher level of order and vitality through coexistence in diversity.

2.2. Ontological structure: Difference, harmony, and dynamic coexistence

From an ontological perspective, the essence of "harmony without uniformity" lies in constructing a dynamic equilibrium structure based on the acknowledgment of difference and harmonious coexistence. This structure first establishes the ontological legitimacy of difference—difference is a fundamental attribute of all existence, the very source of vitality and creativity in the universe. To negate difference is to negate existence itself ^[5]. Second, harmony is defined as the optimal state of coexistence achieved through non-antagonistic interaction among differences. It is not a static end state, but a continuously adaptive and dynamic process ^[6].

Harmony and difference exhibit a mutually constitutive and co-creative relationship at the ontological level: without difference, harmony becomes a hollow sameness; without harmony, difference degenerates into disorder and conflict. This relationship is vividly exemplified in complex systems such as the "One Country, Two Systems" framework, where "One Country" provides the structural unity, and "Two Systems" coexist and evolve through dynamic interaction. Its resilience stems precisely from institutional tolerance and integration of differences ^[7]. This ontological structure provides a fundamental insight for intercultural communication: effective communicative paradigms must transcend superficial conformity or suppression of difference, and instead aim to build dynamic balancing mechanisms that accommodate, coordinate, and transform differences—treating cultural heterogeneity as an ontological resource for constructing more inclusive and creative communities.

2.3. Theoretical transformation pathways of ontological reconstruction

The ontological reconstruction of "harmony without uniformity" seeks to transform its classical wisdom into core theoretical resources for addressing contemporary intercultural dilemmas. The first task in this reconstruction is to affirm the ontological legitimacy of incommensurable difference. This means recognizing, at the philosophical level, that distinct cultural systems possess unique value logics and modes of existence grounded in their own historical trajectories. It requires communicative agents to discard cultural hierarchies and to respect the heterogeneity of others while maintaining their own cultural subjectivity. Liang Shuming's comparative work on Chinese and Western cultures serves as a model of creative dialogue rooted in cultural subjectivity at the ontological level ^[8].

The core of the reconstruction lies in deconstructing the static ideal of harmony and affirming its ontological meaning as a process of dynamic consensus-building. This entails moving beyond the traditional focus on “adaptation” or “assimilation” in intercultural theory toward an understanding based on dialogic rationality and mutual construction. The aim is not to eliminate differences to achieve absolute sameness, but, as seen in the Confucian idea of *minben* (people-centeredness), to pursue overlapping consensus and cooperative frameworks based on the fundamental needs of multiple cultural agents. This ontological transformation offers deep philosophical legitimacy and direction for constructing a new China-ASEAN intercultural communication paradigm—such as designing difference-sensitive evaluation indicators based on regional cultural characteristics, building negotiation mechanisms grounded in mutual empowerment, and developing strategies that transform rather than suppress conflicts. Ultimately, it points toward achieving sustainable symbiotic prosperity through cultural diversity.

3. Theoretical paradigm of China-ASEAN intercultural communication competence

3.1. Existing theoretical paradigms and their limitations

Current theories on China-ASEAN intercultural communication primarily transplant the Western cognition–adaptation paradigm, represented by Hofstede’s cultural dimensions and Byron’s competence model. These models have shown instrumental value in the early stages of regional cooperation—for instance, through the use of power distance analysis to inform policy design or cultural intelligence to enhance business localization effectiveness^[9]. However, this paradigm has structural flaws. It presupposes an absolute opposition of cultural differences, falling into the trap of difference-centrism, and reduces ASEAN’s “unity in diversity” cultural ecology into a static source of conflict. Its deeply embedded Western modernist value assumptions also fail to explain the interactive tradition of “harmonious coexistence” between China and ASEAN. More critically, its explanatory power at the regional level is insufficient. The paradigm focuses on resolving technical conflicts but obscures the mechanisms through which shared values are generated. In scenarios such as deep cooperation under the Belt and Road Initiative, it cannot support the construction of strategic mutual trust or explain the disparities in cultural influence under asymmetric power relations.

These limitations call for a fundamental shift in theoretical logic—from “managing differences” to “creating consensus”—moving beyond instrumental rationality to construct a culturally inclusive dialogic framework. This new model should integrate the wisdom of traditional Chinese culture with ASEAN’s unique characteristics to build a novel analytical paradigm. Such a transformation is not only an academic innovation but also a theoretical cornerstone for building a China-ASEAN community with a shared future.

3.2. Structural dilemmas in regional practice

In regionalized contexts, the limitations of the current paradigm manifest as a dual dilemma of unidirectional cognitive frameworks and fragmented practical pathways. Theoretically, it sticks to the binary mode of cultural opposition, simplifying communication into a linear process from identifying differences to making behavioral adaptation. This leads to cultural relativism fatigue and an overemphasis on differences, causing actors to overlook inherent cultural connections—for example, value-based deadlocks in China-ASEAN business negotiations. Such rigid thinking cannot explain the coexistence mechanisms of ASEAN’s multiculturalism and hinders the formation of a deeper cooperative consensus.

Practically, the absence of consensus-building results in weakened action effectiveness. The shared development aspirations driven by ASEAN's regional community awareness are narrowed into mere "difference adaptation" goals, shrinking spaces for dialogic negotiation. In collaborative areas like transnational environmental protection or cultural heritage preservation, cultural diversity has failed to become an innovative resource and instead has led to the dilemma of "each appreciating their own beauty, but unable to achieve mutual beauty." The lag in theory seriously hampers the construction of a regional community of shared humanity, necessitating the development of an operational framework that balances cultural uniqueness with regional integration.

3.3. The inevitable path of paradigm transformation

The deepening of China-ASEAN relations from economic cooperation to a community of shared humanity makes paradigm transformation essential in three respects:

First, it is necessary to integrate variables such as geopolitical factors and historical memory to cope with complex cultural interactions in emerging contexts like the digital economy; Second, it is critical to overcome the fundamental tension between Western instrumental rationality and the region's cultural gene of "harmonious coexistence"; Third, the joint construction of the Belt and Road Initiative demands a shift beyond conflict-oriented assumptions to the proactive building of shared value foundations.

Confucian philosophy of "harmony without uniformity" offers both philosophical and methodological support for this transformation. Its ontological foundation of "dynamic balance in coexistence of differences" challenges absolutist views of cultural difference and underpins a theory of cultural co-construction. Its advocacy of the "hehe (harmonious integration)" path enables the transformation of differences into sources of innovation, and concretely guides a three-dimensional practical framework: building a multi-dimensional evaluation system that emphasizes both cultural differences and commonalities, establishing a consultation mechanism based on overlapping consensus, and developing a "difference-empowered" model of cooperation.

This transformation signifies a paradigm leap from "managing differences" to "co-creating symbiosis", offering a regional epistemological model for building a community with a shared future for humanity.

4. Insights from the concept of "harmony without uniformity" for paradigm transformation

4.1. Direction and objectives of the transformation

The Confucian concept of harmony without uniformity sets the core direction for transforming intercultural communication paradigms: to break free from the binary logic of "cultural conflict-adaptation" and build a three-dimensional framework of "difference-consensus-symbiosis." By drawing on the practical wisdom of "zhong he" (attaining harmony through balance), it transforms cultural differences into resources for dialogue. This requires the theoretical system to establish inclusive evaluation criteria and methodological tools that allow for equal interpretation of Chinese and ASEAN cultural traits ^[10]. The transformation aims to construct mechanisms for dynamic balance. In terms of cultural identity, it seeks to transcend the binary of "assimilation/isolation" and foster a model of mutual subjectivity. On the level of interaction strategies, it integrates ASEAN's indigenous wisdom with the Confucian notion of hehe (harmonious integration) to form a flexible operational framework that unifies cultural authenticity with behavioral adaptation.

The ultimate goal is to construct a community of symbiotic intercultural communication development.

The historical wisdom of “bringing harmony to all nations” (xie he wan bang) provides a valuable reference for contemporary practice. The theoretical system should activate the economic and social value of cultural differences by designing mechanisms for knowledge sharing and resource integration, transforming differences into drivers of innovative development. Given the unique advantages of China and ASEAN in terms of geopolitical complementarity and civilizational dialogue, the paradigm shift must respond to regional integration needs. Institutional arrangements should protect cultural diversity, ensuring that the enhancement of intercultural competence and the growth of shared interests become mutually reinforcing ^[11]. Essentially, this transformation reconstructs the cognitive paradigm of intercultural communication—turning difference from an obstacle into a catalyst for mutual learning among civilizations, and offering a theoretical reference rooted in Eastern wisdom and regional characteristics for global research.

4.2. Theoretical reconstruction of ethical values

The ethical value system embedded in the harmony without uniformity concept provides a core compass for paradigm transformation ^[12]. The ethical standard of “a gentleman seeks harmony without being the same” constructs a dialectical relationship between difference and consensus, reflected in three key dimensions: Cultural subjectivity emphasizes seeking common values on the basis of recognizing uniqueness, urging communicators to reject assumptions of cultural superiority and avoid unilateral output; Dialogue mechanisms go beyond the “conflict–fusion” framework by employing the principle of “appreciating one’s own beauty and the beauty of others” to achieve value amplification; Ethics of cooperation reframe differences as creative resources. The Zhong He methodology guides intercultural cooperation beyond utilitarian aims toward sustainable value co-creation.

This ethical reconstruction drives a dual transformation of the paradigm: from an assimilationist mindset of “eliminating difference” to a symbiotic mindset of “respecting difference”; from zero-sum cultural competition to a collaborative path of value co-creation. It not only offers ethical guidance for resolving cultural conflict but also constructs a theoretical framework for multicultural coexistence, marking a paradigm shift in intercultural research from instrumental rationality to ethical rationality. This transformation aligns with global consensus on preserving cultural diversity and lays a cultural-ethical foundation for the China-ASEAN community with a shared future.

4.3. Systematic construction of practical pathways

The practical pathways inspired by harmony without uniformity begin with educational innovation. Inclusive values should be embedded into curricula to form a pedagogy oriented toward mutual cultural learning. Through immersive experiences such as classical text study and international practice bases, dynamic cultural cognition can be fostered, laying the cognitive groundwork for paradigm transformation ^[13]. Training in cultural sensitivity must be systematized, establishing a cognitive path of “difference–understanding–integration.” With the aid of situational simulations and case studies of conflict, symbol recognition skills can be enhanced, guiding individuals from defensive reactions to adaptive participation, and ultimately cultivating empathetic intercultural strategies.

At the policy level, a long-term cooperation mechanism is needed. Dedicated funding should support academic exchange and language training to promote bidirectional knowledge flows, while a cultural resource database should be built to provide normative support. Policy design must avoid cultural superiority and ensure

that the principle of harmony without uniformity permeates institutional structures.

Together, educational reform, experiential training, and policy support form a three-pronged drive that collectively pushes the paradigm from a unidirectional adaptation model to a bidirectional mutual-learning model—achieving synergistic advancement amid cultural differences.

5. Conclusion

This study has analyzed the philosophical core and contemporary transformation logic of the Confucian concept of harmony without uniformity, in light of the practical context of China-ASEAN intercultural communication. It reveals the dual ontological and methodological support this concept provides for paradigm transformation. The research establishes the dialectical structure of “recognizing differences — seeking consensus — harmonious coexistence” as the core pathway to overcoming limitations in existing paradigms. By replacing cultural negation with respect for difference and surpassing adaptation-assimilation mechanisms through negotiated consensus, the concept effectively addresses structural shortcomings in Western theoretical frameworks. This inclusive mindset not only aligns with the multicultural coexistence demands of the global era but also anchors values for regional cooperation.

Differences in political systems, religious beliefs, and other dimensions between China and ASEAN can be transformed—through the dialogic principles of harmony without uniformity—into constructive resources for building new regional relationships. Intercultural communication practices must go beyond surface-level cultural comparison and instrumental training, toward a synergy mechanism centered on shared values, structured through institutional collaboration, and connected via mutual cultural learning. This transformation represents not only a contemporary activation of Confucian *hehe* wisdom but also a contribution to intercultural theory for constructing a community with a shared future for humanity. While theoretical interpretations of harmony without uniformity are increasingly mature, practical validation remains underdeveloped. Future research should focus on the China-ASEAN cooperation context, establishing an evaluation framework that integrates quantitative and qualitative methods to systematically assess the concept’s empirical effectiveness in cultural conflict mediation, dialogic discourse construction, and regional trust-building—especially its adaptive application in deep cooperation under the Belt and Road Initiative.

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Implementation of the New Curriculum Standards: Empirical Research and Path Exploration of Life-Oriented Teaching in Primary Chinese Language Education

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Abstract: The 2022 edition of the “Chinese Curriculum Standards for Compulsory Education” emphasizes that Chinese language teaching should be “based on life”, with life-oriented teaching emerging as a crucial pathway for enhancing students’ core competencies in Chinese. However, practical implementation faces challenges such as superficial understanding among teachers, poor compatibility of teaching models, and a disconnect between theory and practice. Supported by theories such as Tao Xingzhi’s life education theory, this study employs literature research, questionnaires (administered to 160 teachers from four primary schools in the S district of Chongqing), interviews (with 10 teachers), and case analysis (including texts like “A Mother’s Deep Affection”) to conduct its research. The findings reveal that while teachers recognize and value life-oriented teaching, there are issues such as insufficient innovation in classroom formats, a pronounced tendency towards exam-oriented teaching, low professionalism in training, obstacles posed by the exam-oriented system, and inadequate home-school collaboration. Based on these findings, the study proposes expanding life-oriented teaching materials, constructing a systematic teaching framework, and promoting integration with learning task clusters, providing references for improving teaching quality.

Keywords: Primary Chinese language education; Life-oriented teaching; Life education

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1. The raising of the issue

In the current educational transformation, life-based teaching stands as a pivotal issue in primary school Chinese language education. As technologies like artificial intelligence integrate into social life, education must cultivate students’ ability to adapt to future living environments. The Compulsory Education Chinese Language Curriculum Standards (2022 Edition) explicitly advocate a learning approach that “takes life as its

foundation, centers on language practice activities, is guided by learning themes, and utilizes learning tasks as its vehicle”^[1]. This guiding principle positions life-based teaching as a cornerstone of Chinese language education, highlighting its pivotal role in enhancing students’ core literacy competencies and promoting their holistic development. However, the advancement of life-oriented teaching has not been without challenges. On one hand, some teachers possess only a superficial understanding of life-oriented teaching, resulting in a lack of flexibility in their instructional methods, which come across as rigid. They merely incorporate “life-oriented” elements in a formalistic manner, failing to genuinely integrate Chinese language knowledge with students’ lives. This approach not only disrupts classroom order and impedes progress but also solidifies students’ thinking patterns, limiting the development of their innovative and critical thinking abilities. On the other hand, the existing life-oriented teaching models exhibit poor compatibility with other instructional approaches, making it difficult to form a synergistic system. This leads to a monotonous and rigid teaching style with low efficiency, preventing the full realization of the advantages of life-oriented teaching. Furthermore, although the new curriculum standards have provided a clear direction for Chinese language education, their implementation period has been short, with theoretical research remaining shallow and practical exploration still in its initial stages, resulting in a disconnect between theory and practice. Frontline teachers often encounter significant difficulties in translating the requirements of the curriculum standards into teaching practices due to a lack of thorough understanding of their connotations, highlighting an urgent need for systematic research to provide feasible guidance. Life-oriented teaching aligns closely with modern pedagogical concepts, fully respecting the physical and mental development patterns of primary school students, and harmonizes well with the requirements of the 2022 edition of the curriculum standards. Delving into strategies for life-oriented teaching in primary school Chinese under the backdrop of the new curriculum standards holds immense practical significance. From the perspective of refining teaching approaches, it facilitates the deep integration of the new curriculum standards with life-oriented teaching, fostering the construction of a more scientific, efficient, and dynamic Chinese language teaching system. From the standpoint of practical guidance, by comprehensively analyzing existing issues and actively exploring targeted solutions, it can provide frontline educators with a solid theoretical foundation and highly operable practical references, thereby aiding in enhancing the quality of primary school Chinese language teaching, effectively cultivating students’ abilities to apply Chinese language knowledge, and nurturing their core competencies. This, in turn, lays a solid foundation for students’ lifelong learning and future development.

2. Literature review

Research on the connection between education and life abroad continues to deepen, incorporating a new perspective of technological integration on the foundation of traditional theories. Dewey’s theory of “Education is Life” remains a central framework, with scholars in recent years further integrating digital life scenarios to propose that “life-oriented teaching should align with students’ digital native experiences”^[2-3]. Sukhomlinsky’s concept of “learning through real life” has given rise to research on “project-based life practices”, emphasizing the cultivation of comprehensive abilities through community service and interdisciplinary life tasks^[4]. The UNESCO 2022 report “The Future of Education” supplements the “Four Pillars” with “learning to cope with uncertainty”, prompting many countries to integrate life-oriented teaching with the cultivation of future survival skills, exemplified by Finland’s interdisciplinary fusion practice of “life skills courses” with Chinese language teaching in basic education^[5]. Currently, domestic research primarily focuses on the relationship

between Chinese language education and life. Tao Xingzhi's theory of life education remains central, but recent studies have increasingly concentrated on the integration of "task groups in the new curriculum standards with life", such as Wen Rumin's proposal to "activate task group teaching through life scenarios" [6-7]. Scholars have further explored the "application of Chinese language in real-life contexts", emphasizing the deepening of textual understanding through family and community life scenarios. In recent years, domestic research has pointed out new issues in life-oriented teaching, such as "insufficient utilization of digital materials", "imbalance in life materials between urban and rural areas", and "disconnection from the evaluation of core competencies." Additionally, some teachers struggle to balance "life-orientation" and "subject specificity." Scholars generally agree that life-oriented teaching represents a crucial pathway for implementing the "practice-based education" advocated in the 2022 edition of the new curriculum standards. It can facilitate the cultivation of core competencies such as "cultural confidence" and "language proficiency." Moreover, in the context of the "double reduction" policy (reducing the excessive homework load and off-campus tutoring burden), life-oriented teaching can optimize homework design and enhance students' initiative in learning.

3. Research design

This study follows a progressive logical framework of "conceptual clarification — current situation analysis — strategy construction" to conduct the research: Firstly, by integrating the requirements of "contextuality" and "practicality" from the 2022 edition of the "Chinese Curriculum Standards for Compulsory Education", along with Tao Xingzhi's theory of life education and Li Jilin's theory of situational education, the study precisely defines the connotation of "life-oriented teaching in primary school Chinese"—that is, a teaching model grounded in the cognitive patterns and life experiences of primary school students, transforming textbook knowledge into real-life scenarios and practical tasks, and clarifying its intrinsic connection with the cultivation of core competencies [1]. The research process employs a variety of methods: The literature review method systematically examines relevant literature and policy documents on life-oriented teaching and the cultivation of core competencies in Chinese language education from both domestic and international sources over the past five years, clarifying research boundaries and theoretical underpinnings to avoid duplication. The questionnaire survey method distributes 160 teacher questionnaires (with a 100% response rate and 91.25% effectiveness rate) to four primary schools in the S district of Chongqing and conducts in-depth interviews with 10 teachers of varying teaching experience to obtain authentic and specific teaching data, providing empirical evidence for problem analysis. The case study method selects classic texts from the Ministry-edited textbooks, such as "A Mother's Deep Affection" and "Brush Li", and analyzes the application paths of life-oriented teaching strategies in classroom introductions, text interpretations, and homework designs, taking into account the characteristics of students at different academic levels, to enhance the practical guidance of the research findings.

4. Research Findings

4.1. The results of the questionnaire survey

4.1.1. Teachers' cognition and attitude: Possessing a basic understanding and showing a high level of importance

All teachers have some understanding of life-oriented teaching, with 25% stating they have a "very good understanding", 66.4% saying they have a "moderate understanding", and 8.6% indicating they have a "limited

understanding” (**Figure 1**). Among those who recognize its importance (accounting for 90% of the total), 70% believe it is “extremely important”, while 20% consider it “moderately important.” Additionally, 10% of the teachers deem it “not very important.”

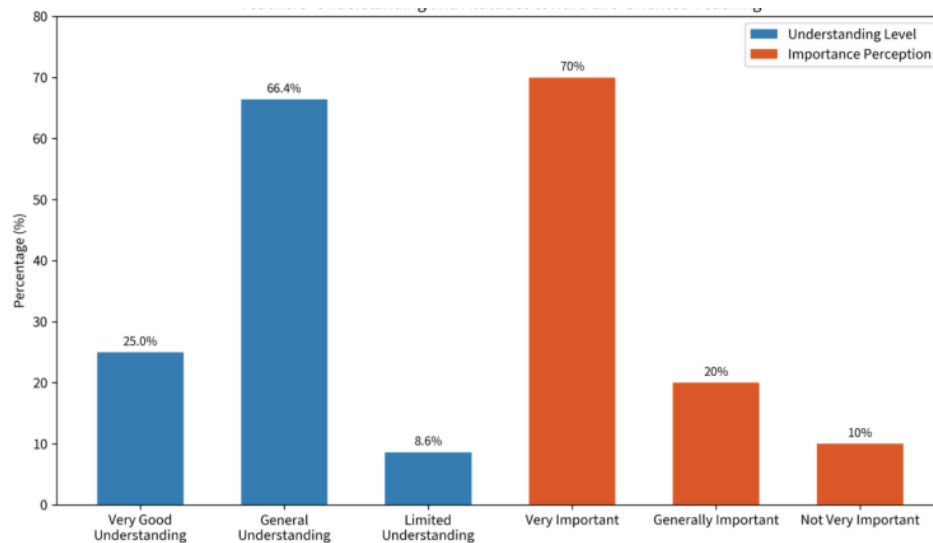


Figure 1. Teachers’ understanding and attitudes toward life-oriented teaching

4.1.2. Teaching implementation orientation: Focus on knowledge application in real life, with improvements in assignment design

71.2% of teachers believe that there is a “very strong” connection between teaching materials and real life, while 21.25% consider it “relatively strong.” Regarding the application of classroom knowledge to real life, 41.3% of teachers “often” pay attention, and 47.5% “sometimes” do. In terms of assigning life-oriented homework, 23.3% of teachers “often” do so, and 56.6% “sometimes” do (**Figure 2**). When it comes to encouraging students to answer questions by relating to real life, 43.3% of teachers “often” do this, and 50% “sometimes” do. It is evident that teachers generally emphasize the connection between teaching materials and real life, pay attention to the practical application of knowledge, and there has been an increase in life-oriented homework assignments under the “double reduction” policy.

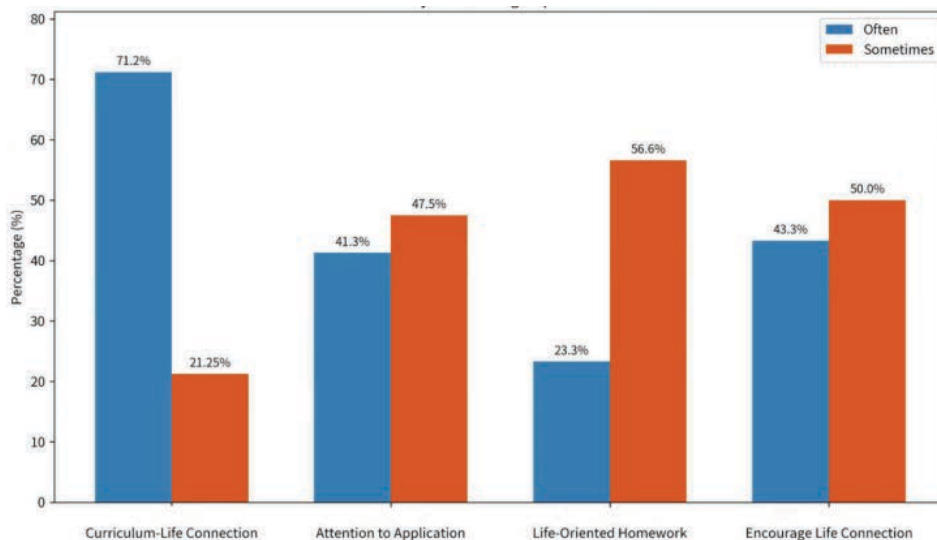


Figure 2. Tendency in teaching implementation

4.1.3. Classroom teaching behaviors: Lack of innovation in forms, with a persistent exam-oriented tendency

45% of teachers employ “group discussion learning”, 28.8% rely on “pure theoretical explanations”, 14% use “situational teaching methods”, and 8.8% incorporate “everyday life knowledge” (Figures 3 and 4). There is a lack of innovation in teaching forms, with situational teaching methods and the integration of everyday life knowledge not being widely adopted. Additionally, 70% of teachers focus their lectures on “key knowledge points for exams”, while only 12.5% emphasize the “application of life knowledge”, and 17.5% pay attention to “emotional attitudes and values.” Teaching remains predominantly exam-oriented. Furthermore, 43.7% of teachers obtain life-related materials from “the News Broadcast”, 27.5% from the “internet”, and only 18.5% through “observing students’ lives.” The teaching materials are distant from students’ lives, making it difficult to stimulate their interest.

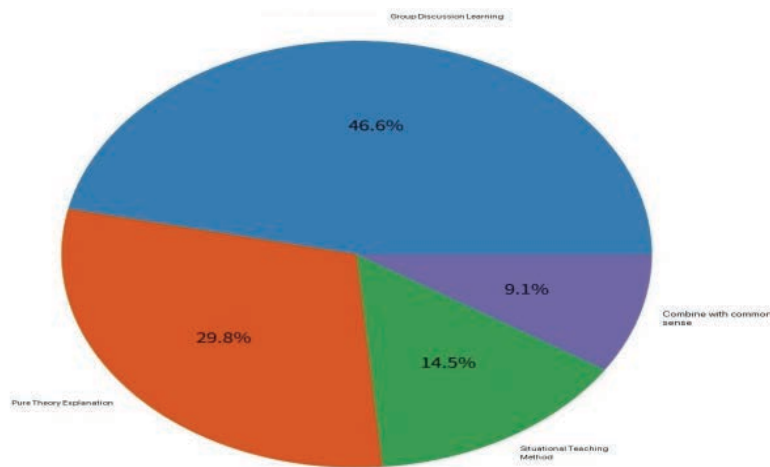


Figure 3. Distribution of teaching methods

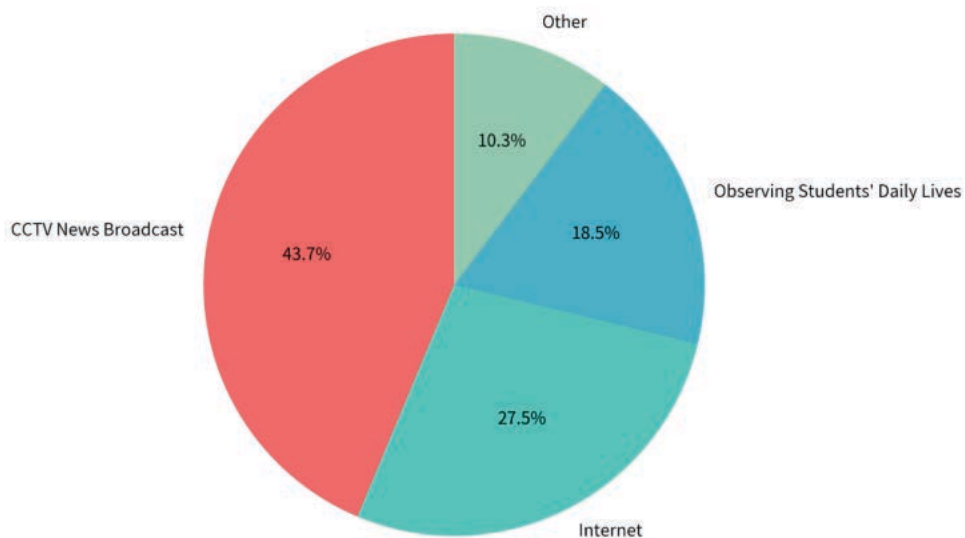


Figure 4. Teachers' sources for obtaining life-related teaching materials

4.1.4. Teacher training status: Training coverage is extensive, but application skills remain underdeveloped

100% of teachers have participated in “teaching observation sessions”, 90% have attended “demonstration classes by renowned teachers”, and 60% have taken part in “expert lectures” (Figures 5 and 6). While the training coverage is extensive, its professionalism is low. Additionally, 40% of teachers lack the “ability to create teaching scenarios”, 37.5% are deficient in “the ability to apply theoretical knowledge”, 20% struggle with “the ability to integrate life materials into teaching materials”, and only 2.5% lack “the ability to organize life-oriented practical activities.” Teachers exhibit insufficient capabilities in the detailed application of teaching methods.

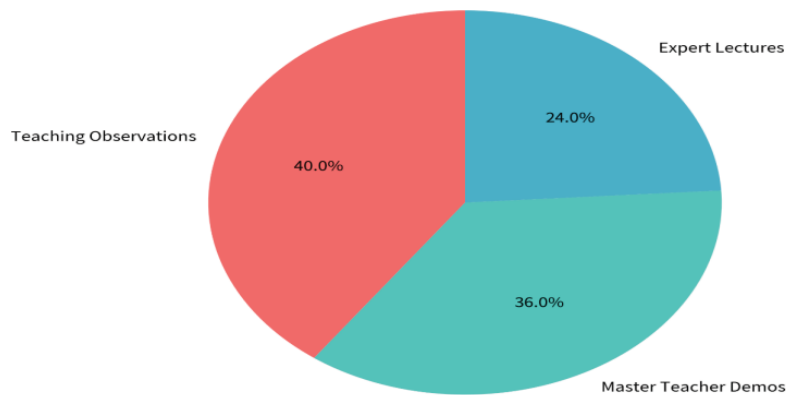


Figure 5. Teacher training participation rates

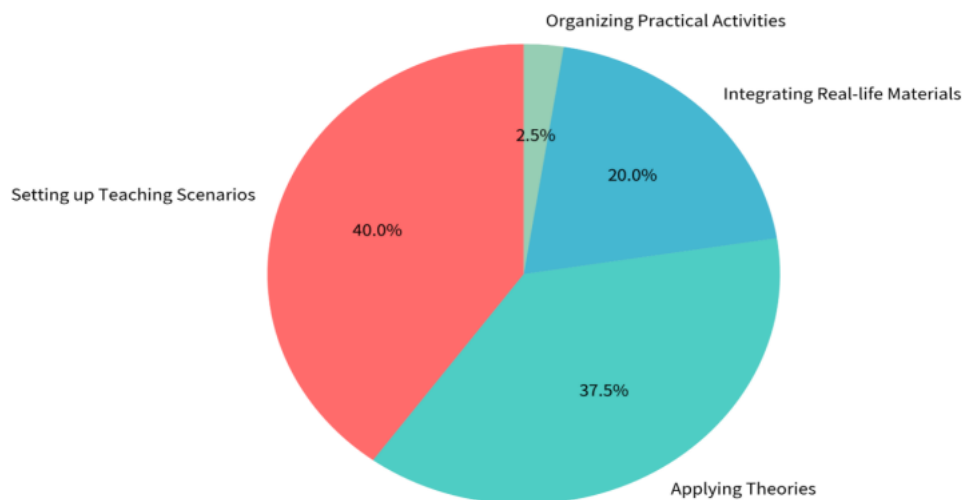


Figure 6. Teachers' skill gaps in life-oriented education

4.1.5. Implementation dilemmas in teaching: The exam-oriented system as the core obstacle, with multiple factors constraining progress

56.7% of teachers believe that the greatest difficulty lies in “the challenge of implementation under the exam-oriented background”, 23.3% attribute it to “students’ limited life experiences”, 16.7% cite “the difficulty

in finding life cases that align with the text”, and 3.3% mention “inadequate teaching facilities” (**Figure 7**). The exam-oriented education system and the performance-driven evaluation system are the primary obstacles.

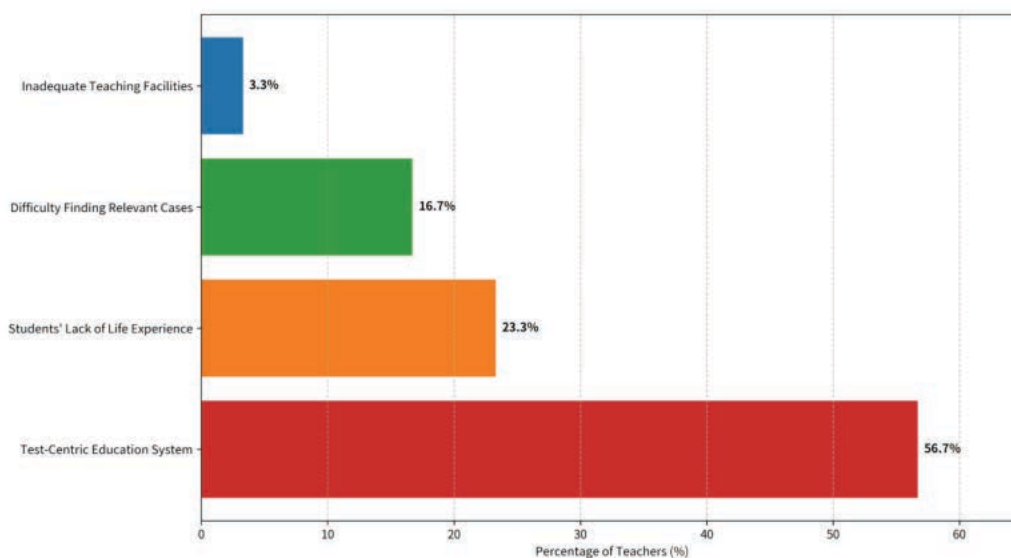


Figure 7. Challenges in implementing life-related teaching approaches

4.2. Findings from the interviews

During the interviews, most teachers endorsed the concept of life-oriented teaching and agreed with the idea that “Chinese language education originates from life.” They believed that teaching could be conducted by integrating life elements, guiding students to accumulate materials from their daily lives, and designing practical tasks. Some teachers had already made initial attempts: When introducing a lesson, they would use popular songs, trending news, or life-related videos to stimulate students’ interest. For example, they would use the scene of a school sports meet to introduce writing instruction for “Recording a Game.” In terms of homework assignments, they designed practical tasks such as “helping family members write a shopping list” or “recording family anecdotes.” However, the effectiveness of these assignments depended on parental cooperation and supervision, and their implementation was influenced by the level of family participation. When interpreting texts, teachers would guide students to empathize by relating to their own life experiences, such as drawing on their experiences of “arguing and then reconciling with friends” to help them understand the emotional changes of characters in the text. However, significant issues persist in practice: Teachers have a superficial understanding of life-based teaching, often limiting themselves to simple extensions of textbook content while lacking innovative designs that integrate students’ daily lives (such as after-school care activities or household chores). Teaching evaluations remain heavily exam-focused, neglecting assessments of students’ practical language skills in real-life contexts (such as oral communication and practical writing); Schools provide insufficient support, lacking targeted training while overloaded schedules and non-instructional tasks leave teachers no time to refine life-based teaching plans; Communication between schools and families is inadequate, with schools failing to fully convey the value of life-based teaching to parents. Some parents undervalue practical assignments, undermining the implementation of teaching outcomes.

5. Conclusions and recommendations

5.1. Expand life-oriented materials to enrich teaching resources

Chinese language teaching should be firmly rooted in real life. Teachers should take the initiative to guide students in discovering the value of the Chinese language in everyday life and establish a bidirectional connection between “life” and “Chinese language.” When it comes to accumulating materials, teachers can instruct students to start from daily scenarios: observe the gestures and language used by traffic police to direct traffic on the way to and from school, the sales pitches of vendors in the wet market, and the conversations of elderly people in the community. These real-life people and scenarios can then be transformed into writing materials, which not only enrich the content of compositions but also enable students to compare and analyze textual characters during reading, thereby enhancing their reading comprehension and transferable skills. After studying descriptive texts such as “Jiuzhaigou Valley” and “Listening to the Springs at Dinghu Mountain”, in addition to having students introduce scenic spots to their parents as “family guides”, teachers can also extend practical tasks. For example, students can be asked to draw a “tourist map of local scenic spots” and write accompanying descriptions, or conduct a “survey of natural landscapes nearby” to document the plant changes and seasonal characteristics in parks and residential areas. In response to the phenomenon of non-standard character usage in society, organize the “Little Defenders of Characters” campaign, where students are grouped to inspect street billboards and shop names, recording and correcting misspelled characters. Regularly hold “Newspaper Reading Sessions”, encouraging students to read news and stories aloud to elderly residents in the community, thereby strengthening their language application skills through practice. Meanwhile, teachers need to screen and guide the materials collected by both teachers and students to prevent them from deviating from teaching objectives, ensuring that every piece of real-life material precisely serves the absorption and internalization of textbook knowledge.

5.2. Building a systematic and life-oriented teaching system

5.2.1. Set real-life teaching objectives

Guided by the core competency cultivation requirements outlined in the 2022 edition of the new curriculum standards, the concept of integrating real-life elements is incorporated into the design of teaching objectives, breaking free from the limitations of traditional “knowledge infusion.” Taking the example of “A Mother’s Deep Affection” from the fifth-grade volume of the Ministry-Edited Textbook, the text conveys profound familial love through descriptions of a mother supporting her child’s education amidst poverty. During teaching, objectives can be set around “appreciating familial love and mastering methods of character depiction”: begin by introducing the lesson with “sharing heartwarming little things family members have done for you”, to evoke students’ life experiences; then guide students to read the text aloud while relating it to their own experiences, enabling them to empathize with the author’s gratitude towards their mother; finally, have students imitate the descriptive techniques of appearance, language, and actions used in the text to write a paragraph about “My Family Member.” Through such objective design, the integration of knowledge instruction with real-life experiences is achieved, while also nurturing students’ emotional expression and humanistic qualities.

5.2.2. Innovative life-based teaching methods

Based on the characteristics of students at different academic levels, diverse teaching methods should be designed. In lower-grade teaching, given that the texts often revolve around everyday events, role-playing can be employed. For instance, when teaching “I Am a Little Bug”, students can assume the roles of a little bug, a

dung beetle, a mantis, and other characters. By integrating their observations of insects in real life, they can act out the content of the text through dialogues and movements, transforming abstract words into vivid scenes and thereby deepening their understanding and memory of the text. For middle and upper grades, scenario-based teaching methods can be utilized. For example, when teaching “Two Children Debate About the Sun” from the sixth-grade volume, a “campus debate competition” scenario can be created, with “the distance of the sun” as the debate topic. Students can be grouped to organize and present the viewpoints and evidence of the two children from the text, simulating the debate process and understanding the main theme of the article through critical thinking. Additionally, practical life-based activities can be conducted. For instance, in the teaching of “Oral Communication: Reporting the News”, students can first be guided to watch “News Broadcast” to learn the tone and structure of news reporting. Then, they can be grouped to collect life news such as interesting campus stories and good deeds in the community for classroom reporting. After the reporting, a “news summarization” session can be arranged, where other groups are required to summarize the core information, enhancing language organization and logical thinking skills through interaction.

5.2.3. Optimizing life-based evaluation methods

Break away from the “score-only” evaluation model and establish a diverse, life-oriented evaluation system. In terms of evaluation content, in addition to classroom performance and homework, practical activities such as speech contests, poetry recitations, and hand-copied newspaper designs should be incorporated, providing platforms for students with different strengths to showcase their abilities and comprehensively assess their overall Chinese language proficiency. Regarding evaluation methods, a combination of “written comments + incentives” should be adopted. For students’ practical achievements, specific comments should be used to highlight strengths and suggest areas for improvement, while boosting their confidence through methods such as awarding small stamps and selecting “Chinese Language Stars.” Peer evaluation and group mutual evaluation should also be introduced, allowing students to identify shortcomings and learn from each other’s strengths through mutual assessment. Furthermore, a home-school joint evaluation system should be implemented through channels such as WeChat groups and parent-teacher meetings. For instance, videos of students’ practical activities like “Family Tour Guide” and “Little Defenders of Characters” can be shared, enabling parents to participate in the evaluation process and form an educational synergy, making the evaluation more scientific and life-oriented.

5.3. Promoting the integration of life-based teaching with learning task clusters

The learning task clusters proposed in the 2022 edition of the new curriculum standards are highly aligned with the concept of life-oriented teaching, using real-life contexts as carriers and tasks as driving forces. Taking the teaching of “Brush Master Li” from the fifth-grade volume of the Ministry-Edited Textbook as an example, instruction can be designed around the thematic task cluster of “Folk Culture”: begin by introducing a real-life story of farmers in Kaihua manually making tofu to spark students’ interest in “folk craftsmanship” and create a life-oriented learning context; then, present the core task of “exploring the superb skills of Brush Master Li”, guiding students to read the text in small groups and underline key phrases describing his craftsmanship; after completing the task, organize students to stage a textbook drama, requiring them to incorporate their life experiences to portray Brush Master Li’s movements and expressions, thereby deepening their understanding of the character; next, propose an advanced task of “analyzing the role of Cao Xiaosan and learning the technique

of indirect description”, encouraging students to compare the text with their experiences of “bystanders” in real life to comprehend writing skills; finally, elevate the theme by urging students to pay attention to folk craftsmanship around them and assign homework on “popularizing folk cultural heritage”, such as interviewing local artisans and creating promotional posters for intangible cultural heritage. Throughout the teaching process, tasks are interconnected through life-oriented contexts, fulfilling the requirements of the task clusters while enabling students to acquire knowledge and enhance their abilities through real-life experiences, achieving “multiple gains from a single lesson.”

Disclosure statement

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Research on the Innovation of Standardized Training Mode for Business English Talents in the Context of Cross-border E-commerce

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Abstract: With the rapid development of the digital economy, cross-border e-commerce has become an important engine for the growth of China's foreign trade. The demand for compound talents with both business English competence and practical cross-border e-commerce skills is increasingly urgent. However, the current training mode for business English talents still has problems such as insufficient standardization and disconnection from industry needs, making it difficult to meet the development requirements of the cross-border e-commerce industry. By analyzing the existing problems in the training of business English talents against the background of cross-border e-commerce, this paper explores the innovative paths of the standardized training mode. The paper aims to provide a reference for the reform of business English majors in colleges and universities, help cultivate high-quality talents that meet industry standards, and promote the sustainable and healthy development of the cross-border e-commerce industry.

Keywords: Cross-border e-commerce; Business English talents; Standardized training mode

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1. Introduction

Against the background of the deep integration of globalization and digitalization, the transaction volume of China's cross-border e-commerce has been continuously rising. In 2024, the import and export scale of cross-border e-commerce exceeded 2 trillion US dollars, becoming a key force in stabilizing foreign trade. Cross-border e-commerce business covers links such as international market research, cross-border platform operation, multilingual customer service, and international logistics coordination. It puts forward higher requirements for talents' practical ability in business English application, cross-border e-commerce operation, and cross-cultural communication competence. As a core major for cultivating compound foreign trade talents, the traditional training mode of business English mainly focuses on the teaching of language skills and basic business knowledge. It has not formed a standardized training system adapted to the cross-border e-commerce industry,

resulting in an obvious gap between talent supply and enterprise demand ^[1]. Therefore, in-depth analysis of the existing problems in the current training of business English talents and the construction of a standardized and systematic training mode have become important issues for promoting the development of the cross-border e-commerce industry and the professional construction of colleges and universities.

2. Existing problems in the training of business English talents in the context of cross-border e-commerce

2.1. Vague orientation of training objectives and disconnection from the actual needs of enterprises

At present, the training objectives of business English majors in most colleges and universities still remain a broad statement of “cultivating compound talents with strong English proficiency and business knowledge”, without precise positioning combined with the job characteristics of the cross-border e-commerce industry. From the perspective of enterprise needs, cross-border e-commerce positions can be subdivided into cross-border platform operation specialists, international marketing promotion specialists, multilingual customer service specialists, cross-border logistics coordinators, etc. ^[2]. Different positions have significant differences in skill priorities. For example, platform operation positions require mastering the rule operation and data analysis capabilities of platforms such as Amazon and AliExpress, while multilingual customer service positions require efficient English communication skills and customer problem-solving capabilities. However, the existing training objectives do not clearly define the specific skills required for these positions, resulting in a lack of pertinence in curriculum design. After graduation, students often need enterprises to conduct long-term pre-job training to be competent for the work. According to the survey, about 68% of cross-border e-commerce enterprises reflect that fresh business English graduates have obvious deficiencies in practical skills such as cross-border e-commerce platform operation and cross-border payment processes, and it is difficult for them to quickly adapt to job requirements ^[3]. The root cause of this phenomenon lies in the disconnection between training objectives and the actual needs of enterprises, failing to form a standardized training orientation oriented by job competence.

2.2. Lagging curriculum system and insufficient connection between theory and practice

The curriculum system of business English majors still has the problems of “valuing theory over practice” and “valuing tradition over innovation”, which makes it difficult to adapt to the rapid development of the cross-border e-commerce industry. Traditional courses mainly focus on theoretical courses such as “Business English Correspondence”, “International Trade Practice”, and “Business English Listening, Speaking, Reading, and Writing.” Although they cover basic business knowledge, they lack practical courses closely related to cross-border e-commerce. The offering rate of courses such as “Cross-border E-commerce Platform Operation Practice”, “Cross-border E-commerce Data Analysis”, “Cross-border E-commerce Training”, and “International Logistics and Supply Chain Management” is less than 40% ^[4]. Even if some colleges and universities offer relevant practical courses, there is a problem of lagging update of course content. For example, knowledge related to emerging cross-border e-commerce models, such as TikTok e-commerce and independent station operation, has not been incorporated in a timely manner, resulting in a disconnection between what students learn and the actual development of the industry. In addition, the connection between theoretical courses and practical courses lacks systematicness. Most practical courses only serve as supplements to theoretical courses,

failing to form a complete chain of “theoretical learning—simulated practice—practical application.” Students find it difficult to effectively combine business English knowledge with cross-border e-commerce practical skills. When facing real cross-border e-commerce business scenarios, they often encounter situations where “they can speak but not act” and “they understand theory but not practice”^[5].

2.3. Lack of practical teaching resources and insufficient actual combat training scenarios

Practical teaching is a key link in cultivating the practical ability of business English talents in the background of cross-border e-commerce. However, the practical teaching resources of business English majors in current colleges and universities are generally insufficient, which it difficult to meet the needs of actual combat training. On the one hand, the construction of on-campus training bases is lagging behind. Most colleges and universities only equip basic language laboratories or simple cross-border e-commerce simulation software. This software often has single functions and outdated data, and cannot simulate real cross-border e-commerce platform operation scenarios. For example, they cannot realize the connection with real payment systems or simulate the real-time tracking process of international logistics, resulting in a significant reduction in students’ training effects^[6]. On the other hand, the depth of school-enterprise cooperation is insufficient. Although some colleges and universities have established cooperative relationships with cross-border e-commerce enterprises, most of them stay at the shallow level of cooperation, such as “enterprise visits” and “expert lectures”, and fail to form in-depth cooperation models such as “order-based training” and “school-enterprise joint training.” Students have difficulty entering enterprises to participate in real cross-border e-commerce business operations. According to statistics, only 23% of business English students have the opportunity to participate in real cross-border e-commerce projects of enterprises during their school years. The practical ability of other students can only be improved through classroom simulation training, which can be difficult to meet the industry’s requirements for talents’ actual combat ability^[7].

2.4. Single structure of the teaching staff and lack of cross-border e-commerce practical experience

The professional quality of the teaching staff directly affects the quality of business English talent training. At present, the teaching staff of business English majors in colleges and universities has the problems of a single structure and a lack of cross-border e-commerce practical experience. Most teachers have backgrounds in English or international trade, with solid language teaching ability and theoretical knowledge reserves, but they lack practical work experience in the cross-border e-commerce industry and have not participated in actual businesses such as cross-border e-commerce platform operation and cross-border digital marketing, making it difficult to provide students with professional practical guidance in the teaching process^[8]. For example, when explaining the course “Cross-border E-commerce Platform Operation”, some teachers can only introduce platform rules based on textbook content, and cannot share common problems and solutions in store operation combined with their own practical experience, resulting in a lack of practicality and pertinence in course teaching. In addition, the training of teachers in colleges and universities mainly focuses on the update of teaching methods and theoretical knowledge, and few organize teachers to participate in practical training or on-the-job training in cross-border e-commerce enterprises, leading to the difficulty of teachers’ knowledge systems keeping up with the rapid development of the cross-border e-commerce industry. At the same time, colleges

and universities have insufficient efforts in introducing part-time teachers from enterprises, making it difficult to integrate the practical experience of industry experts into classroom teaching, which further aggravates the disconnection between the teaching staff and industry needs.

3. Innovative paths of the standardized training mode for business English talents in the context of cross-border e-commerce

3.1. Precisely position training objectives and build a job competence-oriented standardized system

The standardization of training objectives should focus on the needs of cross-border e-commerce positions. It is necessary to conduct job competence research in conjunction with industry associations and leading enterprises to clarify the core competence indicators of different positions. For segmented positions such as cross-border e-commerce platform operation, multilingual customer service, and international logistics coordination, formulate quantifiable competence standards. For example, include “Amazon store setup and optimization”, “English customer complaint response time limit ≤ 2 hours”, and “cross-border logistics exception handling accuracy rate $\geq 95\%$ ” into the training objectives^[9]. At the same time, establish a hierarchical training system. The basic level focuses on business English communication and basic cross-border e-commerce operations, while the advanced level emphasizes special skills such as data analysis and digital marketing. This ensures that the training objectives not only meet the general industry standards but also meet the personalized needs of enterprises. By releasing the “White Paper on the Competence of Business English Talents in Cross-border E-commerce”, convert the job competence standards into specific indicators in the training plan, realize the precise connection between training objectives and enterprise needs, and solve the previous problems of vague objectives and disconnection between supply and demand^[10].

3.2. Optimize the curriculum system structure and achieve in-depth integration of theory and practice

The innovation of the curriculum system needs to break the traditional simple superposition mode of “theory + practice” and build a standardized curriculum system of “scenario-based modules + dynamic updates.” Add cutting-edge courses such as “Operation of Emerging Cross-border E-commerce Platforms” and “Cross-border Digital Content Creation (English)”, and incorporate emerging models such as TikTok e-commerce and independent station operation into the teaching content. Reconstruct core curriculum modules. For example, integrate real email cases from cross-border e-commerce platforms into “Business English Correspondence”, and add practical simulation links of cross-border payment, customs declaration, and inspection into “International Trade Practice” to realize the synchronous improvement of language ability and professional skills^[11]. Establish a dynamic update mechanism for curriculum content. Every semester, cooperate with enterprise experts to sort out the latest industry policies and technical trends, and update no less than 20% of the curriculum cases and training projects to ensure that the curriculum content keeps pace with industry development. In addition, set up a three-stage curriculum process of “theoretical learning—on-campus simulation—enterprise actual combat.” For example, students first learn the theory of platform rules, then simulate store operation through on-campus training software, and finally enter enterprises to participate in real order processing, forming a closed-loop training of theory and practice^[12].

3.3. Integrate practical teaching resources and build a multi-level actual combat training platform

The standardized construction of practical resources needs to make joint efforts from three dimensions: on-campus, off-campus, and online. On campus, build a “cross-border e-commerce simulation training base”, introduce a simulation system consistent with the functions of real platforms, covering the entire business processes such as store operation, logistics tracking, and payment settlement. Equip professional training tutors to guide students in solving problems in simulated operations, such as handling cross-border return disputes and optimizing English product listings. Off campus, deepen school-enterprise cooperation, co-build “enterprise practice bases” with cross-border e-commerce enterprises, and implement “order-based training.” Enterprises participate in the formulation of training plans throughout the process and provide real business projects for students to practice. For example, let students participate in the enterprise’s overseas market research and English product promotion. Students’ practical results are included in the course assessment ^[13]. Build an “online cross-border e-commerce training cloud platform” to integrate resources such as industry case libraries, practical video courses, and online simulation question banks. Students can carry out independent training anytime and anywhere. The platform automatically records training data and generates competency evaluation reports to provide a basis for personalized training. Through the construction of a multi-level platform, ensure that each student participates in no less than 3 real cross-border e-commerce projects during their school years, with the actual combat training time not less than 600 class hours, so as to improve the standardization level of practical ability ^[14].

3.4. Optimize the structure of the teaching staff and strengthen teachers’ practical ability in cross-border e-commerce

The standardized construction of the teaching staff needs to build a system from three aspects: “introduction + training + assessment.” On the one hand, increase the intensity of introducing part-time teachers from enterprises, hire operation directors and senior customer managers of cross-border e-commerce enterprises as part-time teachers, and undertake no less than 32 class hours of practical courses every semester, such as explaining practical content, such as store traffic optimization skills and overseas social media marketing strategies. On the other hand, strengthen the training of on-campus teachers’ practical ability, formulate the “Plan for Improving Teachers’ Practical Ability in Cross-border E-commerce”, require teachers to take on-the-job training in enterprises for no less than 3 months every two years, participate in real business projects of enterprises, and organize teachers to participate in cross-border e-commerce industry certification training, such as Amazon Global Selling official training and cross-border e-commerce operator qualification certification, to ensure that teachers have solid practical ability ^[15]. Establish a standardized teacher assessment mechanism, and include cross-border e-commerce practical experience and enterprise project guidance results in the teachers’ annual assessment indicators. For example, require teachers to guide students to complete at least 1 enterprise cooperation project every year, or publish 1 paper related to cross-border e-commerce teaching practice. Force teachers to improve their practical teaching ability through assessment, and solve the previous problems of a single teacher structure and insufficient practical experience.

4. Conclusion

This paper addresses the problems existing in the training of business English talents in the background of

cross-border e-commerce, such as vague objectives, lagging courses, insufficient practice, and weak teachers. It constructs the innovative path of the standardized training mode from four dimensions: the quantification of training objectives oriented by job competence, the optimization of the curriculum system integrating theory and practice, the construction of a multi-level actual combat platform, and the construction of a double-qualified teaching staff. By converting industry needs into implementable training standards, this path effectively bridges the gap between talent supply and enterprise demand, and provides a systematic plan for the reform of business English majors in colleges and universities. In the future, it is necessary to keep up with the pace of policy adjustments and technological innovations in the cross-border e-commerce industry, continuously and dynamically update training standards and teaching content, further deepen the school-enterprise collaborative education mechanism, promote the formation of positive interaction between the training of business English talents and the development of the cross-border e-commerce industry, and ultimately achieve a win-win situation for the improvement of the quality of talent training in colleges and universities, the development benefits of enterprises and the enhancement of industry competitiveness.

Disclosure statement

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Digital Intelligence Drives the Generation of New Quality Literacy: Constructing a Value-Added Evaluation System for University Teachers' Deep Learning from a Complex Systems Perspective

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Abstract: In response to the national strategy of integrated development of education, science, and technology, and talent, this study addresses the critical need to transform university teacher development from traditional “instrumental training” toward cultivating “new-quality competencies” aligned with new-quality productive forces. Grounded in complex systems theory, this research proposes a novel Deep Learning Value-Added Evaluation (D-VAE) framework to bridge theoretical and methodological gaps in defining and measuring teachers’ deep learning and competency growth. The study defines university teachers’ new-quality competencies as a five-dimensional structure comprising High-Consciousness Learning, AI Symbiosis, Transdisciplinary Integration, Pedagogical Innovation, and Ethical Responsibility. Methodologically, the study constructed a multi-layered D-VAE model integrating input, process, output, value-added, and contextual dimensions, supported by a $5 \times 3 \times 45$ indicator cube with explicit data sources, calculation rules, and ethical review mechanisms. Utilizing longitudinal equating and hierarchical linear modeling, the framework enables full-chain estimation of teacher competency growth and teacher–student synergistic value-added. This research contributes theoretically by translating policy discourse into a measurable educational construct and offers a replicable system-level solution for teacher evaluation, promoting the transition from performance accountability to public good governance in higher education.

Keywords: Digital intelligence; New quality literacy; Deep learning; Value-added evaluation; Complex systems

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1. Introduction: Paradigm shifts in the professional development of university teachers in the digital intelligence era

1.1. Problem statement: From “instrumental training” to the “cultivation of new-quality competencies”

The report to the 20th National Congress of the Communist Party of China firstly proposed the integrated

planning of “education, science and technology, and talent”, emphasizing that higher education should align with the development of new-quality productive forces and take the lead in digital transformation. New-quality productive forces are characterized by “human–machine integration, digital–physical symbiosis, intelligent interaction, and foundational breakthroughs”, among which teachers with interdisciplinary innovation capabilities and ethical governance awareness represent the most dynamic variable ^[1]. However, traditional university teacher development programs remain at the level of “instrumental training”, primarily manifested in the following ways: a focus on the accumulation of isolated skills while neglecting systemic competency development; an emphasis on horizontal performance comparisons rather than longitudinal value-added evidence; and a prioritization of external accountability over the stimulation of intrinsic motivation. Consequently, issues such as the “digital divide”, “ethical risks”, and “evaluation distortions” have become critical bottlenecks hindering the high-quality development of higher education ^[2].

International research indicates that teacher professional learning is undergoing a paradigm reconstruction centered on “deep learning–practical wisdom–collaborative value creation” ^[3]. Deep learning emphasizes teachers’ knowledge creation and value generation through the integration of cognitive, metacognitive, affective, and interactive dimensions in authentic contexts ^[4]. However, three major research gaps persist: First, at the conceptual level, few studies define the structural boundaries and philosophical foundations of “new-quality competencies” for university teachers within the discourse of new-quality productive forces. Second, at the methodological level, there is a lack of causal models that capture the complete evidence chain of “teacher learning input–deep learning process–new-quality competency output–teacher–student collaborative value creation. Third, at the evaluation level, longitudinal value-added frameworks have primarily been applied in basic education, while the complexity, disciplinary heterogeneity, and digital–intelligent contextual factors of higher education remain significantly underestimated ^[5]. Therefore, there is an urgent need to develop an indicator system and theoretical model for “Deep Learning Value-Added Evaluation (D-VAE)” for university teachers, addressing the strategic demands of the “Education Power” initiative for a new paradigm in teacher development.

1.2. Theoretical gaps: Disconnections among new-quality competencies, deep learning, and value-added evaluation

1.2.1. Research on new-quality competencies: Conceptual borrowing and contextual absence

The term “new-quality competencies” originates from the policy discourse on “new-quality productive forces” but lacks a rigorous definition from an educational perspective. Existing digital competency frameworks (e.g., DigCompEdu, HL-DigiEdu, and industry standards for teachers’ digital literacy) predominantly focus on “technical operation-resource integration-instructional optimization” dimensions, paying insufficient attention to “human-machine collaborative creation”, “ethical governance responsibilities”, and “cross-cultural-cross-disciplinary integration.” Moreover, they lack a unified philosophical–scientific framework grounded in the context of China’s higher education system.

1.2.2. Research on deep learning: Student orientation and teacher absence

While the learning sciences have extensively explored deep learning, most studies focus on K–12 students, offering limited insights into the unique aspects of university teachers’ “professional deep learning”—such as advanced disciplinary knowledge, complex teaching contexts, and multiple roles in research, teaching, and

service. Furthermore, the causal mechanisms through which teachers' deep learning contributes to multi-level collaborative value creation for the "self–student–institution" remain a black box.

1.2.3. Research on value-added evaluation: Misalignment between basic and higher education

Value-added evaluation has been incorporated into teacher performance accountability systems in countries like the United States and the United Kingdom. However, these models largely rely on standardized tests, suffering from simplistic indicators, disciplinary limitations, and significant ethical controversies. Domestic research also concentrates on academic achievement in basic education, lacking tailored indicators for higher education's "complex outcomes" (e.g., interdisciplinary innovation capability, research-to-teaching translation, and ethical collaborative governance) and failing to integrate multimodal data from digital–intelligent scenarios ^[6].

2. Theoretical framework: A complexity model of university teacher deep learning oriented by new-quality competencies

2.1. Philosophical foundation: Metaphors of teacher learning from a complex systems perspective

2.1.1. Ontological turn: From "entity—attribute" to "relation—emergence"

Traditional teacher development research treats competencies as static attribute sets, neglecting their "generative" and "context-dependent" nature ^[7]. Complex systems theory emphasizes that teacher learning is an emergent process coupled across "multi-agent–multi-level–multi-timescale" dimensions: at the micro-level, interactions among cognition, emotion, and technology produce nonlinear fluctuations; at the meso-level, tasks related to teaching, research, and social service form attractors; at the macro-level, institutional systems, disciplinary cultures, and policy orientations constitute external control parameters. Therefore, new-quality competencies are not merely "additive modules" but new qualitative states emerging from the system's cycle of "digital–intelligent input–deep learning–feedback iteration."

2.1.2. Epistemological reconstruction: From "representational acquisition" to "participatory generation"

Representationalist epistemology views learning as knowledge "transfer", reducing teachers to "information transmitters" ^[8]. The sociocultural–material turn argues that teachers and digital–intelligent technologies form "heterogeneous networks", where competencies are generated through continuous negotiation among "human–technology–context." University teachers' disciplinary knowledge, teaching contexts, and AI tools form a "cognitive ecology", where their deep learning is "participatory generation" rather than "isolated acquisition."

2.1.3. Axiological dimension elevation: From "performance accountability" to "public good"

Within the discourse of new-quality productive forces, the ultimate value of university teacher learning is not merely performance enhancement but cultivating new-quality talent with global competitiveness and ethical responsibility, thereby realizing sustainable "individual–disciplinary–societal" public good ^[9]. Public good refers to goods or services that are non-excludable and non-rivalrous, meaning no one can be excluded from using them, and one person's use does not diminish another's. In education, public goods can be manifested through high-quality educational services that enhance societal human capital and promote sustainable development ^[10]. Consequently, value-added evaluation must transcend unidimensional indicators like "scores–publications" and

incorporate long-term effects such as “teacher–student collaborative value-added” and “contributions to ethical governance” to achieve the goal of education as a public good.

2.2. Conceptual generation: The five-dimensional structure of university teachers’ “new-quality competencies”

Based on triangulation among policy discourse, international frameworks, and the local context, this study defines university teachers’ new-quality competencies as “a composite capability system for teachers in the digital–intelligence era to utilize high-consciousness learning, transdisciplinary integration, and ethical governance to promote synergistic innovation among individuals, students, and disciplines”, detailed into the following five dimensions:

High-Consciousness Learning (HCL): Refers to teachers maintaining metacognitive awareness of the “unknown–known” continuum, possessing sixfold consciousness (vision, problem, creation, collaboration, critique, and value), and autonomously setting learning goals and iterating strategies amidst rapid technological change.

AI Symbiosis (AIS): Emphasizes teachers forming “complementary–mutually reinforcing–co-evolutionary” relationships with generative AI: capable of leveraging large models for higher-order cognitive tasks while critically correcting algorithmic biases and data ethics, achieving integrated innovation of “human intelligence + machine intelligence.”

Transdisciplinary Integration (TDI): Facing complex real-world problems, teachers can transcend disciplinary boundaries, integrate knowledge, methods, and cultural perspectives to develop innovative curricula like STEAM and sustainability education, cultivating students’ systems thinking and ability to tackle wicked problems.

Pedagogical Innovation (PI): Designing integrated “learning–research–service” teaching models in digital–intelligent environments, utilizing technologies like learning analytics, XR, and digital twins to reinvent personalized, inquiry-based, and service-learning processes.

Ethical Responsibility (ER): Encompasses data ethics, algorithmic justice, privacy protection, and sustainable digital governance. Teachers embed ethical considerations throughout the entire process of instructional design, research activities, and social service, guiding students to form values oriented towards “technology for good.”

2.3. Process mechanism: The “four-dimensional coupling” spiral of deep learning

Cognitive Dimension: Teachers engage in conceptual reorganization and model construction based on disciplinary frontiers and teaching problems, using knowledge graphs and generative AI, forming a “deep understanding–knowledge creation” loop.

Metacognitive Dimension: Utilizing learning dashboards to monitor teaching effectiveness in real-time, employing “prediction–monitoring–evaluation” cycles to adjust strategies, and achieving self-directed learning.

Affective Dimension: Activating teachers’ professional well-being and sense of mission through digital badges, peer assessment, and narrative reflection, reducing technological anxiety and burnout risks.

Interactive Dimension: Within the “human–technology–context” network, teachers engage in multimodal interactions with AI, students, and colleagues: co-planning lessons with AI, co-creating knowledge with students, and sharing data with peers, promoting the emergence of distributed cognition.

These four dimensions are mutually coupled, forming a “Digital–Intelligent Deep Learning Spiral”: each cycle re-embeds new-quality competencies at a higher level, creating a “stepped–leaping” growth trajectory.

2.4. Value-added logic: The “dual-level emergence” of teacher–student synergy

Traditional value-added evaluation focuses on the unidirectional causality of “teacher → student”, neglecting the reverse effect of “student → teacher” and the contextual effects of “institution–discipline.” This study proposes a “dual-level emergence” logic: Level 1 (Micro): Teacher deep learning → Enhancement of new-quality competencies → Improvement of teaching practice → Value-added in student academic achievement and core competencies. Level 2 (Macro): Student value-added feedback → Enhancement of teacher emotion and efficacy → Further stimulation of deep learning engagement → Emergence of institutional innovation ecosystems. The two levels are coupled through a “data–evidence–improvement” closed loop, achieving “individual–organizational” synergistic value-added. This synergistic value-added not only enhances individual and organizational effectiveness but also provides a public good for society by promoting overall social progress and sustainable development through the high-quality development of education.

3. D-VAE indicator system and model construction: An evidence-based framework for digital–intelligent enabled deep learning value-added evaluation of university teachers

3.1. Theoretical model: The D-VAE complexity framework

Integrating the above dimensions, the “Digital–Intelligent Enabled Deep Learning Value-Added Evaluation (D-VAE)” theoretical model is constructed, comprising: (1) Input Layer: Innate competencies, digital–intelligent foundation, ethical baseline. (2) Process Layer: Four-dimensional deep learning (cognitive, metacognitive, affective, interactive). (3) Output Layer: Five-dimensional structure of new-quality competencies. (4) Value-Added Layer: Value-added in teacher new-quality competencies, value-added in student core competencies. (5) Context Layer: Institutional digital governance, disciplinary culture, policy control. The model, characterized by the complex system features of “non-linearity, feedback, emergence”, provides a conceptual blueprint for the subsequent indicator system and multilevel linear modeling.

3.2. Indicator system architecture

Table 1 presents the D-VAE indicator cube: 5 first-level dimensions, 15 second-level sub-dimensions, 45 third-level observation points. Each observation point is equipped with three elements: “data source–calculation rule–ethics review”, achieving the integration of indicators–algorithms–governance.

Table 1. The D-VAE indicator cube

First-level dimension	Second-level sub-dimension	Third-level observation point (Calculation rule)	Digital intelligence source	Ethical review
A High-Consciousness Learning	A1 Vision Awareness	A1-1 Frequency of setting semester goals (≥ 3 times/semester)	Teacher development platform goal module	Anonymized storage
	A2 Problem Awareness	A2-1 Proportion of high-cognitive classroom questions (Bloom's Level ≥ 4)	Classroom voice AI tagging	Informed consent
	A3 Creative Awareness	A3-1 Number of co-created lesson plans using generative AI (cumulative)	Collaborative lesson preparation system	Algorithm transparency
B Human-Machine Synergy	B1 Complementary Decision-Making	B1-1 AI recommendation adoption rate (adoptions/recommendations)	LMS logs	Fairness audit
	B2 Critical Correction	B2-1 Number of algorithm bias identifications (supervision records)	Peer review system for lessons	Bias detection
C Cross-Boundary Integration	C1 Interdisciplinary Integration	C1-1 Number of interdisciplinary concept map nodes (≥ 50)	Knowledge graph engine	Copyright review
	C2 Method Integration	C2-1 Number of instructional design documents utilizing diverse methods	Instructional design repository	Peer review
D Educational Innovation	D1 Model Redesign	D1-1 Complexity of blended learning flowchart (nodes ≥ 20)	Process mining tool	Explainability
	D2 Technology Adaptation	D2-1 Usage duration of immersive technology (minutes/instructional hour)	XR device logs	Safety & compliance
E Ethical Responsibility	E1 Data Ethics	E1-1 Student data anonymization rate (100% = full score)	Data governance platform	Third-party audit

Note: *Shortcuts given in abbreviations

4. Conclusion: Towards an educational new-quality governance ecosystem of “teacher–student collaborative value-added”

4.1. Theoretical contribution

A unified “New-Quality Competency” framework transcending the “instrument–performance” paradigm. Grounded in complex systems philosophy, this study is the first to translate the “new-quality productive forces” policy discourse into the five-dimensional structure of “university teacher new-quality competencies” within an educational context, demonstrating its unique connotations distinct from existing digital competency frameworks—a dual foundation of “High-Consciousness Learning” and “Ethical Responsibility”, dual drivers of “AI Symbiosis” and “Transdisciplinary Integration”, and an ultimate orientation towards “Pedagogical Innovation.” This framework provides a deducible, measurable, and improvable conceptual tool for teacher professional development in the smart education era, filling the theoretical gap in “deep learning–competency value-added” in higher education.

4.2. Methodological innovation

Constructing the integrated “indicator–algorithm–governance” D-VAE model. Addressing the common dilemma of “abundant data, scarce evidence, feeble improvement”, this paper developed a $5 \times 3 \times 45$ three-level

cube indicator system, paired with longitudinal equating, empirical Bayesian dynamic weighting, and piecewise linear HLM, achieving full-chain estimation from “baseline–process–value-added.”

5. Conclusion

University teacher deep learning is not merely a “means” enabled by digital–intelligent technologies but also the “end” of reshaping educational value in the era of new-quality productive forces. The D-VAE framework, grounded in complex systems philosophy, leveraged by evidence-based evaluation, and safeguarded by ecological governance, addresses the triple challenges of “how teachers learn, how competencies grow, how teachers and students grow together.” It provides a replicable, scalable, and sustainable “system-level solution” for building a strong education nation. In the future, with continuous cross-regional, cross-cultural, and cross-institutional validation and iteration, university teacher evaluation will transition from “performance accountability” to “public good governance”, ultimately achieving multi-dimensional synergistic value-added for “individual growth, student success, disciplinary development, and societal prosperity.”

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Examination and Reconstruction: Dual Dilemmas and Improvement Paths of the Training Model for Foreign-Related Rule of Law Talents in Colleges and Universities

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Abstract: Against the backdrop of increasingly frequent international exchanges and accelerated globalization, the international legal environment has gradually become more complex. Issues such as the reconstruction of the international rule system and intensified institutional competition in emerging fields have raised requirements for talents, leading to a straight-line growth in the demand for foreign-related rule of law talents. In this context, the talent training models of colleges and universities are facing enormous challenges. Based on this, this paper will focus on analyzing the practical needs, necessity, and dilemmas of training foreign-related rule of law talents in colleges and universities, and explore the specific implementation paths of their training models, in order to provide theoretical references for the transformation of the training models of foreign-related rule of law talents in colleges and universities.

Keywords: Foreign-related rule of law; Globalization; Law; Governance system; Colleges and universities; Talent training

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1. Introduction

In recent years, with the advancement of the “Belt and Road” Initiative, the global governance system has accelerated its reconstruction and transformation. This has made it necessary for China to accelerate the construction of foreign-related rule of law and gain more initiative, integrating legal games into the dimensions of industrial chain security and national security. Under this foundation, the strategic value of training foreign-related rule of law talents in colleges and universities has become increasingly prominent. However, the existing training models still have dual dilemmas that need to be addressed urgently^[1]. As key institutions for cultivating high-quality talents, colleges and universities should take the practical needs of foreign-related rule of law as

the starting point, and explore improvement paths from multiple dimensions, such as talent training objectives, curriculum systems, and teaching model innovation. The goal is to cultivate more high-quality rule of law talents who are not only familiar with Chinese law but also proficient in international rules, and can serve the overall situation of China's opening-up.

2. Practical demands for the training of foreign-related rule of law talents in colleges and universities

2.1. An inevitable requirement to serve the national strategy for foreign-related rule of law construction

At present, China is in a critical stage of high-level opening-up. Driven by the "Belt and Road" Initiative, the scale of international trade and investment continues to expand, and China's legal interactions with other countries around the world are becoming increasingly frequent. The foreign-related legal disputes and rule-based games it faces are also becoming more complex. This puts forward stricter requirements for foreign-related rule of law talents. Such talents not only need to be high-quality individuals with systematic legal knowledge, familiarity with international rules, and cross-cultural communication skills, but also need to be high-caliber professionals who know how to use international rules to safeguard national sovereignty, security, and development interests ^[2]. As important institutions for talent training, colleges and universities need to integrate national strategic demands into the entire process of training objectives, curriculum design, and practical teaching. They should clarify the alignment between talent training and national strategies, adjust talent training objectives accordingly, help students understand the rule of law connotation of national strategies, and cultivate talents that can provide personnel support for China to gain advantages in rule of law competition in the complex international environment ^[3].

2.2. An urgent need to adapt to the high-quality development of foreign-related legal services industry

Currently, the international situation is complex and volatile. Amid such unprecedented changes, foreign-related legal service businesses are evolving at an accelerated pace, and their service scopes are constantly expanding. They have extended from traditional fields such as international trade and international investment to emerging areas like cross-border finance, intellectual property rights, data compliance, and environmental and climate law. This shift has transformed the demand for talents from single-discipline knowledge-based talents to interdisciplinary talents ^[4]. Therefore, when training foreign-related rule of law talents, colleges and universities should place greater emphasis on developing students' practical abilities and comprehensive literacy. They need to integrate knowledge and skills from various fields of current foreign-related legal services into all aspects of talent training, increase the proportion of practical teaching, and use methods such as case teaching, situational simulation, and project-based teaching to guide students in applying legal knowledge to solve practical problems. By doing so, they can cultivate practical and interdisciplinary talents who can meet the needs of foreign-related legal services.

2.3. An inherent demand to enhance the global competence of rule of law talents

With the deepening of international exchanges and the acceleration of globalization, talents with global competence have become a key requirement for positions in international affairs. Under the trend of cultural

diversity, to gain a firm foothold in the core of development, foreign-related enterprises not only need talents with professional legal knowledge and language skills, but also require comprehensive talents who can understand the differences in legal cultures and social systems of different countries (cross-cultural cognitive ability) and flexibly apply international rules to solve problems ^[5]. Innovating the training model of foreign-related rule of law talents in colleges and universities is a fundamental requirement to adapt to national rule of law reforms under the global governance system, and also an inherent demand to enhance the global competence of rule of law talents, which holds important contemporary value. Only by possessing comprehensive global competence can talents gain the initiative in foreign-related legal practice and achieve professional development ^[6].

3. Dilemmas faced by colleges and universities in training foreign-related rule of law talents

3.1. Vague orientation of talent training

Against the backdrop of the globalized era, China's demand for high-level foreign-related rule of law talents is becoming increasingly urgent. In response, colleges and universities have launched various initiatives in the training of such talents. However, the effectiveness of talent training is not ideal, and the fundamental reason lies in the vague orientation of talent training in these institutions. Specifically, on the one hand, some colleges and universities have an insufficient understanding of the development trend of international affairs. Their talent training objectives remain confined to the knowledge framework of traditional legal talents, with insufficient emphasis on the interdisciplinary literacy and international perspective required for foreign-related talents. This leads to inadequate depth and breadth in covering core content such as foreign-related rule of law, resulting in an incomplete establishment of students' international rule of law knowledge system ^[7]. On the other hand, interdisciplinary talents are now in high demand, which requires colleges and universities to pay attention to the interdisciplinary nature of foreign-related rule of law and integrate the teaching of other professional knowledge—such as language, digital technology, and foreign trade rules—into talent training. However, the talent training objectives of some current colleges and universities are not integrated with professional knowledge, failing to form a differentiated talent training pattern.

3.2. Inadequate recognition of practical demands

Practical ability is a key factor for colleges and universities to achieve high-quality training of foreign-related rule of law talents. Therefore, when designing training programs and models for foreign-related rule of law talents, colleges and universities should be practice-oriented, accurately grasp the country's practical needs and development trends, and ensure precise alignment between talent supply and demand. Nevertheless, current colleges and universities have inadequate recognition of the practical demands for foreign-related rule of law talent training. On the one hand, these institutions focus more on theoretical knowledge in training, making it difficult to target the actual needs of the country and enterprises in foreign-related legal practice. As a result, it is hard for colleges and universities to truly take practical demands as the core training objective in the training process. On the other hand, due to inadequate recognition of current practical demands, the cooperation between colleges and universities and practical departments—such as foreign-related law firms, arbitration institutions, and multinational enterprises—mostly remains in the form of framework agreements, lacking substantive cooperation content. This causes the practical teaching of colleges and universities to become a mere formality,

making it difficult for students to understand real foreign-related rule of law business ^[8].

3.3. Imperfect curriculum system

Compared with other professional courses, the training of foreign-related rule of law talents involves greater uncertainty and complexity, requiring colleges and universities to actively align with job requirements and standards, and update and improve the curriculum system. Currently, the curriculum system construction of some colleges and universities is imperfect and presents a fragmented state, which is particularly prominent in terms of curriculum content update, curriculum module setting, and teaching methods ^[9]. From the perspective of teaching content, the latest achievements in cutting-edge fields—such as international rule reforms, digital economy rule of law, and global climate governance—have not been incorporated in a timely manner. Curriculum cases and teaching materials still focus on traditional foreign-related legal business, which is disconnected from the current development trend of foreign-related legal practice. From the perspective of curriculum module setting, there are no interdisciplinary modules; courses such as “Law and Foreign Languages”, “Law and International Politics”, and “Law and Digital Technology” are offered as electives, making it impossible to achieve in-depth knowledge integration and application. From the perspective of teaching methods, the methods are overly simplistic, still dominated by teacher lectures, and lack interactive teaching methods—such as case teaching and project-based teaching—that can promote knowledge integration. This makes it difficult for students to integrate knowledge from different fields and apply it to practice.

4. Improvement paths for the training model of foreign-related rule of law talents in colleges and universities

4.1. Accurately orient training objectives and build an interdisciplinary talent quality system

In the past, when setting talent training objectives, colleges and universities had the problem of vague talent training orientation, which led to indistinct characteristics of interdisciplinary talents and made it difficult to meet the needs of the market and national strategies. Based on this, to get rid of this dilemma and help students adapt to international development trends, colleges and universities need to accurately orient training objectives and build an interdisciplinary talent quality system. On the one hand, in terms of training objective orientation, colleges and universities should clearly distinguish the core differences between foreign-related rule of law talents and traditional legal talents, integrate the cultivation of international rule literacy and cross-cultural competence into talent training objectives, and improve students’ ability to handle cross-border legal affairs by using international rules ^[10].

On the other hand, in the construction of the quality system, it is necessary to break through the limitation of single knowledge imparting and form a three-in-one quality framework covering legal professional competence, international general competence, and professional ethics. This enables students to, on the basis of mastering professional competence, become proficient in foreign language communication, cross-cultural cognition, operation of digital rule of law tools, and other abilities. Meanwhile, colleges and universities should focus on their own disciplinary advantages and regional development characteristics, formulate differentiated talent training programs, and avoid homogenization in talent training ^[11]. At the same time, colleges and universities also need to establish a dynamic adjustment mechanism, conduct regular research on the adjustment of national foreign-related rule of law strategies and changes in foreign-related legal service formats, and timely

optimize training objectives and quality systems to ensure that talent training is accurately aligned with the needs of the times.

4.2. Optimize the curriculum system to adapt to the complex and changing needs of foreign-related legal practice

The construction of a curriculum system is the foundation and carrier for colleges and universities to train foreign-related rule of law talents, and it is a key guide that determines curriculum content, curriculum structure, talent training objectives, and teaching methods. In the process of training foreign-related rule of law talents, colleges and universities need to optimize training programs in combination with their own foreign-related rule of law talent training objectives and training mechanisms ^[12]. First, regarding the curriculum structure, colleges and universities can establish a three-level curriculum structure to form a hierarchical and logically coherent knowledge system. For example, the basic level should focus on basic knowledge of foreign-related rule of law, and use core courses such as jurisprudence, constitutional law, civil law, and criminal law to strengthen students' basic knowledge structure. On this basis, it is necessary to strengthen basic competence courses such as college English and cross-cultural communication to lay a solid knowledge foundation for students. The core level should highlight the professional characteristics of foreign-related rule of law, focus on the connected teaching of domestic law and international law, and help students build an integrated knowledge framework of foreign-related rule of law. The expansion level can expand courses such as international rules for the digital economy, cross-border data compliance, and legal issues in global climate governance, in combination with current international trends and communication situations, so as to improve students' cognition and response capabilities in cutting-edge fields.

Second, in the past curriculum system, curriculum content was usually static and rigid, with a slow update speed, making it difficult for students to access up-to-date knowledge. In this regard, it is necessary to update and expand the core professional content. For example, courses such as international political economy and introduction to global governance can be introduced to help students understand the political and economic logic behind foreign-related legal issues and improve their comprehensive analysis and strategic thinking abilities. Finally, colleges and universities need to recognize the role of practical teaching in talent training, increase the proportion of practical teaching, and achieve an organic balance between theoretical teaching and practical teaching, so that students can adapt to the complex and changing needs of foreign-related legal practice.

4.3. Innovate talent training models and create a diversified and collaborative education pattern

In the traditional talent training model, there is a disconnect between theoretical and practical teaching, making it difficult for students to effectively apply their knowledge to actual positions. To better enable students to adapt to international changes and the needs of foreign-related rule of law positions, colleges and universities need to innovate talent training models and build a new education pattern featuring diversified collaboration and dynamic adaptation. First, colleges and universities can carry out in-depth cooperation with enterprises and implement a school-enterprise collaborative education model in the talent training process. Based on students' academic performance and post-standards, colleges and universities can establish foreign-related rule of law studios with enterprises and introduce real corporate projects, allowing students to use their knowledge systems to complete the entire project process. Specifically, students can be divided into project teams, with

clear task objectives and division of responsibilities for each team. In-school teachers and off-campus practical tutors jointly serve as instructors to guide students in completing tasks such as case acceptance, legal analysis, document drafting, court debate, and execution follow-up. This allows students to experience foreign-related legal practice operations through real projects and enhance their practical problem-solving capabilities.

Second, colleges and universities need to rely on digital technology and practical training-based resources to build a situational teaching platform covering functions such as international commercial negotiation rooms, simulated international arbitration tribunals, and cross-border legal dispute mediation rooms. They can use VR and AR technologies to reproduce complex foreign-related legal scenarios and allow students to complete a full set of work processes according to assigned roles. This not only enables students to intuitively experience the operation process and professional atmosphere of foreign-related legal practice, but also encourages them to flexibly apply legal knowledge and practical skills to deal with various complex situations. Finally, with the deepening of international exchanges and the growing demand for foreign-related rule of law talents, colleges and universities have gradually recognized the importance of international competitions and begun to explore a new “competition-integrated” training model. Taking competitions as the main practical path to improve teaching effectiveness, this model realizes the goal of “using competitions as practice.” Based on this, colleges and universities can build international legal practice platforms, organize students to participate in high-level activities such as international commercial arbitration mock competitions, international human rights law moot courts, and global youth legal forums, and encourage students to participate in the work of international organizations and foreign-related legal institutions as volunteers or interns. This allows students to practice rule application and strategic thinking abilities in real international legal scenarios.

5. Conclusion

To sum up, the examination and reconstruction of the training model for foreign-related rule of law talents in colleges and universities is an inevitable requirement to serve international exchanges and cooperation. By taking measures such as building an interdisciplinary talent quality system, optimizing the curriculum system, and innovating talent training models, colleges and universities can align talent training with the needs of foreign-related rule of law positions, and cultivate interdisciplinary talents who have a solid foundation in Chinese law, possess international rule literacy, and demonstrate practical capabilities.

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Exploration and Practice on Cultivating College Students' Innovative Practical Abilities: Integration of Competition, Teaching and Learning, and Empowerment via Digital Intelligence

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Abstract: The “integration of competition, teaching, and learning” model plays a key role in fully mobilizing college students' enthusiasm and initiative for learning, stimulating their innovative potential, and ultimately achieving the goals of “promoting teaching through competitions” and “promoting learning through competitions.” “Empowerment via digital intelligence” specifically refers to building a flexible, independent, and open new human-machine collaboration environment for college students by relying on advanced digital intelligence technologies. When students are in this environment, their innovative awareness can be stimulated, their practical skills can be honed, and thus their innovative practical abilities can be significantly improved. Focusing on competitions of different forms and contents, such as physics academic competitions, physics experiment competitions, optoelectronic design competitions, and material-related competitions, and relying on digital twin platforms as well as advanced artificial intelligence (AI) technology, augmented reality (AR) technology, virtual reality (VR) technology, etc., this paper focuses on exploring effective strategies for cultivating college students' innovative practical abilities. By building a diversified practical platform, this paper aims to meet the personalized and diversified development needs of college students, comprehensively improve their innovative practical abilities, and, at the same time, inject strong impetus into the all-around development of college students.

Keywords: Integration of competition, teaching, and learning; Empowerment via digital intelligence; College students; Innovative practical abilities; Cultivation strategies

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1. Introduction

With the increasing depth of higher education reform, cultivating college students' innovative practical abilities has gradually become one of the important contents of university education and teaching reform. Stimulating college students' innovative awareness, cultivating their spirit of cooperation, and improving their practical abilities have not only become the internal demand for responding to international scientific and technological

competition, but also the inevitable trend for building a country with strong science and technology. However, under the traditional education and teaching model or talent training model, some universities have encountered a series of challenges and difficulties in cultivating college students' innovative practical abilities, such as outdated concepts, single methods, and a lack of resources. This may lead to the situation that the trained talents are difficult to meet the high requirements of social development for talents in the new era. Therefore, this paper proposes two new models, namely "integration of competition, teaching, and learning" and "empowerment via digital intelligence", in order to build a new teaching ecology, promote the innovation of talent training models, help cultivate more innovative, interdisciplinary, and application-oriented talents, and make a modest contribution to building a powerful country in education.

2. The significance of cultivating college students' innovative and practical abilities

2.1. Meeting the social demand for talents in development

At present, China is in a period of rapid social and economic development, and the social demand for talents is gradually shifting from "knowledge-oriented" to "innovation-oriented" and "practice-oriented", which is highly consistent with the goal of cultivating college students' innovative and practical abilities. Especially with the emergence and development of a series of emerging technology fields, the society's demand for high-quality, competent, and outstanding workers has become increasingly urgent, and cultivating college students' innovative and practical abilities is precisely the core path to meet this demand^[1]. On one hand, from the macro perspective of national strategy, with the extensive implementation of the "Innovation-Driven Development Strategy", the development of more and more emerging industries relies on interdisciplinary talents who possess both innovative thinking and practical abilities. As the reserve force of such talents, the cultivation of college students' innovative and practical abilities deserves high attention. On the other hand, from the micro perspective of enterprise development, in today's era, the essence of competition among countries or in the market lies in the competition for talent. As the main platform for cultivating outstanding talents, colleges and universities should conform to the trend of the times and place the cultivation of college students' innovative and practical abilities at the core of talent development^[2]. Only in this way can more high-quality talents for the new era be delivered to enterprises and society, and can enterprises achieve high-quality and sustainable development.

2.2. Comprehensively enhancing the quality of talent cultivation in colleges and universities

First of all, cultivating college students' innovative and practical abilities has forced the reform and innovation of traditional teaching models and methods in colleges and universities. The traditional teaching model has a serious problem of "valuing knowledge imparting over ability cultivation", and teachers have always been in a dominant position, which makes it difficult to fully arouse students' enthusiasm and initiative in learning. However, cultivating college students' innovative and practical abilities requires teachers to actively introduce diverse teaching methods, such as project-driven teaching, case teaching, and situational teaching. These innovative teaching methods can ignite students' passion for learning and practice, transform the classroom from a dull space into a vivid and engaging one, and thereby provide students with favorable opportunities and platforms for innovation and practice^[3]. Secondly, cultivating college students' innovative and practical abilities relies on well-designed innovative practice projects. These projects often involve interdisciplinary knowledge

and skills, and may also include a series of competition activities. This not only breaks the limitations of traditional single-discipline teaching and promotes the integration of interdisciplinary knowledge, but also enables students to face various complex problems directly. This plays a positive role in improving their problem-solving abilities, innovative abilities, and practical abilities. With the deepening of educational and teaching reforms in colleges and universities, the quality of talent cultivation in schools will be significantly improved, and at the same time, a brand-new teaching ecology can be built.

2.3. Laying a solid foundation for college students' healthy development

Innovative and practical abilities serve as a strong driving force for college students to realize their personal values, and also act as an inherent support for safeguarding their healthy development, helping them grow into outstanding talents more needed by society and the country. On one hand, the process of innovation and practice is a process of tempering college students' will and character. It is conducive to fostering their firm will to persevere and courage to practice; at the same time, it hones their resilience, significantly enhances their ability to cope with pressure and setbacks, and thereby improves their overall quality. On the other hand, the cultivation of innovative and practical abilities helps college students realize their self-worth and strengthens their self-confidence and sense of honor. For example, with competitions as an effective platform, if college students achieve excellent results in competitions, their sense of honor and self-confidence will be greatly boosted. Such positive emotions help alleviate the anxiety and negative feelings that college students may encounter in the process of studying, daily life, internships, and practical training. They can consolidate students' psychological defense lines and comprehensively improve their mental health. This not only broadens the path for college students' future development but also enables them to face challenges and overcome difficulties with a more positive and optimistic attitude, thereby promoting their healthy and happy growth and development^[4-5].

3. Effective strategies for cultivating college students' innovative practical abilities—From the perspective of integration of competition, teaching, learning, and innovation, and digital-intelligent empowerment

3.1. Construction of an intelligent teaching and practice platform

An intelligent teaching and practice platform helps transform the originally dull and tedious classroom into a vivid, interesting, and intuitive one. Its most prominent feature is its ability to closely integrate theory with practice, providing students with an immersive learning experience and achieving the goal of personalized teaching. Firstly, build multi-dimensional virtual simulation practice modules to give full play to the auxiliary teaching role of digital-intelligent technologies such as VR (Virtual Reality), AR (Augmented Reality), and digital twin. Teachers can develop virtual simulation experiment projects with higher matching degrees according to the characteristics of different disciplines, like physics and materials science. The purpose is to provide students with a more realistic and flexible practice environment, while ensuring the seamless connection between practical teaching and the industrial frontier^[6]. Taking the digital twin platform as an example, teachers can use this platform to closely connect the digital world with the physical world. By promptly converting innovative ideas, raw materials, and other elements into digital models, a realistic, visualized, and refined digital factory is presented to students. This fully mobilizes their learning enthusiasm, promotes the in-depth integration of teaching and scientific research, and, more importantly, provides a strong platform support for cultivating college students' innovative practical abilities. From the students' perspective, they can use the

digital twin platform to conduct an in-depth exploration of the internal structure and operation mechanism of complex projects. Through bold innovation and repeated practice, they continuously optimize the design scheme, aiming to improve the precision and practicality of the projects. Secondly, create an interactive practice space with in-depth integration of online and offline ^[7-8]. Specifically, teachers can encourage students to break free from the constraints of traditional classrooms and use online innovative practice collaboration platforms to carry out cross-regional and interdisciplinary communication and practice. Students from different regions, different schools, and different majors can form online innovative practice groups, select their own projects, and complete discussions and practices. In this process, on-campus teachers and enterprise mentors can form a dual-tutor team to provide students with professional guidance and timely assistance, so as to fully stimulate students' innovative potential and continuously temper their practical abilities. In addition to online innovative practice, colleges and universities should also cooperate with enterprises, scientific research institutions, and other parties to build offline practice bases for students. These bases are equipped with advanced experimental equipment and create realistic work scenarios, aiming to bring students an immersive experience, promote the rapid transformation of innovative ideas into physical products, and provide platform support for the incubation of college students' creative ideas ^[9].

3.2. Promoting the discipline competition-driven model

The key to the “integration of competition, teaching, learning, and innovation” lies in “competition.” Taking this as a starting point, teachers can closely integrate competition, teaching, and learning, build a bridge between theoretical teaching and innovative practice, and promptly guide students to apply theories to practice, ultimately achieving the goals of promoting teaching through competitions and promoting learning through competitions. Studies have shown that cultivating college students' innovative practical abilities is an inherent requirement for advancing discipline competitions; conversely, advancing discipline competitions is an external driving force for cultivating college students' innovative practical abilities. The close integration of the two is an inevitable trend in talent cultivation in colleges and universities. Therefore, teachers should attach importance to the organic combination of discipline competitions and teaching content, providing strong support for the cultivation of college students' innovative practical abilities. Specifically, first of all, teachers can transform competition projects into teaching cases and integrate them into the daily teaching process, promoting the seamless connection between classroom teaching and discipline competitions. This not only deepens students' understanding and cognition of the theoretical knowledge they have learned, but also targets the improvement of their problem-solving and practical abilities ^[10]. For example, with physics academic competitions and physics experiment competitions as important carriers, teachers can conduct in-depth research and analysis of the competition content, introduce it into the classroom, and guide students to closely connect the knowledge they have learned to solve problems and summarize experiences. Ultimately, this achieves the goal of feeding back teaching through competitions and realizes a twice-the-result-with-half-the-effort teaching effect. Secondly, in order to fully arouse college students' enthusiasm and initiative in participating in competitions, colleges and universities can establish incentive mechanisms such as allowing competitions to replace courses or using competition achievements to exchange for credits. For students who have achieved excellent results in competitions, they can apply for additional corresponding credit rewards or apply for exemption from certain courses ^[11-12]. This is highly attractive to most college students. To help students achieve excellent results, on-campus teachers and off-campus mentors can form a “dual-tutor” team to provide timely and professional

guidance or assistance to students preparing for competitions. This enables students to face various challenges that may arise in competitions with greater enthusiasm and solid knowledge and skills, effectively improving their competition performance^[13–14].

3.3. Deepening interdisciplinary integration

The cultivation of college students' practical and innovative abilities requires the collaborative promotion of multiple disciplines; it is difficult to achieve satisfactory talent cultivation results relying solely on the strength of a single discipline. Therefore, the primary task of colleges and universities is to form an interdisciplinary innovative teaching team composed of teachers from multiple disciplines, providing a solid teaching support for college students' innovative practice. For example, focusing on the theme of "Intelligent Optoelectronic Design", colleges and universities should actively invite teachers specializing in information technology, electronic engineering, materials science, and other fields to participate. Teachers from different disciplinary directions should take the initiative to undertake their respective responsibilities. By providing students with differentiated and professional guidance and assistance, they offer strong support for the advancement of themed projects^[15]. On this basis, colleges and universities should establish a "project bidding and leadership appointment" system. In short, students can form interdisciplinary innovative practice teams on their own and "bid for" projects that they are interested in and competent for from the interdisciplinary innovation project pool announced by teachers. After multiple rounds of competitions, teachers can assign the corresponding projects to the winning teams. The purpose of this approach is to fully stimulate students' sense of competition, promote the integration between disciplines, and enable teams to generate innovative sparks through intense interactions, exerting a positive promoting effect on the cultivation of students' innovative abilities^[16]. Furthermore, colleges and universities should continuously update their professional curriculum systems. By setting up interdisciplinary curriculum modules, they can broaden students' horizons, allowing students to accumulate experience and practice skills through the integration of interdisciplinary knowledge, thereby laying a solid foundation for their future practical work in professional positions.

4. Conclusion

To sum up, the cultivation of college students' innovative practical ability is not an achievement that can be accomplished overnight; it is notably systematic and long-term in nature. Based on the two dimensions of "integration of competitions, teaching, learning, innovation, and entrepreneurship" and "digital and intelligent empowerment", this paper expounds on the specific methods and implementation paths for cultivating college students' innovative practical ability. It aims to give full play to the powerful role of digital and intelligent technologies in empowering teaching and talent development, enriching students' experience in participating in competitions, and helping them accumulate valuable experience. It is hoped that this can promote the all-round development of students, lay a solid foundation for their future career paths, and make a modest contribution to the construction of an innovative country.

Disclosure statement

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Exploration on the Reform of All-English Teaching for the “Electrical Machines and Towage” Course for International Students

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Abstract: In recent years, with the rapid development of China’s economy and the continuous improvement of its international influence, more and more international students have chosen to study in China. Due to the continuous update and iteration of technical fields such as new energy electric vehicles, intelligent robots, and electric aviation, the number of international students majoring in electrical engineering has also increased significantly. As a core professional basic course for international students majoring in electrical engineering, the teaching quality of the “Electrical Machines and Towage” course is directly related to the learning effect of subsequent professional courses. To further improve the teaching effect and fully consider the differences in culture, educational background, and professional foundation of international students from different countries, this study proposes and practices a trinity teaching method of “theory + simulation + experiment.” By systematically optimizing the teaching content, teaching methods, and assessment system, this paper summarizes and discusses the all-English teaching reform practice of the “Electrical Machines and Towage” course, aiming to provide useful references for the teaching reform of related majors and courses in other domestic universities.

Keywords: Electrical Machines and Towage; All-English teaching; Teaching reform; International students; Trinity teaching

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1. Introduction

With the in-depth implementation of the “Belt and Road” Initiative and the continuous improvement of the internationalization level of China’s higher education, the scale of international students studying in China has been expanding, and the structure of student sources has become increasingly diversified^[1–3]. Among them, engineering education, especially the major of Electrical Engineering and Its Automation, is highly favored by international students due to its close connection with cutting-edge industries (such as new energy and

intelligent manufacturing). The “Electrical Machines and Towage” course is an important professional basic course that connects the preceding and the following in the electrical engineering major. It has abstract content, a strong theoretical nature, and a close combination with practice^[4-5]. However, in the all-English teaching environment, facing the international student group with language barriers, cultural differences, and uneven professional foundations, the traditional “cramming” theoretical teaching model is insufficient and difficult to achieve the expected teaching goals^[6-8].

Therefore, how to carry out all-around reforms on the course’s teaching objectives, content, methods, and evaluation system according to the characteristics of international students, stimulate students’ learning initiative and creativity, and cultivate their ability to solve complex engineering problems has become an urgent and important teaching research topic. Based on the teaching practice of Shanghai Dianji University, this paper discusses the reform path of all-English teaching for the “Electrical Machines and Towage” course for international students.

2. Course objectives and teaching team construction

2.1. Multi-dimensional course objectives

Through systematic theoretical learning, simulation training, and experimental operation, this course aims to help international students achieve the following four-dimensional objectives.

2.1.1. Objective 1: Master the basic knowledge of electrical machines

Deeply understand the basic structure, operating principles, and electromagnetic-mechanical energy conversion relationship of major electrical machine types, including DC machines, asynchronous machines, AC synchronous machines, permanent magnet machines, and transformers.

2.1.2. Objective 2: Master the driving characteristics of electrical machine systems

Proficiency in classic traction control methods for electrical machines, such as starting, speed regulation, and braking, and the ability to analyze their operating characteristics under different loads.

2.1.3. Objective 3: Master the basic experimental methods of electrical machines

Cultivate students’ hands-on ability and awareness of engineering practice through the disassembly and assembly, no-load and load experiments of DC motors and three-phase asynchronous motors (**Figure 1**).

2.1.4. Objective 4: Understand modern electrical machine design methods

Introduce finite element analysis (FEA) methods based on industrial-grade software such as ANSYS, enabling students to understand the process of rapid design and simulation of modern electrical machine performance and broaden their technical horizons (**Figure 2**).

2.2. International teaching team construction

To support the achievement of course objectives, educators have built a joint teaching team consisting of “university teachers + enterprise experts + overseas renowned professors”:

University teachers, as the leading force of the course, are responsible for systematic theoretical teaching and daily tutoring.

Enterprise mentors, invited from technical enterprises such as ANSYS China Co., Ltd., are responsible for teaching the latest engineering cases and practical skills of electrical machine simulation design, bringing the latest industrial needs into the classroom.

Overseas renowned professors, hired from world-renowned universities such as King's College London (UK), regularly give academic lectures to introduce cutting-edge international research results, ensuring the international advanced nature of the course content.

This “triple-teacher integration” model effectively integrates academic, industrial, and international resources, providing a solid guarantee for the high-quality implementation of the course.

3. Reconstruction and optimization of teaching content

The course adopts the internationally classic textbook *Electric Machinery* (Stephen Umans, Seventh Edition), absorbs advanced teaching concepts from British and American universities, and reconstructs the knowledge system based on the actual situation of international students in our university^[9–10]. This forms an integrated model of “theoretical teaching (36 class hours) + experimental teaching (6 class hours) + simulation design (6 class hours).”

3.1. Theoretical teaching content: Maintaining essentials and pursuing innovation

On the basis of ensuring the teaching depth of classic content such as DC machines, transformers, induction machines, and synchronous machines, the educators have significantly increased the teaching content of new types of electrical machines widely used in modern electric vehicles and industrial drives, including permanent magnet synchronous machines (PMSM) and switched reluctance machines (SRM). This measure has greatly stimulated students' interest in learning and kept the course content closely focused on the frontiers of modern industry.

At the same time, ideological and political elements are subtly integrated into the course. In combination with the “Belt and Road” Initiative, when explaining the global cooperation cases of Chinese new energy enterprises (such as BYD and CATL), the educators naturally promote China's foreign policy of good-neighborliness, friendship, and win-win cooperation. This helps international students deepen their understanding of China's development and establish a positive image of China as a major country in the world.

3.2. Practical teaching link: Integration of virtual and real, and competence-oriented approach

The practical link is the key to cultivating students' engineering competence. Educators have deeply integrated the concept of Outcome-Based Education (OBE) for engineering education professional certification into teaching^[11–13].

3.2.1. Basic experiment level

Retain and strengthen traditional electrical machine experiments (such as disassembly and assembly, no-load/load experiments) to help students establish an intuitive understanding of the internal structure of electrical machines.

3.2.2. Virtual simulation level

Introduce software such as ANSYS Maxwell/SIMPLOER and offer special topics on electrical machine electromagnetic field and system simulation. Students are required to model the experimental electrical machines (**Figure 1**), compare and analyze the simulation results with experimental data, and deeply understand the differences and connections between theory and practice.

3.2.3. Comprehensive innovation level

Encourage students to conduct inquiry-based learning, try to carry out multi-physics field (such as electromagnetic-thermal-structural) coupling simulation of electrical machines, and think about how to optimize the design to deal with complex engineering problems in specific application scenarios such as electric vehicles and robots.



Figure 1. International students disassembling and assembling electrical machines



Figure 2. International students using ANSYS software for electrical machine design

This practical system, featuring “integration of virtual and real, and progressive advancement”, has effectively strengthened students’ abilities to think independently and innovatively solve complex engineering problems.

4. Reform and implementation of teaching methods

In view of the characteristics of international students—active thinking but uneven academic foundations, and English being a non-native language—educators have implemented a student-centered and diversified teaching method.

4.1. Implementation of heuristic and blended teaching

The one-way classroom model of “teacher lecturing and students listening” is abandoned, and heuristic teaching is adopted instead (**Figure 3**). Teachers guide students to think proactively by asking continuous questions and setting up problem scenarios. Students are encouraged to step onto the podium to explain exercises or share

insights, realizing a “flipped classroom” and maximizing the effect of in-class interaction ^[14].

At the same time, an online-offline blended teaching system is established. Using the Chaoxing Learning Platform, an online resource library is built (**Figure 4**), which includes course PPTs, teaching videos (12 videos), thematic discussion forums (4 forums), and a question bank (more than 100 questions). Students can preview, review, and take self-assessments at any time. Teachers gain a precise understanding of learning difficulties through online data and provide targeted explanations in offline classes, forming a teaching closed loop.



Figure 3. Heuristic classroom teaching



Figure 4. Established online course teaching website

4.2. Advocating the integration of Chinese and foreign cultures to enhance educational effects

Leveraging the multicultural backgrounds of international students, a “15-minute presentation” session is set up in class. Students can introduce their own country’s culture, industries, or share application cases combined with professional knowledge. On this basis, teachers supplement relevant examples of China’s technological

development and international cooperation (such as energy projects in the China-Pakistan Economic Corridor). This turns the classroom into a platform for cultural exchange, professional learning, and friendship cultivation, subtly enhancing the educational effect of ideological and political education in the course.

4.3. Optimizing assessment methods and increasing course challenge

To comprehensively evaluate learning outcomes, educators have reformed the assessment system, emphasizing process-oriented evaluation and competence orientation:

Reduce the proportion of the final exam and increase the weight of usual grades.

Enrich assessment forms: including online quizzes (for basic theories), in-class presentations (for expression ability), experimental reports (for practical ability), simulation project reports (for innovation and comprehensive analysis ability), and final exams (for mastery of systematic knowledge).

Emphasize “applying what is learned”: In the assessment of simulation and experiments, special attention is paid to the process of students analyzing and solving complex engineering problems (**Figure 5**), rather than only focusing on the results. The assessment questions are designed with a certain degree of difficulty and openness to increase the course challenge and motivate students to engage in in-depth learning.

5. Course features and innovations

The teaching reform of this course highlights “high-level”, “innovation”, and “challenge.”

5.1. High-level

It organically integrates knowledge impartment, competence development (solving complex engineering problems, cross-cultural communication), and quality improvement (innovation awareness, international cooperation perspective), cultivating students’ high-level thinking and application abilities (**Figures 5 and 6**).

5.2. Innovation

In terms of content, cutting-edge technologies and scientific research achievements are introduced; in terms of methods, heuristic teaching, blended teaching, and practical teaching combining virtual and real are integrated; in terms of resources, self-compiled characteristic simulation textbooks are developed, and rich online resources are built, featuring advanced forms and strong interactivity.

5.3. Internationalization and challenge

Teaching cases, literature reading, and lectures all emphasize an international perspective. The assessment method focuses on academic English and application abilities, with a high difficulty coefficient. It poses a beneficial learning challenge to students and meets the requirements of cultivating first-class international talents.

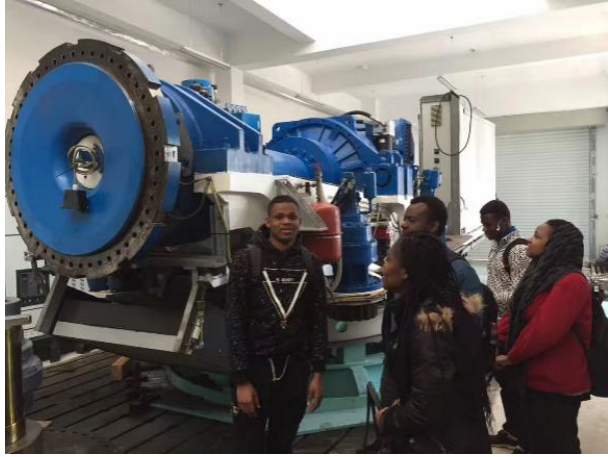


Figure 5. Students participating in the discussion of complex engineering problems



Figure 6. Students conducting electrical machine performance experiments

6. Conclusion

Through the systematic teaching reform of the all-English “Electrical Machines and Towage” course, which adheres to the principles of “student-centered, competence-oriented, integration of virtual and real, and cultural integration”, the study has initially constructed a new teaching model suitable for the characteristics of international students^[15–16]. Practice shows that this model has effectively improved international students’ learning enthusiasm, engineering practical ability, and cross-cultural academic communication ability, and the teaching effect has been significantly enhanced.

In the future, the course team will continue to deepen cooperation with enterprises and overseas universities, continuously update teaching cases and simulation projects, and further enrich online teaching resources. Educators are committed to building this course into a first-class all-English demonstration course in Shanghai, so as to cultivate more international high-quality engineering and technical talents who understand China, are friendly to China, and have strong competitiveness for the country.

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Research on Multimodal Communication of Lacquer Art from the Perspective of Digital Humanities

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Abstract: This study explores the practice, challenges, and opportunities of multimodal dissemination of lacquer art from the perspective of digital humanities. It begins by reviewing the development of digital humanities, emphasizing its application in art and cultural studies, particularly in the field of lacquer art. Through case studies, the article examines the multimodal expression and dissemination of lacquer art in digital environments, such as the use of 3D modeling, virtual reality (VR), and augmented reality (AR) technologies. These technologies not only enhance the interactivity and experiential quality of lacquer art education but also facilitate its international dissemination. The study also highlights the technical and cultural challenges faced in promoting traditional art through digital means, including high costs, technical barriers, maintenance requirements, and the difficulty of preserving cultural authenticity while ensuring effective dissemination. Additionally, the role of social media and online platforms in modern lacquer art dissemination is discussed ^[1]. These platforms provide extensive visibility and communication channels for artworks, fostering a multicultural community of lacquer art enthusiasts and opening new avenues for global dissemination and cultural exchange.

Keywords: Digital humanities; Multimodal dissemination; Lacquer art; Virtual reality

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1. Current status of digital humanities development

1.1. Definition and development of digital humanities

Digital Humanities is an interdisciplinary field that integrates computer science and humanities methods, focusing on the digitization and analysis of cultural heritage. Its history can be traced back to the 1960s, with an initial focus on the digital processing and statistical analysis of texts ^[1]. During this period, researchers mainly used simple computational tools to encode, store, and retrieve textual data for the study of literature and historical documents. With the development of computer science and advances in information technology, the

field of digital humanities has gradually introduced more complex and powerful tools and methods.

After entering the 21st century, digital humanities has developed into a global research field. Its research objects are no longer limited to literature and history, but have also expanded to multiple humanities disciplines such as art, music, drama, philosophy, etc. This expansion is due to the widespread application of digital technology, which enables scholars to process and analyze various multimodal data ^[2].

1.2. Digital technology and traditional handicrafts

The combination of digital technology and traditional handicrafts not only opens up new areas of research and creation but also greatly enhances the accessibility and expressiveness of traditional art forms. In the field of lacquer art, this fusion is manifested on multiple levels, from artistic creation to educational promotion, and then to cultural preservation; each aspect has been innovated and developed as a result. 3D modeling provides unlimited possibilities for modern design, allowing artists to freely experiment and modify designs in a digital environment, creating shapes and patterns that traditional craftsmanship cannot achieve. Digital drawing boards and professional drawing software enable designers to draw complex patterns and colors more accurately, achieving fine effects that traditional manual techniques cannot achieve ^[3].

By digitizing the images, production process, historical background, and relevant literature of lacquer artworks, a comprehensive digital archive can be established, providing valuable resources for researchers and the public. This not only contributes to academic research but also provides a solid foundation for the protection and inheritance of lacquer art culture. Through online platforms, lacquer artists can share their knowledge and experience with global enthusiasts, while also drawing inspiration from other cultures and technologies.

2. Overview of multimodality and applications

2.1. Concept of multimodality

Multimodality is a method of using multiple sensory modes when studying, communicating, or expressing information. These modes include text, images, sound, video, as well as other sensory channels such as touch or action ^[5]. The core of multimodal research lies in exploring how to optimize the transmission and reception experience of information by integrating these different forms and expressions of data ^[4].

Multimodal applications are not limited to education and academic research, but are also widely used in fields such as art, advertising, corporate communication, and media production. Multimodality is not only an effective way to achieve multi-level and multi-angle communication of information ^[5].

2.2. Multimodal application categories

The application of multimodal technology in the field of digital humanities not only deepens the integration of technology and culture but also spans multiple practical fields, greatly expanding the ways of information transmission and reception. In addition to education, museums, and artistic creation, multimodal technology is widely used in various fields such as media, advertising, and user interface design. In the field of media and advertising, multimodal technology makes content creation and information dissemination more attractive and effective ^[6].

Multimodal technology greatly enhances the attractiveness and dissemination of information by providing rich sensory experiences and interactivity. With the continuous development of technology and the expansion of application fields, multimodal technology will play a greater role in future digital humanities research and

practice, bringing new opportunities and challenges to traditional fields ^[7].

3. Practical applications of multimodal dissemination of lacquer art

As shown in **Table 1**, the practical applications of multimodal dissemination integrate text and images, video and audio, interactive media and virtual reality, as well as social media and online platforms, using various technologies and tools to innovatively enhance the educational and exhibition effects of lacquer art. These methods not only increase interactivity and immersive experiences but also effectively expand the audience scope of lacquer art, break through the limitations of time and space, and attract the interest of more young audiences.

Table 1. Analysis of practical applications of multimodal dissemination of lacquer art

Content	Specific technologies and tools	Effects and significance
Integration of Text and Images	Online image libraries, complex metadata and semantic tags, interactive timelines, virtual exhibitions, digital books, tutorials, 3D rendering technology, AR technology	Enhance the dynamics and interactivity of lacquer art dissemination; improve the efficiency of academic research and personal learning; provide vivid cultural stories of lacquer art; enrich users' learning experience; expand the audience scope of lacquer art.
Integration of Video and Audio	Documentaries, teaching videos, interactive virtual workshops, high-definition recording, audio narration, virtual reality technology, audio guides	Provide dynamic and immersive experiences; enhance the multisensory experience of the audience; promote the international dissemination of lacquer art; improve the audience's understanding and recognition of lacquer art; enhance the interactivity and interest of teaching; broaden the channels of international dissemination.
Interactive Media and Virtual Reality	Touchscreens, interactive exhibitions, digital games, virtual reality technology, Augmented Reality (AR) technology	Change the ways of lacquer art education and exhibition; provide immersive experiences and interactivity; break through the limitations of time and space; improve the interactivity and educational value of exhibits; attract the interest of young audiences; inherit the traditional skills and knowledge of lacquer art.
Social Media and Online Platforms	Social media platforms (Weibo, WeChat, Douyin, Kuaishou), short videos, story posts, live streaming, professional online platforms (Bilibili, Zhihu, Douban), e-commerce platforms (Taobao, JD.com), international shipping options, interactive comments, multilingual explanations	Improve the visibility of lacquer art; establish a cross-regional and multicultural community of lacquer art enthusiasts; promote knowledge sharing and skill improvement; expand the international market of lacquer art; enhance the audience's sense of participation and belonging; promote the dissemination of lacquer art knowledge and skills; expand the market and cultural exchange of lacquer art; provide new economic opportunities.

3.1. Application of text and images

The combination of text and images has brought unprecedented dynamism and interactivity to the learning and promotion of lacquer art in the digital environment. This diversified application not only improves the effectiveness of education and display, but also greatly expands the audience range of lacquer art. Online image libraries not only provide basic search and classification functions, but also integrate complex metadata and semantic tags that cover details such as the historical background, style features, production techniques, and cultural significance of lacquer artworks ^[8]. This deep information enables researchers and art enthusiasts to conduct more precise and in-depth queries, thereby enhancing the efficiency of academic research and personal learning.

Secondly, digital books and tutorials can automatically adjust the content presented based on the user's learning progress and interests. For example, beginners may receive more introductions to basic knowledge

and simple techniques, while more advanced learners can delve deeper into complex lacquer art techniques and cultural analysis. Combining advanced graphics rendering techniques, these tutorials can provide virtual workshops where users can “practice” lacquer art production in a controlled environment, including steps such as mixing paint, application design, and completing works.

3.2. Integration of video and audio

The combination of video and audio provides a more dynamic and immersive experience platform for the dissemination of lacquer art. By producing documentaries, instructional videos, and interactive virtual workshops about lacquer art, audiences can not only visually appreciate the beauty and exquisite craftsmanship of lacquerware but also listen to detailed explanations from craftsmen, understand material selection, process flow, and creative concepts ^[9].

3.3. Use of interactive media and virtual reality technology

The application of interactive media and virtual reality (VR) technology has completely changed the traditional way of educating and showcasing lacquer art. These technologies not only provide a highly immersive and interactive experience but also break through the limitations of time and space, allowing viewers to experience and understand the fine craftsmanship and aesthetic value of lacquer art more comprehensively and deeply. Interactive media technologies, such as touch screens, interactive displays, and digital games, make the display of lacquer art more vivid and engaging. In the exhibition, interactive screens can display the production process of different lacquer artworks, and viewers can choose to watch detailed introductions of specific crafts through touch operation.

Virtual reality technology creates a fully immersive environment, providing users with an experience as if they were in a real lacquer art workshop. In such a virtual environment, users can not only observe every detail, but also interact with objects in the environment, such as simulating various stages of lacquer art production, from preparing raw materials to painting and carving; all steps can be experienced one by one.

3.4. The role of social media and online platforms

Social media and online platforms play a crucial role in the dissemination and promotion of lacquer art, not only greatly increasing the visibility of lacquer art but also helping to establish a cross-regional and multicultural community of lacquer art enthusiasts ^[10]. Social media platforms such as Weibo, WeChat, TikTok, and Kwai allow lacquer masters and fans to show the unique charm and complex craft of lacquer art in the form of short videos, story posts, and real-time live broadcasts.

Professional online platforms and communities, such as Bilibili, Zhihu, and Douban, provide a place for lacquer enthusiasts to share and learn. On these platforms, beginners and experts can exchange skills and discuss various aspects of lacquer art, from basic knowledge to advanced skills.

With the popularity of social media and online platforms, lacquer artworks and related cultural content have rapidly spread to various parts of the world, enhancing the international community’s awareness and appreciation of this traditional art form. Through these platforms, lacquer art is not only a form of artistic expression but also a bridge connecting different cultural and historical backgrounds, enhancing international cultural exchange and understanding.

4. Challenges and opportunities in the digital humanities perspective of lacquer art

4.1. Technical and cultural challenges encountered by digital technology in the dissemination of lacquer art

Although digital technology has brought unprecedented opportunities for the dissemination of lacquer art, it also faces a series of technical and cultural challenges in practical applications. Advanced digital devices and technologies such as high-resolution scanners, 3D modeling software, and virtual reality devices are often expensive, which may be difficult for many independent artists and small studios to afford. This high cost limits the popularization and application of technology, especially in areas with limited resources. In addition to cost factors, mastering this high-tech equipment and software often requires new technical training for lacquer artisans. The complexity of digital technology requires artists to possess skills different from traditional crafts, such as computer operation and software programming abilities, which increases the difficulty and time of learning. With the increase of digital projects, how to effectively store, manage, and protect these large amounts of digital data has become another challenge. Although digital technology provides new ways for the preservation and display of lacquer art, the inheritance of traditional lacquer art largely relies on direct communication and practical learning between masters and apprentices.

4.2. Potential and possibility of multimodal propagation in promoting lacquer art

Multimodal propagation has shown great potential and possibilities in promoting lacquer art. By combining various forms such as text, images, audio, video, and interactive media, multimodal communication can more comprehensively and deeply showcase the unique charm of lacquer art.

Multimodal communication can provide a multisensory experience through rich media forms, enhancing the audience's understanding and interest in lacquer art. For example, by showcasing the production process of lacquer art through videos, accompanied by explanations from craftsmen and background music, the audience can more intuitively feel the aesthetic and artistic value of lacquer art.

5. Conclusions

This study explores the practice, challenges, and opportunities of multimodal dissemination of lacquer art from the perspective of digital humanities. By analyzing the current development status of digital humanities, the concept and application of multimodality, and the role of interactive media and social platforms in the dissemination of lacquer art, digital humanities provide new technological means and perspectives for the preservation, research, and dissemination of lacquer art. By utilizing digital technology, the digital documents of lacquer art can provide researchers and the public with broader and deeper access permissions. At the same time, the application of technologies such as 3D modeling and virtual reality provides new possibilities for the display and experience of lacquer art. These technologies not only contribute to the protection and inheritance of traditional art but also stimulate public interest and appreciation of lacquer art. Although digitization has brought many conveniences, there are also a series of technological and cultural challenges in the digital humanities application of lacquer art. The high cost and maintenance requirements at the technical level, as well as how to maintain the cultural authenticity and artistic depth of lacquer art in the digital process, are all issues that need to be taken seriously and addressed. This requires practitioners not only to master advanced digital technology but also to have a profound understanding of the cultural background of lacquer art.

In addition, the widespread application of multimodal communication has opened up new paths for the

education, promotion, and innovation of lacquer art. By combining various media such as text, images, and videos, multimodal communication enhances the interactivity and experiential nature of lacquer art education, helping to reach a wider audience, especially the younger generation. At the same time, the active use of social media and online platforms has provided a strong impetus for the global dissemination of lacquer art and promoted cultural exchange and understanding between countries. The research and practice of digital humanities in lacquer art have shown that the combination of traditional art and modern technology not only provides new opportunities for the inheritance and development of art itself, but also promotes the protection and promotion of cultural diversity. In the future, with the continuous advancement of technology and the expansion of application fields, the digitization and multimodal dissemination of lacquer art are expected to achieve greater innovation and breakthroughs, providing more possibilities and vitality for the protection and utilization of global cultural heritage.

Disclosure statement

The authors declare no conflict of interest.

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Research on the Integration of Piano Performance Techniques into the Keyboard System

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Abstract: Piano performance is a comprehensive art form that integrates technique, music, and aesthetics. Drawing upon decades of performance and teaching practice, this paper systematically sorts out the essence of the Soviet piano school and the Western classical performance system/tradition. By synthesizing pedagogical principles from masters including Cao Ke'en, Alexander Goncharov, Steven Thomas, Liu Shikun, and Yin Chengzong, a technique training system centered on “finger-wrist-arm-weight” has been established. Research indicates that deeply integrating performance techniques with the keyboard’s physical structure, harmonic logic, and musical style is the key pathway for cultivating students’ growth from “technical craftsmen” to “artistic expressers.” This paper aims to provide theoretical reference and practical paradigms for piano pedagogy, advancing the scientific and systematic transmission of performance techniques.

Keywords: Piano performance techniques; Keyboard system; Soviet piano school; Teaching system; Weight transfer; Musical expression

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1. Introduction

Since its invention by Bartolomeo Cristofori in 1709, the piano has become one of the most expressive instruments on the Western classical musical and even the global musical stage. Its keyboard system, composed of 88 black and white keys, serves not only as a mechanism for producing sound but also as a bridge connecting the performer’s inner world to musical compositions. However, piano instruction has long been plagued by an imbalance—overemphasizing technique while neglecting integration. Many students compartmentalize technical training from musical expression, mastering complex passages yet struggling to infuse music with soul.

As a performer and educator with over forty years of dedication to piano artistry, the author has had the

privilege of studying under masters of the Soviet piano tradition, such as Cao Ke'en and Alexander Goncharov, later receiving instruction from Western classical music experts like Steven Thomas, and benefiting from the guidance of Chinese piano masters, including Liu Shikun and Yin Chengzong. Since joining the American Piano Institute in 2016 to participate in international teaching research projects, the author has progressively validated and refined the training concept of “integrating piano performance techniques into the keyboard system” through follow-up instruction and data analysis of hundreds of students. This paper will deeply explore the scientific validity and practical feasibility of this concept from three dimensions: theoretical origins, systematic construction, and practical application ^[1].

2. Theoretical origins: The fusion of techniques from diverse schools and keyboard cognition

The development of piano performance techniques has always been closely intertwined with the characteristics of the keyboard system and the evolution of musical styles. Different schools offer distinct interpretations of “how technique should integrate with the keyboard”, and the author’s research is founded upon the synthesis and refinement of these various approaches.

2.1. Technical foundations and keyboard logic of the soviet piano school

The Soviet piano school is renowned worldwide for its “rigorous, solid, and comprehensive” technical training system, whose core lies in deeply integrating technical exercises with the physical structure of the keyboard and harmonic functions. This concept was profoundly embodied in the author’s early stage of piano performance through the instruction of Professor Cao Ke'en.

Professor Cao Ke'en, an educator who pioneered the introduction of the Soviet piano teaching system to China, emphasized that “technique serves keyboard cognition.” In foundational finger training, she rejected mere mechanical repetition and instead combined exercises from Hanon and Czerny with the keyboard’s tonal layout: Combining them with complex-tone finger exercises featuring chromatic progressions. For instance, during keyboard technique exercises centered on C major, she required students not only to achieve balanced finger articulation (lifting and lowering evenly) but also to use subtle dynamic variations to highlight the stability of the tonic chord (C-E-G) and the directional tendencies of the subdominant chord (F-A-C) and dominant chord (G-B-D). This training made the author realize that the keyboard is not an isolated collection of notes, but a “logical network” interconnected by harmonic relationships—finger movements must follow the rules of this network to give music its inherent coherence ^[2].

In auditory training, Professor Cao’s approach also revolves around the keyboard system. She instructs students to rapidly locate tonal centers on the keyboard through aural recognition and harmonic transposition without consulting sheet music, or to precisely reproduce the positions and intervals of complex contrapuntal lines on the keyboard by first singing them by ear. This “hand-ear coordination” training fundamentally establishes a conditioned reflex in the brain linking “sound perception→keyboard position→finger movement.” It lays a crucial foundation for subsequent integration of more complex techniques: the neural-linguistic training foundation.

Upon entering university, the author studied under Professor Alexander Gontcharov, an authentic inheritor of the Soviet piano school. His research on polyphonic training and pedal technique further deepened the

author's understanding of "technique-keyboard integration." Professor Gontcharov believed that the essence of polyphonic music lies in "the independence and dialogue of multiple voices", and the key to achieving this goal is to establish "layered control" of the fingers on the keyboard. In his teaching, he adopted the "polyphonic playing method": first, students played the subject voice of a fugue with one hand to experience its melodic line; then, the counter-subject voice was added. Students were required to "separate" the multiple voices on the keyboard through differences in touch and depth of touch, varying phrasing expressions, and dramatic treatment of specific sections within the overall structure. For example, when performing Bach's Fugue in C Major from Book I of *The Well-Tempered Clavier*, the subject voice requires a slightly heavier touch to emphasize its solemnity, while the counter-subject demands a lighter, more delicate touch to simulate the agility of dialogue. This training not only significantly enhances finger independence and the brain's ability to process multiple layers of voice parts but also deepens the author's understanding of the dialectical relationship between the keyboard's "vertical harmonic framework" and "horizontal melodic flow"—technique integration must balance harmonic richness with melodic clarity^[3-4].

Professor Goncharov's research delves particularly deeply into pedal technique. He views the pedal as an "extension of the keyboard", believing its function extends beyond merely sustaining sound to serve as a tool for shaping musical color and spatial perception. For works from different periods, he proposed specific pedaling principles: for Classical-era compositions (such as Haydn and Mozart), "half-pedaling" and "short pedaling" techniques are required, i.e., pressing the pedal halfway to two-thirds of its depth and controlling its release time, to prevent harmonic blurring. For Romantic-era works (such as Chopin and Liszt), diverse pedal techniques can be employed to express intense dramatic and spatial sonic effects, including "shaking pedal" (rapid alternating presses), "blending pedal" (layering harmonic treatments), and "harmony-sustaining pedal" (shifting to the 1/3 position and immediately pressing down again to retain the preceding chord). For Impressionist-era works (such as Debussy and Ravel), one must combine the soft pedal with the sostenuto pedal to explore the infinite possibilities of keyboard timbre, discerning the addition or reduction of pedals by hearing the hazy blended sound effects. These theories and methods of Professor Gontcharov made the author realize that integrating pedal technique expands the functional capabilities of the keyboard system—it enables the fixed keyboard structure to produce an infinite variety of sound effects according to musical needs.

2.2. Style interpretation and technique adaptation of the Western classical performance system

If the Soviet piano school built the technical framework for the author's "technique-keyboard integration", then the experience of studying under Professor Steven Thomas during the exchange in the United States made the author learn how to flexibly adjust the way of technique integration according to differences in musical styles.

As the fifth-generation direct disciple of Beethoven, Professor Steven Thomas centers his teaching on "technique guided by score research." He places immense emphasis on the study of original scores, believing that the choice of performance techniques must be based on an accurate grasp of the composer's intent. When analyzing the first movement of Beethoven's *Moonlight Sonata*, he pointed out that the "molto espressivo" (extremely expressive) marking in the score does not require exaggerated arm movements. Instead, it should be achieved through a "gradual increase and decrease in touch" from the fingertips—transitioning from the soft touch of fingertips to a slightly heavier contact with the pads, then returning to delicacy. This technique mimics the shimmering reflections on a lake under moonlight. Such integration serves the expression of musical

imagery, not mere technical display.

In the research on the compatibility between playing techniques and keyboard styles, Professor Thomas proposed the “period-style touch technique.” He argued that the structural differences between keyboard instruments from different historical periods (such as the harpsichord and the modern piano) dictate corresponding playing techniques:

Baroque period (Bach, Handel, Scarlatti): Due to the lighter action of the historical harpsichord, the “finger close-to-key” technique is employed, emphasizing granularity and clarity while avoiding excessive reliance on arm weight.

Classical period (Mozart, Beethoven): The prototype of the modern piano has appeared, but the action is still sensitive. It is necessary to combine finger agility with subtle wrist cushioning to achieve an “elegant and balanced” timbre.

Romantic period (Chopin, Liszt): The modern piano has matured, featuring a heavier action that allowed musicians to utilize arm weight and body weight transfer. Through “deep touch”, they achieved rich dynamic layers and emotional tension.

Professor Thomas’s research has enabled the author to transcend the technical limitations of any single school, realizing that “integrating techniques into the keyboard system” is not a fixed model but needs to be continuously adjusted according to the evolution of musical styles—the physical characteristics of the keyboard system and the historical context of musical styles jointly determine the selection and application of techniques.

2.3. Humanistic spirit and technical innovation of Chinese piano art

In recent years, the author has been fortunate to receive guidance from Chinese piano masters such as Liu Shikun and Yin Chengzong. Their practice of combining the aesthetic conceptions of Eastern culture with Western piano techniques has infused new meaning into the concept of “integrating techniques into the keyboard system.”

Mr. Liu Shikun’s performance is famous for the “balance between power and poetry.” He believes that the pinnacle of technique lies in achieving “invisibility” (trace-less)—where the audience perceives no technical effort, but is wholly immersed in the emotion brought by the music. When guiding the author in performing Chopin’s Nocturne Op.9 No.2, he emphasized that the continuous sixteenth-note ornamentation should not be executed as a display of rapid fingerwork. Instead, subtle wrist rotation combined with fingers lightly touching the keys should create ornamentation that flows as naturally as “running water.” This integration of techniques underscores the principle of “priority to artistic conception”—every note and every movement on the keyboard must serve the expression of “poetic imagery.”

Mr. Yin Chengzong’s exploration of “nationalized piano performance” has further expanded the expressive boundaries of the keyboard system. By adapting works such as the Yellow River Concerto and The Red Lantern, he has integrated the timbre characteristics of Chinese national instruments into piano performance. For instance, when imitating the “harmonics” of the guzheng, he requires pianists quickly and lightly touch the keys with the fingertips and then lifting them immediately, utilizing the keyboard’s resonance to create an ethereal effect; when imitating the “portamento” of the erhu, he employs lateral wrist movements to allow fingers to glide slightly across the keys, achieving gradual pitch transitions. These innovative techniques do not negate the Western system but, grounded in an understanding of the keyboard’s physical properties, infuse it with the humanistic spirit of Eastern music—the integration of techniques must not only follow the logic of the

keyboard but also carry cultural significance ^[5].

3. System construction: A “four-in-one” training system of “finger-wrist-arm-weight”

Based on research and integration of diverse schools of thought, combined with the author’s years of teaching practice, since 2016, when he served as an international researcher at the American Piano Institute, the author has progressively developed a “four-in-one” training system centered on “finger-wrist-arm-weight.” This system aims to integrate students’ playing technique with the keyboard system into an organic whole, achieving the unity of “technical automation” and “freedom of musical expression.”

3.1. Finger training: Precise control of keyboard tactility

Fingers serve as the most direct link between the performer and the keyboard. The core of finger training lies in achieving a unified balance of “independence, uniformity, and sensitivity.” In teaching, the author divides finger training into three stages:

3.1.1. Foundational finger strength stage

For beginners, the focus is on developing strength in the metacarpal joints. During “high finger lifting” exercises, students are instructed to naturally raise their fingers (approximately 5-8 centimeters), then strike the keys swiftly and powerfully using the metacarpal joints as pivots, immediately relaxing afterward. Simultaneously, combine targeted exercises, such as the characteristics of different keys in different tonalities and complex chromatic scale pattern training, allowing students to feel the consistency of finger force generation in different keyboard positions—for example, when playing the D major scale, attention should be paid to the black key positions of F# and C#, and compared with the positions in C major, the hand shape needs to be adjusted to match the key positions and finger curvature during playing to ensure the stability of key pressing. Complex chromatic scale finger exercises involve practicing across the entire keyboard to develop sensitivity to the distinct widths of white and black keys. Through sustained practice, students achieve seamless integration of touch across all keys, overcoming the common performer’s “fear of black keys” ^[6].

3.1.2. Uniform control stage

For intermediate students, finger uniformity is developed through materials such as Czerny’s Piano Rapid Etudes (Op.299), Cramer’s Etudes, and Bach’s Three-Part Inventions. During practice, students are required to employ the “metronome progressive method”—starting at a slow tempo ($J=60$), ensuring consistent note duration and dynamics while achieving complete relaxation in playing, then gradually accelerating. Simultaneously, students intensify practice alternating between chromatic scales and various harmonic arpeggios. This honed subtle finger touch distinctions across whole and half-step intervals on the keyboard—emphasizing finger contact sensitivity for chromatic scales while focusing on finger extension/retraction and harmonic color differentiation for arpeggios.

3.1.3. Timbre shaping stage

For advanced students, combine finger training with musical expression. For instance, when performing “The Girl with the Flaxen Hair” from Debussy’s Book I of Preludes, require the soft pads of the fingertips to gently

touch the keys to simulate a “hazy, ethereal” timbre by varying the depth of touch; while performing the third movement of Beethoven’s *Appassionata* Sonata, coordinated force from both fingertips and knuckles is needed to achieve a “firm and powerful” granular timbre. The author often tells students: “To produce different sounds, you must play differently.” This training helps students understand that the way fingers contact the keys directly determines the keyboard’s sonic effect—combining varied touch techniques with different levels of force ultimately aims to achieve diverse timbre expression.

3.2. Wrist training: Pivotal buffer for technique transfer

The wrist serves as a “bridge” during performance, with its flexibility and stability directly impacting the efficiency of technique execution. The author’s wrist training includes the following aspects:

3.2.1. Stability training

When playing fast scales and arpeggios, maintain a level and stable wrist position, avoiding any up-and-down shaking or sideways shifting. Auxiliary exercises such as “single-hand wrist support exercise” can be used—gently support the wrist of the playing hand with the non-playing hand to ensure it remains steady throughout the performance, allowing the fingers to become the primary source of power. For instance, when practicing numerous scale-based exercises, the wrist must provide stable support and movement, allowing the fingers to race across the keyboard swiftly. This prevents intonation errors caused by wrist instability.

3.2.2. Flexibility training

When playing chord progressions and octave passages, emphasize wrist rotation and cushioning. For example, when transitioning between C major and G major chords (C-E-G→G-B-D), the wrist needs to rotate slightly inward, allowing the arm’s weight to shift naturally for smoother chord transitions; when playing octaves, keep the wrist relaxed, using gentle up-and-down cushioning to absorb the impact of the downstroke and prevent arm stiffness. Simultaneously, through “alternating staccato and legato exercises”, students experience the wrist’s regulatory function: during staccato, the wrist drives fingers to strike keys rapidly before snapping back; during legato, the wrist facilitates smooth transitions, creating “seamless connection” between notes.

3.2.3. Coordination training

Combine wrist training with finger and arm movements to establish a “finger-wrist-arm” linkage. For instance, when performing the rapid cadenza passages in Liszt’s *Hungarian Rhapsody No. 2*, the wrist serves as the pivot point, driving fingers to leap swiftly across the keyboard while coordinating with subtle arm movements to achieve a “light yet powerful” performance effect. This training helps students recognize that the wrist serves as a “transit station” for integrating techniques into the keyboard—it precisely transmits arm power to the fingers while adjusting the direction and angle of force application according to changes in keyboard position ^[7].

3.3. Arm training: Dynamic regulation of force output

The arm serves as the primary source of power in piano performance, and the core of its training lies in balancing “relaxation and control.” The author focuses on the following points in teaching:

3.3.1. Relaxation awareness training

Have students stand with arms raised high, then abruptly swing arms forward while bending at the waist,

allowing arms to naturally hang and sway. Sense the relaxed state under gravity, then transfer this sense of relaxation to keyboard performance. When playing slow and lyrical passages (e.g., Chopin's Nocturne Op.9 No.1), complete arm relaxation is required. Guide the arms through the wrists, allowing their weight to naturally transfer to the fingertips to achieve a "full yet soft" timbre. Simultaneously, through the "arm weight dropping exercises"—where the arms fall freely through the air, with fingers immediately relaxing upon key contact—students grasp the principle that "weight equals sound."

3.3.2. Power control training

When performing passages requiring strong dynamics (such as the piano adaptation of Beethoven's Symphony No.5), students are instructed to utilize arm strength not through rigid exertion, but by engaging core support and power to drive the arms into a natural downward motion. For example, when playing fortissimo (ff) chords, the body's center of gravity may shift slightly forward, allowing the arms to exert downward force. After touching the keys, maintain arm stability to prevent wasted energy. Simultaneously, through "dynamic gradient exercises"—progressively building force from piano (p) to fortissimo (ff)—students develop the ability to finely modulate arm strength.

3.3.3. Dynamic coordination training

Integrating arm training with keyboard intervals and chord structures. For instance, when playing wide intervals (such as tenths and elevenths), arms must flexibly adjust their extension according to the keyboard spacing while maintaining shoulder relaxation; when playing dense chords, arms should remain stable to ensure precise finger placement on the keyboard. This training helps students understand that arm movement must adapt to the physical structure of the keyboard—the integration of techniques involves aligning arm strength with the keyboard's spatial layout.

3.4. Weight mastery: Multi-dimensional shaping of sound layers

Weight mastery represents an advanced stage in piano technique, deeply integrating the movements of fingers, wrists, and arms with the acoustic properties of the keyboard to achieve rich variations in timbre and dynamics. The author emphasizes the following aspects in teaching:

3.4.1. Weight gradation training

Divide arm weight into four levels: "fingertip weight" (using only finger strength), "wrist weight" (finger + wrist strength), "forearm weight" (finger + wrist + arm strength), and "body weight" (full-body engagement), allowing students to select the appropriate weight level according to musical demands. For example, when performing the fugue theme in Bach's *The Well-Tempered Clavier*, "fingertip weight" can be used to highlight line clarity; when performing Brahms' *Intermezzo* Op.119, No.4, "arm weight" can be employed to create a deep, rich timbre.

3.4.2. Weight transfer training

This is the core exercise that combines weight control with keyboard harmonic logic. When playing chord progressions (such as I-IV-V-I), students are required to naturally transfer weight from one chord to the next through wrist rotation and arm movement. For example, when playing the I-IV progression in C major (C-E-

G→F-A-C), the weight of the arm needs to smoothly transfer from the central C area to the F area to create a more fluid harmonic connection. Additionally, when playing polyphonic music, contrasting weight between different voices can achieve layered contrast—the thematic voice uses heavier weight, while the accompaniment voice employs lighter weight.

3.4.3. Correlation training between weight and timbre

Let students understand the direct relationship between weight and timbre—lighter weight produces softer timbre, while heavier weight yields fuller timbre. In teaching instruction, use the exercise “play the same note with different weights” to help students experience timbre changes produced by three touch techniques: light fingertip touch (soft), finger pad touch (full), and arm weight (heavy). For example, when performing the theme of Mozart’s Piano Sonata K.545 First Movement, a lighter touch is required to convey the work’s stylistic character.

4. Conclusion

In summary, “integrating piano performance techniques into the keyboard system” constitutes a systematic endeavor. It is not merely a simple layering of techniques, but rather a process of deeply coupling the performer’s physical capabilities and musical understanding with the physical characteristics of the keyboard and the intrinsic logic of musical works.

This study examines the Soviet piano school, the Western classical performance system, and Chinese piano art practices to reveal diverse pathways for integrating technique: the Soviet school emphasizes the structural fusion of technique with keyboard harmonic logic; the Western system prioritizes the historical adaptation of technique to musical styles, while Chinese pianists’ explorations have infused this integration with culturally innovative approaches.

The “four-in-one” training system of “finger-wrist-arm-weight” developed on this foundation represents an organic synthesis and practical application of the aforementioned multifaceted concepts. It aims to internalize techniques into the performer’s muscle memory through scientific and rigorous training, ultimately achieving the artistic realm of “unity of man and piano.”

The author hopes that this study can provide a theoretical framework and practical paradigm for piano pedagogy, help more learners and educators recognize the importance of integrating techniques with the keyboard system. This approach aims to advance the art of piano performance through both tradition and innovation, cultivating outstanding pianists who possess both solid technical foundations and profound musical expression.

Disclosure statement

The author declares no conflict of interest.

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Research on the Ability of Integrating Curriculum Ideology and Politics into College Chinese Teachers and Its Influencing Factors

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Abstract: Curriculum ideology and politics is an important measure for colleges and universities in the new era to implement the fundamental task of establishing morality and cultivating people. As a basic major in the field of humanities and social sciences, the Chinese discipline plays an important role in implementing curriculum ideology and politics. However, the reality that the implementation ability of curriculum ideology and politics of college Chinese teachers varies, and the influencing factors are complex and diverse, has affected the effective implementation of curriculum ideology and politics. This study adopts a quantitative method to explore the factors influencing the implementation ability of curriculum ideology and politics of college Chinese teachers, providing a reference basis for improving their implementation ability. The research results show that the overall implementation ability of curriculum ideology and politics of college Chinese teachers is at a medium-upper level, among which the teaching design ability is relatively strong and the teaching evaluation ability is relatively weak; teachers' personal factors (ideological and political awareness, ideological and political knowledge and ideological and political ability), school environmental factors (school attention degree, training mechanism and evaluation mechanism) and social environmental factors (social atmosphere and policy support) all have a significant positive impact on the implementation ability of curriculum ideology and politics.

Keywords: Curriculum ideology and politics; Implementation ability; Influencing factors; Chinese teachers

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1. Introduction

In 2016, the President of the CPC put forward at the “National Conference on Ideological and Political Work in Colleges and Universities” that “all kinds of courses should go in the same direction as ideological and political theory courses”, which is the vanguard for all courses to comprehensively implement curriculum ideology and politics. In 2018, the release of the “Basic Requirements for the Teaching of Ideological and Political Theory

Courses in Colleges and Universities in the New Era” clarified the specific requirements and implementation arrangements of curriculum ideology and politics. In 2019, the “Theoretical Opinions on Deepening the Reform and Innovation of Ideological and Political Theory Courses in Schools in the New Era” issued by the Ministry of Education and the “Work Plan for the ‘Quality Improvement Action of Ideological and Political Theory Courses in Schools in the New Era’” issued by the Party Group of the Ministry of Education are of great significance for further promoting the in-depth development of curriculum ideology and politics in colleges and universities. In 2020, the “Guiding Outline for the Construction of Curriculum Ideology and Politics in Higher Education Institutions” issued by the Ministry of Education runs curriculum ideology and politics through the quality system of talent cultivation in colleges and universities, providing scientific guidance and a compliance basis for the construction, development, and evaluation of curriculum ideology and politics. In 2022, the “Implementation Outline for the Quality Improvement Project of Ideological and Political Work in Colleges and Universities” issued by the Ministry of Education clearly put forward to vigorously promoting classroom teaching reform with the goal of “curriculum ideology and politics”, optimizing the curriculum setting, and improving the teaching design. In 2023, the Ministry of Education released the “Guiding Outline for the Construction of Curriculum Ideology and Politics in Higher Education Institutions”, clarifying the basic framework and implementation path of curriculum ideology and politics construction. In 2024, the “Notice on Formulating the Undergraduate Curriculum Teaching Outline in 2024” clearly pointed out that it is necessary to promote the construction of curriculum ideology and politics and the implementation of the talent training plan, emphasizing the integration of curriculum ideology and politics.

From the policies in recent years, it can be seen that at the national level, in the deployment and arrangement of curriculum ideology and politics, the goals are clear, the rhythm is orderly, and the layers are deepening. Guided by policies, curriculum ideology, and politics is further deepened and solidified. The college Chinese course, as a key position for inheriting excellent traditional Chinese culture and cultivating humanistic qualities, the level of its teachers’ ability to integrate curriculum ideology and politics is directly related to the implementation effect of the fundamental task of establishing morality and cultivating people^[1]. However, at present, college Chinese teachers still face many challenges in the process of integrating curriculum ideology and politics, such as insufficient excavation of ideological and political elements, a single integration method, and an imperfect teaching effect evaluation system^[2]. Therefore, systematically studying the ability of college Chinese teachers to integrate curriculum ideology and politics and its influencing factors is of great significance for improving teachers’ teaching level, optimizing curriculum design, and realizing the organic unity of knowledge transfer and value guidance.

This study uses the literature review method and the questionnaire survey method to reveal the existing problems and deficiencies, and puts forward corresponding improvement strategies. On the basis of the existing literature, two problems are solved: (1) What is the current situation of the ability of college Chinese teachers to integrate curriculum ideology and politics? (2) What are the influencing factors of the ability of college Chinese teachers to integrate curriculum ideology and politics?

2. Literature review

Currently, in advancing the reform and construction of ideological and political education in courses, the academic community has established corresponding theoretical systems, typical demonstration cases, and

implementation paths, and achieved certain results ^[3]. Efforts should be made to strengthen the “guidance”, “training”, “assistance”, and “promotion” for professional teachers, driving them to deeply participate in various education-related work ^[4]. Continuous efforts are needed in such aspects as raising awareness, innovating ideological and political education methods, strengthening literacy training, and conducting regular teaching reflections. Traditional Chinese language teaching methods focus on knowledge imparting, lacking guidance on students’ ideological values ^[5]. It is proposed that Chinese language teachers need to strengthen their awareness of ideological and political education and improve their own ideological and political literacy in order to better integrate ideological and political elements into teaching. The importance of improving teachers’ teaching ability in ideological and political education in courses is emphasized, including carrying out thematic training on ideological and political education in courses, encouraging teachers to participate in teaching practice of ideological and political education in courses, and establishing an evaluation mechanism for the teaching effect of ideological and political education in courses ^[6]. The improvement of university professional course teachers’ ability in ideological and political education in courses needs to start from aspects such as teachers’ own literacy, innovation of teaching methods, and school support systems ^[7]. It is pointed out that college Chinese teaching should focus on excavating ideological and political elements in Chinese courses and organically integrate these elements into teaching content through teaching design, so as to realize the organic integration of Chinese teaching and ideological and political education. Xu Xiaojun found that teachers’ ability and school policy support are key factors affecting the effect of ideological and political education in courses ^[8]. Schools should formulate clear plans for the construction of ideological and political education in courses, improve relevant systems, and provide policy support and resource guarantees for teachers ^[9]. The key to improving university teachers’ ability in ideological and political education in courses lies in teachers’ training and professional development ^[10]. As a public education course, college Chinese teaching content is rich in ideological and political education resources, which is consistent with the fundamental task of ideological and political theory courses ^[11]. It is found that the research on ideological and political education in courses shows a trend of interdisciplinary and multi-field application, which needs to start from multiple aspects, such as the improvement of teachers’ ability, the innovation of teaching methods, and the support of school policies. Zhang Daliang emphasized the in-depth integration of ideological and political education and professional education to realize the education of all staff, the whole process, and all-around ^[12]. Existing studies have focused on the implementation effect and influencing factors of ideological and political education in courses, but there is still a lack of empirical analysis on teachers’ ability to integrate ideological and political education in courses.

3. Research design

The samples of this study were collected from Chinese language teachers at 7 universities directly under the administration in western China, with the characteristics of valid samples as follows: Gender structure: females accounted for 79.41% ($n=54$) and males accounted for 20.59% ($n=14$); Teaching experience distribution: those with less than 10 years of teaching experience accounted for 55.89% ($n=38$), those with 11 to 20 years accounted for 30.88% ($n=21$), and those with more than 20 years accounted for 13.24% ($n=9$); Educational background composition: master’s degree holders accounted for 89.71% ($n=61$) and doctoral degree holders accounted for 10.29% ($n=7$). The factors influencing university teachers’ ability to implement ideological and

political education in courses mainly include individual factors, school factors, and social factors. Among them, individual factors include ideological and political awareness, ideological and political ability, and ideological and political knowledge; school factors include the degree of attention, training mechanisms, and evaluation mechanisms; social factors include policy support, ideological and political atmosphere, and ideological and political effectiveness. The dimensions of university Chinese language teachers' ability to integrate ideological and political education into courses include: ideological and political awareness (cognition of ideological and political goals, willingness to implement, and impact on students' development), ideological and political ability (ability to accurately grasp goals, ability to explore elements, and ability to design teaching), ideological and political knowledge (degree of knowledge mastery, degree of understanding of policy documents, and ability to integrate theory and practice), school attention (resources and support, teaching research), and evaluation mechanisms (integration into teaching evaluation system, assessment standards for implementation effectiveness, effectiveness of ideological and political implementation, and students' acceptance of ideological and political education).

4. Influencing factors of curriculum ideology and politics implementation ability

Factors affecting Chinese language teachers' CIP implementation ability are divided into subjective and objective factors. Subjective factors include: insufficient self-awareness of teachers, low work enthusiasm, and lack of teaching reflection. Objective factors include: insufficient school teaching environment and facility resources, and a lack of self-training opportunities. Teachers can adjust teaching strategies in a timely manner, optimize the allocation of teaching resources, and improve the overall quality of education.

4.1. Individual factors

The ideological and political awareness and capabilities of teachers are key to the integration of ideological and political education into courses. Studies have found that teachers' understanding of curriculum-based ideological and political education, their ability to identify ideological and political elements, and the innovation in their integration methods directly affect the effectiveness of such education. For example, some teachers struggle to identify ideological and political elements in professional courses, resulting in rigid integration approaches. In addition, teachers' political literacy, moral literacy, and professional literacy also have a significant impact on their ability to carry out curriculum-based ideological and political education.

Teachers' years of service and professional titles have no significant impact on their ability in this regard, but their disciplinary and professional background has a relatively large influence on their capacity to integrate ideological and political elements into courses. Professional course teachers are relatively weak in ideological and political education capabilities and need to continuously improve through training and practice ^[13]. Furthermore, teachers' teaching experience also affects their grasp and the implementation effect of curriculum-based ideological and political education.

Time and energy are major obstacles restricting teachers from conducting curriculum-based ideological and political education. Teachers face considerable pressure from daily teaching and research tasks, making it difficult to allocate sufficient time to design and implement such education. Therefore, universities need to provide support in terms of time and energy for teachers through policy support and institutional guarantees.

4.2. School factors

The policy support and institutional guarantees of colleges and universities are an important foundation for the implementation of ideological and political education in courses. Schools should formulate clear plans for the construction of ideological and political education in courses, improve relevant systems, and provide teachers with necessary policy support. For example, by establishing special funds and offering training opportunities, schools can encourage teachers to actively participate in the construction of ideological and political education in courses.

Teachers' ability in ideological and political education for courses needs to be continuously improved through systematic training and practice. Schools should regularly carry out special training on ideological and political education in courses, invite experts to provide guidance, and help teachers enhance their ideological and political awareness and teaching capabilities. In addition, schools can also organize activities such as teaching observations and experience exchanges to promote learning and cooperation among teachers.

A scientific and reasonable evaluation and incentive mechanism is an important means to promote the construction of ideological and political education in courses. Schools should establish a sound evaluation system for ideological and political education in courses, which evaluates from multiple dimensions such as the achievement of teaching objectives, student satisfaction, and course demonstration ^[14]. At the same time, by recognizing outstanding teachers and promoting demonstration courses, schools can motivate teachers to actively engage in the construction of ideological and political education in courses.

4.3. Social factors

The social environment and cultural atmosphere exert a significant influence on the integration of ideological and political education into university courses. The diversity of social trends and cultural collisions provides abundant materials for this integration while also posing challenges. University teachers need to actively guide students in establishing correct values and resisting the impact of negative ideological trends during teaching.

The society's awareness and support for the integration of ideological and political education into courses also affect its implementation effect. All sectors of society should strengthen the publicity and promotion of this initiative to enhance public awareness of its importance. Meanwhile, the government and enterprises can support the development of ideological and political education in university courses by providing resource support and participating in curriculum construction.

The development of information technology and the media environment has provided new platforms and means for the integration of ideological and political education into courses. University teachers can utilize integrated media technologies to innovate teaching methods and improve teaching effectiveness. Through online courses, virtual simulation teaching, and other approaches, the attractiveness and appeal of ideological and political education embedded in courses can be enhanced.

5. Conclusions and implications

The improvement of university teachers' ability to integrate ideological and political education into courses is a systematic project that requires joint efforts from three levels: individuals, universities, and society. Teachers should continuously enhance their ideological and political awareness and teaching capabilities; universities should provide policy support and institutional guarantees; and society should create a favorable environment and atmosphere. Only in this way can educators effectively promote the construction of ideological and political

education in courses and achieve the fundamental task of fostering virtue through education in universities.

Teachers still have deficiencies in their own literacy and abilities when implementing ideological and political education in courses. In terms of subjective awareness, apart from an insufficient understanding of the educational concept of ideological and political education in courses, public course teachers also have deviations or even gaps in their cognition of the content that needs to be implemented for the construction of ideological and political education in courses. The fact that teachers have not participated in the compilation of textbooks, publication of papers, or even academic conferences and special lectures related to ideological and political education in courses also reflects that teachers lack opportunities for research and learning in this field. Only by fully understanding ideological and political education in courses and engaging in practical experience can they adapt to the reform of ideological and political education in courses.

In response to the aforementioned issues, schools should organize special training on ideological and political education in courses, with rich and diverse training content. This includes training on instructional design for ideological and political education in courses, where teachers can learn how to excavate ideological and political elements in professional courses—for example, exploring the national spirit and values embodied in literary works in literary appreciation courses to strengthen the sense of the Chinese nation as a community. In terms of teaching method training, teachers should learn how to integrate ideological and political cases into professional teaching using the case teaching method. Additionally, leveraging existing information-based teaching technologies is crucial for enhancing the ability to implement ideological and political education in courses. Learning to use Virtual Reality (VR) technology to showcase red cultural heritage sites allows students to experience the revolutionary spirit immersively, which has proven to be highly effective when integrating ideological and political education into courses such as history and culture.

Teachers should actively participate in academic seminars related to ideological and political education in courses to exchange experiences and the latest research results with peers. At these seminars, teachers can share their practical cases of ideological and political education in courses and gain inspiration from other teachers. Interdisciplinary teacher exchanges on how to integrate ideological and political elements into practical teaching links are also beneficial—for example, liberal arts teachers can learn from science and engineering teachers about methods to guide students in thinking about value-related issues during course discussions.

During the instructional design phase, teachers should systematically plan the objectives and content of ideological and political education. They can integrate the perseverance and courage to explore demonstrated by scientists and educators as ideological and political elements into the formulation of teaching objectives. In organizing teaching content, achievements of China's science and technology (such as the aerospace industry) can be incorporated to cultivate students' sense of national pride. In the process of classroom teaching implementation, a variety of teaching methods should be flexibly used to carry out ideological and political education in courses. For instance, the group discussion method can be adopted to guide students to reflect on relevant ideological and political issues while discussing professional topics. Conducting regular teaching reflections is also a key link in improving the ability to implement ideological and political education in courses. Teachers can keep teaching reflection journals to record the strengths and weaknesses of each ideological and political teaching session, and adjust teaching strategies in a timely manner based on the reflection results. If it is found that a certain ideological and political teaching method is ineffective—such as pure theoretical explanations failing to arouse students' interest—more engaging approaches like displaying audio-visual materials and organizing field visits can be tried to enhance the effectiveness of ideological and political

education in courses.

Universities should carry out joint teaching activities, such as jointly designing and teaching an interdisciplinary course integrating ideological and political education, or organizing interdisciplinary case competitions on ideological and political education in courses. These activities can strengthen collaborative communication among teachers and improve their ability to implement ideological and political education in courses. In addition, universities should conduct exchange activities on ideological and political education in courses with other schools to learn from their excellent experiences and models. Participating in activities organized by organizations such as the Ideological and Political Education in Courses Alliance and regularly organizing teaching observation and experience sharing activities can broaden teachers' horizons and improve their overall ability to implement ideological and political education in courses.

The success of the construction of ideological and political education in courses largely depends on teachers' teaching ability in this field ^[15]. From Super Chinese Class on Shandong Satellite TV to Super Ideological and Political Class on Beijing Satellite TV, these programs not only present an audio-visual feast to the public but also trigger in-depth thinking in the academic community about university teachers' ability to integrate ideological and political education in the media age. These two programs take television media as a carrier, move traditional classrooms to the screen, and realize the organic unity of knowledge dissemination and value guidance through innovative expression methods and interaction modes, providing useful references for university teachers to improve their ability to integrate ideological and political education. The media age calls for the coordinated development of university teachers' ability to integrate ideological and political education ^[16]. Super Chinese Class and Super Ideological and Political Class are not isolated entities but an organic whole that is interrelated and mutually reinforcing. Chinese courses contain rich ideological and political elements, and ideological and political courses also need to rely on the humanistic heritage of Chinese courses to enhance their persuasiveness and appeal.

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Artificial Intelligence and Input Enhancement in L2 Writing: Theoretical and Pedagogical Insights

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Abstract: With the widespread application of generative artificial intelligence in the field of language teaching, second language writing instruction is gradually transitioning toward digitalization and intelligentization. Traditional input enhancement, which relies on manual operations, is monotonous in form and hardly adaptable to the individual differences of learners; it can no longer meet the dynamic needs of second language acquisition in the digital age. Thus, exploring an AI-driven input enhancement model has become a key issue for optimizing L2 writing instruction. This research focuses on the impact of AI input enhancement on students' English writing. As a digital extension of traditional input enhancement, it relies on tools like ChatGPT, Grammarly, and Bing tools, and is theoretically grounded in second language acquisition theories such as the Input Hypothesis, Noticing Hypothesis, and multimodal learning theory. Guided by these theories, it strengthens target language salience through real-time feedback and integrates multimodal resources (text, images, etc.) to construct immersive learning environments, laying a theoretical basis for subsequent research and practice. To validate this approach, existing studies validate it with three paradigms (theoretical speculation, empirical research, mixed methods), each with pros and cons. In practice, AI input enhancement boosts writing efficiency and student confidence while adapting to diverse teaching scenarios. However, it also brings problems such as students' over-reliance on technology, impaired writing originality, controversies over educational equity, insufficient contextual adaptability of tool feedback, and a lack of guidance for higher-order thinking. To address these issues, future efforts should explore differentiated tool-use rules, optimize tool contextual adaptability, and establish an "AI tools+teacher guidance" collaborative model to balance technology empowerment and student autonomy in L2 writing teaching.

Keywords: AI input enhancement; Second language writing; Input Hypothesis

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1. Introduction

1.1. Empowerment of SLA by AI

Generative Artificial Intelligence is a technology that uses machine learning models to learn patterns and

connections from datasets of content created by humans, and then generates new content such as text, images, audio, and video ^[1]. GenAI technology, with ChatGPT as a typical representative, has shown profound application potential in the field of language teaching and learning, and is promoting significant changes in this field.

Existing studies have adopted qualitative analysis methods to systematically explore the effect of GenAI chatbots on SLA ^[2]. Specifically, the advantages of GenAI in assisting L2 learning are mainly reflected in three aspects: first, it can provide real-time feedback on learners' input information, helping learners find and correct language errors in a timely manner; second, it can simulate real dialogue scenarios, creating a practical language environment for learners; third, it can adapt to the differentiated needs of learners and provide personalized support based on individual learning characteristics.

Quantitative studies have further revealed that the language learning model with AI technology makes learners' writing skills and motivation much better. This is shown in many ways — their ability to organize article structure, make content coherent, use correct grammar, and have richer vocabulary all get better. In addition, through three main functions: real-time feedback, personalized adaptation, and emotional support, AI provides strong support for L2 writing ^[1]. Data show that more than 80% of learners in the experimental group reduced their Foreign Language Anxiety (FLA) with the help of AI, 75% of learners improved their learning attitudes through self-directed learning experiences, and the sense of accomplishment brought by “perceived immediate progress” effectively enhanced motivation, forming a positive cycle for the improvement of L2 writing ability.

1.2. Limitations of traditional teaching approaches

In traditional teaching scenarios, teachers are the core guides for learners' language acquisition. However, the popularization of the Internet has completely changed this pattern.

A comparison between the traditional teaching model and the AI-assisted model highlights the inherent shortcomings of the former. In traditional classrooms, EFL learners tend to experience anxiety when completing writing tasks, and this negative emotion has an adverse impact on their writing performance and learning motivation ^[3]. At the same time, the lag and generality of teachers' feedback in traditional teaching make it difficult to meet learners' needs for timely guidance; moreover, over-reliance on teachers may restrict the development of learners' independent inquiry abilities. In addition, some studies point out that although GenAI has significant advantages in writing guidance, the lack of cultivation of learners' critical thinking in the traditional teaching model is likely to lead to learners' over-reliance on GenAI tools in subsequent use, thereby hindering the development of their independent thinking abilities.

1.3. Definition of AI input enhancement

To clarify AI Input Enhancement, we first look at the theoretical origin of “Input Enhancement.” This concept was put forward by Sharwood Smith (1993). Its main idea is to use external methods to make target features (e.g., grammar, collocations) easier to notice. It guides learners to focus on key elements, helping turn input into “intake” ^[4].

In traditional SLA research, Input Enhancement is mostly manual, following “passive reinforcement + single form” (e.g., bolding collocations in texts). It relies on researchers/teachers' subjective judgment (failing to fit learner differences) and uses single carriers (text/audio), unable to meet digital learning's dynamic, multi-

sensory needs.

AI Input Enhancement is a digital extension and technical upgrade of the traditional Input Enhancement theory. Traditional Input Enhancement is an input optimization method led by humans, with a single form and passive reinforcement. AI Input Enhancement, however, is an innovative input method driven by AI, with multiple forms working together and active adaptation. Its core is optimizing the selection, presentation, and processing of input features through intelligent handling.

Both types of Input Enhancement follow the core logic of making features more noticeable and helping turn input into intake. But with technology, AI Input Enhancement solves the shortcomings of traditional Input Enhancement in fitting individual differences, multi-form cooperation, and dynamic adjustment. It better meets the need for efficient input processing in SLA in the digital age.

2. Theoretical foundations of AI input enhancement

2.1. The Input Hypothesis (1980): Focusing on the necessity of comprehensible input

2.1.1. Core theoretical claims

Proposed by Krashen in 1981, the Input Hypothesis is the first theory in the field of SLA that systematically explains the role of input. Its core view can be summarized as follows: the key to SLA lies in exposure to comprehensible input, and the difficulty of the input should be slightly higher than the learner's current level. Here, "i" represents the learner's existing language proficiency, and "+1" represents language materials that are slightly beyond the current level ^[5]. Krashen further pointed out that ideal input should have four characteristics: comprehensibility, interestingness and relevance, non-grammatical sequencing, and sufficient quantity.

In the field of TCFL, Zhu Weijuan conducted empirical observations to verify the applicability of this hypothesis ^[6]. The findings showed that providing Chinese learners with listening materials of appropriate difficulty, such as dialogues containing familiar vocabulary and sentence patterns, and idiom story videos with visual aids, can significantly improve the efficiency of their input absorption. This is consistent with Krashen's emphasis on comprehensible input. Additionally, Bailey and Fahad carried out a case study on Iraqi English learners. They found that when these learners read English novels slightly above their current proficiency level and used bilingual dictionaries to understand new words, their vocabulary size and text comprehension ability gradually improved. This result also confirms the promoting effect of the "i+1" input in SLA ^[7].

2.1.2. Theoretical limitations and implications for this study

In the research on SLA, the Input Hypothesis identifies the core view that input is the prerequisite for language acquisition, but it also has limitations. On one hand, the concept of "i+1" is not clearly defined and is difficult to measure with specific data, so teachers cannot accurately determine the exact "+1" difficulty level that each learner can accept. On the other hand, this theory places too much emphasis on the meaning of input and fails to attach importance to language forms. As a result, some learners, despite being exposed to a great deal of comprehensible language input in immersive teaching, still have problems with inaccurate grammar in what they write or speak.

For AI input enhancement, the value of the Input Hypothesis is mainly reflected in two principles: the input difficulty should be appropriate, and the input quantity should be sufficient. Specifically, AI tools can dynamically assess learners' writing proficiency and generate feedback that matches their difficulty level, such as providing intermediate-level learners with supplementary examples of how to use complex sentence patterns.

In this way, personalized input that meets the “i+1” requirement can be provided to different learners ^[1]. At the same time, AI can also integrate various forms of resources such as text, audio, and images, making the input content more interesting and more closely connected to learning goals, thereby reducing learners’ cognitive load. This is actually an extension of the ideal input characteristics proposed by Krashen in a digital form.

2.2. The Noticing Hypothesis (1990s): Revealing the key role of cognitive regulation

2.2.1. Core theoretical claims

In 1990, Schmidt proposed the Noticing Hypothesis. This hypothesis addresses the limitation of the Input Hypothesis, which overlooks cognitive mechanisms. Its core argument is that “consciously attending to linguistic forms” is a necessary and sufficient condition for converting linguistic input into intake. In other words, learners cannot acquire new linguistic structures through subliminal perception ^[8]. Later, Schmidt further pointed out that noticing is not a single process but consists of two stages: detection and short-term memory rehearsal. Only when learners actively identify the differences between their interlanguage and the target language can linguistic forms be effectively internalized ^[8].

Building on this foundation, Sharwood Smith put forward the concept of Input Enhancement in 1993 ^[4]. This concept advocates using external interventions, such as bolding text, italicizing content, and presenting information at high frequencies, to increase the perceptual salience of target forms, thereby guiding learners to focus on key features. By reviewing relevant literature in 2019, Li Zhiqiang and Li Yongzhong found that the effectiveness of input enhancement has been supported by a number of empirical studies ^[9]. For instance, in English writing instruction, highlighting lexical collocations can reduce learners’ collocation error rates by more than 30% ^[10]. Additionally, when teachers implicitly correct learners’ incorrect expressions through recasts, it can also indirectly prompt learners to notice linguistic forms.

2.2.2. Theoretical limitations and implications for this study

The Noticing Hypothesis clarifies the importance of cognitive regulation in language learning, yet it has two shortcomings. First, the theory focuses more on learners’ passive attention to linguistic forms and fails to fully consider the motivations behind learners’ active attention, such as learning needs and task objectives. Second, traditional input enhancement methods like text annotation mostly rely on a single modality, making it difficult to adapt to the cognitive preferences of different learners. For example, the needs of visual learners differ from those of auditory learners. For research on AI input enhancement, the core value of the Noticing Hypothesis lies in its confirmation of the necessity of “focusing on linguistic forms.” The essence of AI input enhancement is to use technological means to increase the salience of target linguistic forms. For instance, Grammarly marks grammatical errors with red underlines, and ChatGPT highlights differences in lexical collocations through comparative examples. These functions directly reflect the theoretical logic of input enhancement ^[11]. Meanwhile, AI can dynamically adjust the way of enhancement based on the type of learners’ writing tasks: for argumentative essays, it focuses on strengthening logical connectives; for narrative essays, it emphasizes tense consistency. This enables contextualized and personalized attention guidance, which is precisely a breakthrough in addressing the single-modality limitation of traditional input enhancement.

2.3. Multimodal learning theory (2010s): Constructing a “multi-sensory collaboration” input modal

2.3.1. Core theoretical claims

Since the 21st century, with the popularization of multimedia technology, multimodal learning theory has gradually become a research focus in the field of SLA. Its theoretical basis comes from Halliday’s Systemic Functional Linguistics and Kress & van Leeuwen’s Social Semiotics. Kress and van Leeuwen defined “modality” as a regularized resource for meaning construction, including language, images, gestures, sounds, spatial layout, etc.^[12]. They argued that all communicative activities are processes of multimodal collaboration, and different modalities achieve meaning co-construction through complementation, extension, or conflict^[13].

In the field of education, Early et al. pointed out in a special study published in *TESOL Quarterly* that the core value of multimodal teaching lies in two aspects: first, activating multi-sensory channels such as vision, hearing, and touch to improve the comprehensibility of input and memory retention rate; second, integrating learners’ cultural backgrounds and life experiences to promote in-depth connections between language forms and meanings^[14]. For example, Ajayi conducted a study on ESL students in American junior high schools and found that when learners were asked to interpret mobile phone advertisements through multimodal methods (such as drawing, written explanations, and in-class presentations), their text analysis ability was significantly improved. Moreover, this practice also prompted learners to connect the language forms in the advertisements with their own community experiences (e.g., using red to mark elements symbolizing gang violence), realizing the personalized meaning construction of language input^[15].

Combining the practice of English teaching in China, Wang Chunlei and Li Chili proposed a three-dimensional interaction model for multimodal classrooms. Before class, teachers conduct multimodal lesson preparation (e.g., sharing video courseware and audio lesson plans) and students conduct multimodal preview (e.g., group audio discussions and image annotations) through online platforms^[13]. During class, students solve preview problems through multimodal collaboration among peers (e.g., film dubbing and multimodal reports) and multimodal interaction between teachers and students (e.g., micro-lecture explanations and gesture feedback). After class, the continuity of input is achieved through the interaction between offline and online classrooms (e.g., online inquiries and offline Q&A sessions). This model has verified the significant role of multimodal input in improving classroom participation and learning efficiency.

2.3.2. Theoretical limitations and implications for this study

While multimodal learning theory has expanded the formal boundaries of input, current research still has a focus on description rather than application. On one hand, most studies concentrate on the impact of multimodality on reading comprehension and listening, with insufficient attention paid to productive tasks such as writing^[16]. On the other hand, the integration of multimodal resources lacks systematicity, which easily leads to “modal overload” and instead increases learners’ cognitive load^[17].

For research on AI input enhancement, the guiding significance of multimodal learning theory is reflected in three aspects. First, AI can integrate multimodal resources such as text, images, and audio to achieve input enhancement. For example, Bing Image Creator converts writing topics into visual images to help learners build content frameworks; Bing Chat supplements audio interpretations of cases across multiple fields to strengthen the support for arguments^[18]. Second, AI can dynamically adjust the way of enhancement by analyzing learners’ modal preferences, for instance, some learners prefer visual cues while others prefer auditory feedback, thus

avoiding modal overload. Third, AI can record learners' multimodal outputs, such as writing drafts, drawing annotations, and audio reflections, to build an "input-output" closed loop. This helps teachers and learners track the internalization process of linguistic forms, and it is precisely the digital implementation of the core propositions of "meaning co-construction" and "contextual adaptation" in multimodal theory.

The research on AI input enhancement is a continuation and innovation of this evolutionary trend. Based on the difficulty adaptation principle of the Input Hypothesis, it uses AI's personalized assessment to achieve an accurate supply of "i+1" input. With the focus on form as the core, it optimizes the salience of target language forms through technical means. Taking the multi-sensory collaboration of multimodal theory as the path, it integrates digital resources to build a diversified input model. This provides a systematic theoretical framework for analyzing how AI optimizes the input link in English writing.

3. Pedagogical applications and effectiveness

In the field of SLA research, Input Enhancement serves as a key intervention method to guide learners' attention to language forms. Its research path has always centered on the core question of "how to promote language acquisition through input design." Existing literature explores the mechanism and practical effects of Input Enhancement from different dimensions, mainly through three paradigms: theoretical speculation, empirical research, and mixed methods research. These three paradigms complement each other while having significant differences in research objectives and methodological logic, jointly forming the methodological system of Input Enhancement research.

Theoretical speculation is based on language acquisition theory and semiotic theory. It focuses on the rationality and mechanism of Input Enhancement and provides a framework for empirical research. From the perspective of SLA theory, the Input Hypothesis (Krashen, 1981) and the Noticing Hypothesis (Schmidt, 1990) are the core theoretical supports for Input Enhancement research. Starting from these hypotheses, Li Zhiqiang points out that input enhancement, through prominent designs at the visual or semantic level (such as underlining and bolding), can guide learners to allocate limited cognitive resources to target language forms, thereby promoting the construction of connections between form and meaning^[9, 19]. This view provides a theoretical basis for the attention-guiding function of input enhancement and explains why enhancement designs are often used in the teaching of formal aspects such as grammar and vocabulary.

The introduction of multimodal semiotic theory has further enriched the theoretical dimension of Input Enhancement. By analyzing the process of L2 learners' interpretation of multimodal texts, Ajayi proposes that Input Enhancement should not be limited to a single text modality^[15]. Instead, it should construct a more comprehensive language cognitive framework through multimodal collaborative enhancement, such as "text+image" and "text+audio." For instance, in English vocabulary teaching, combining text bolding (visual enhancement) of target vocabulary with synchronized pronunciation audio (auditory enhancement) can help learners establish connections between the form, sound, and meaning of vocabulary simultaneously. In his research on English classroom reconstruction, Wang Chunlei further points out that the development of AI technology has made multimodal input enhancement possible. For example, intelligent teaching platforms use dynamic animations to enhance the application scenarios of grammatical rules, combining abstract language forms with specific contexts^[13]. This is consistent with the view that "modal diversity promotes language acquisition" in *TESOL Quarterly* (2015) and also provides a theoretical direction for the technical application

of input enhancement in real learning scenarios. For example, they only infer the effectiveness of enhancement through the Noticing Hypothesis but fail to explain the differences in learners' preferences for enhancement modalities (e.g., visual learners vs. auditory learners), leading to a certain disconnect between theoretical conclusions and practical needs.

Empirical research focuses on quantitative analysis. Through rigorous experimental design and data statistics, it establishes a clear connection between Input Enhancement and SLA effects, with the advantage of objective and verifiable conclusions. In the study on the correlation between Input Enhancement types and vocabulary acquisition, Zhou Rong and Lü Lishan adopted a 2×2 between-subjects experimental design, with visual enhancement (with/without underlining) and task involvement load (high/low) as two independent variables^[20]. They quantified the effects of form and meaning acquisition of vocabulary collocations through immediate and delayed tests. The results showed that the vocabulary form mastery score of the enhanced group (M=8.63) was significantly higher than that of the non-enhanced group (M=7.80), and this effect was more prominent in high-involvement tasks ($t=2.486$, $P=0.016$). This study is the first to confirm through empirical data that the promoting effect of input enhancement on vocabulary form acquisition is regulated by task cognitive load, providing quantitative evidence for the task adaptability of input enhancement. In the research on grammar teaching, Wong compared the differences of effects between visual enhancement (bolding) and semantic enhancement (contextual explanation with example sentences)^[21]. He found that visual enhancement was more effective in grammar form memory (e.g., tense rule recognition), with a 21% increase in accuracy, while semantic enhancement was more advantageous in grammar meaning understanding (e.g., pragmatic differences of tenses). This empirical conclusion provides specific guidance for the selection of enhancement types under different teaching objectives.

The rise of AI technology has promoted the development of empirical research on Input Enhancement towards a more refined direction. In their meta-analysis of GenAI chatbots, Li et al. integrated 41 sets of empirical data and found that the overall effect size of GenAI tools with input enhancement functions (such as ChatGPT's highlighting of target sentence patterns) on SLA was 0.576 (95% CI=[0.385-0.768]), and enhancement modalities (with an effect size of 0.751 for text + audio enhancement) had a significant regulatory effect on the effect size^[22]. This result provides systematic empirical support for the effectiveness of input enhancement in the AI era.

Through the combination of quantitative and qualitative methods, the mixed methods research paradigm comprehensively reveals the operation process of input enhancement and learners' cognitive feedback. In the research on AI-assisted writing, Yan adopted a mixed method of classroom observation, learning logs, and in-depth interviews to explore the impact of ChatGPT's input enhancement (real-time marking of writing errors) on L2 learners. Quantitative data showed that the writing error rate of learners using the enhancement function decreased by 32%. Qualitative interviews further revealed that learners believed that enhancement not only helped them quickly locate grammatical problems but also improved their self-correction ability through classified marking of error types (e.g., tense errors, collocation errors). This conclusion not only quantifies the effect of input enhancement but also explains the cognitive mechanism behind the effect, making up for the lack of explanation in pure empirical research on "why it is effective." In their research on AI writing tools, Roe et al. combined questionnaire surveys and text analysis to quantify learners' acceptance of input enhancement (78% of learners recognized the auxiliary value of enhancement). At the same time, by comparing the text characteristics before and after enhancement, they found that the text fluency (e.g., sentence cohesion

score) of the enhanced group increased by 18%. The combination of attitude data and text data provides more comprehensive evidence for the practical applicability of input enhancement.

In summary, the three paradigms of theoretical speculation, empirical research, and mixed methods research have promoted the research progress of input enhancement in SLA from different dimensions: theoretical speculation provides a framework orientation, empirical research establishes quantitative connections, and mixed methods research achieves an in-depth explanation.

4. Challenges and controversies

In the research field of the impact of AI input enhancement on students' English writing, existing studies have formed two main camps regarding technology-enhanced input: one in support and the other in doubt. The core of the controversy focuses on the balance between technology empowerment and learning autonomy, as well as the definition of the boundaries of tool use.

4.1. Perspectives in support of AI input enhancement

The supporting camp believes that AI input enhancement tools significantly promote students' English writing learning by optimizing input forms, improving feedback efficiency, and meeting personalized needs. Their core advantages are reflected in three aspects: efficiency improvement, confidence building, and multi-scenario adaptability.

Regarding efficiency improvement, the input enhancement functions of AI tools can reduce learners' cognitive load and the time cost of non-core tasks. O'Neill and Russell's study on Grammarly found that DWAs can quickly identify grammar errors and vocabulary collocation problems in writing [24]. This allows learners to avoid spending excessive energy on self-correcting basic language errors and instead allocate more cognitive resources to higher-order writing tasks such as content ideation and logical organization. Similarly, Liu et al. pointed out that ChatGPT can generate structured texts (such as argumentative essay frameworks and PPT outlines) and image description texts, while Bing Chat can supplement real-time academic literature and cross-field cases (such as AI applications in healthcare and manufacturing) [18]. The combination of the two can increase the efficiency of students' material collection and framework construction in the pre-writing stage by about 40%, effectively shortening the cycle from "starting from scratch" to completing the first draft. This view is supported by Lai's empirical research. His study showed that the experimental group using AI input enhancement tools had an average 28% reduction in the time to complete the first draft compared to the traditional teaching group, and their text structure integrity scores were significantly higher ($M=8.21$ vs $M=6.73$) [25]. These studies, from the dual perspectives of task completion efficiency and cognitive load optimization, have fairly well verified the practical value of AI input enhancement in English writing learning and provided empirical support for technology-assisted writing teaching. In terms of short-term task effectiveness, O'Neill and Russell's study on Grammarly, Liu et al.'s analysis of the collaborative application of ChatGPT and Bing Chat, and Lai's experiment on low-intermediate English as a Foreign Language (EFL) learners all quantified the advantages of AI input enhancement in reducing the time spent on basic language correction and accelerating writing framework construction through specific data (such as error location speed, the proportion of first draft completion time reduction, and the increase in text structure integrity scores). They clearly demonstrated the optimization effect of technology on the writing process, echoing Law's conclusion in

the review of GenAI language teaching applications that “AI can improve language learning efficiency through real-time feedback and structured output”, and further strengthening the research consensus on the efficiency dimension ^[26].

From the perspective of confidence building, AI input enhancement tools can effectively alleviate learners’ Foreign Language Anxiety and enhance writing confidence through real-time feedback and non-judgmental support. Biju et al.’s quasi-experimental study showed that more than 80% of the learners in the experimental group believed that the grammar correction, structure optimization suggestions, and alternative expression recommendations provided by ChatGPT reduced their concerns about “being judged for mistakes”, with an average decrease of 1.8 points (out of 5) in the writing anxiety scale score ^[1]. Seventy percent of the learners reported that the “perceived immediate progress” brought by AI tools (such as quickly correcting grammar errors and receiving positive feedback) significantly enhanced their writing self-efficacy. Lai further pointed out that AI tools have a more obvious effect on enhancing the confidence of low-intermediate EFL learners ^[25]. After using tools such as Grammarly and QuillBot, this group’s language self-efficacy (such as confidence in vocabulary and grammar accuracy) scores increased by 23%, and their performance self-efficacy (such as confidence in completing writing tasks) scores increased by 19%. Existing studies have deeply revealed the emotional value of AI enhancement in the process of English writing information construction, providing important references for understanding how technology alleviates writing anxiety and optimizes the information processing mindset. Biju et al. found through a quasi-experimental study that more than 80% of the learners in the experimental group had reduced concerns about “being judged for mistakes” due to ChatGPT’s real-time feedback, and their foreign language anxiety scale scores decreased significantly. This is consistent with Lai’s research conclusion on low-intermediate EFL learners. After using AI tools, this group’s language self-efficacy and performance self-efficacy both increased significantly. These studies focused on the changes in emotional states during the information construction process, recognizing the promoting effect of anxiety alleviation on learners’ active engagement in core tasks such as information integration and logical organization. This is consistent with Law’s view in the review of GenAI language teaching applications that “AI can create a safe learning environment through non-judgmental feedback”, enriching the research connotation of AI input enhancement in the dimension of emotional support.

Regarding multi-scenario adaptability, AI input enhancement tools can provide diverse input forms to meet the needs of different writing tasks and learning scenarios. Liu et al. found that in multimodal writing tasks, the image descriptions generated by ChatGPT can serve as effective cue words to assist Bing Image Creator in generating visual materials that fit the theme, enabling the text and images to complement each other in meaning and enhancing the multimodal expression effect of writing. In traditional argumentative essay writing, AI tools can help students build a coherent logical framework by generating “transition texts” (such as definitions and background knowledge). Roe et al. also mentioned that the “style switching function” (such as the conversion between academic and colloquial styles) of tools like Wordtune can provide learners with language input references for multiple scenarios, expanding the application boundaries of the target language.

4.2. Perspectives questioning AI input enhancement

The questioning camp argues that excessive use of AI input enhancement tools may lead to weakened learning autonomy, a lack of educational equity, and impaired writing originality.

Regarding technology dependence, some studies point out that over-reliance on AI input enhancement

tools will weaken learners' independent thinking and language internalization abilities. A survey by Roe et al. shows that 37.5% of students, after long-term use of Automated Paraphrasing Tools, developed the behavior of "directly copying and slightly adjusting AI-generated content", which reduced their independent thinking about argument ideation and sentence pattern innovation. Approximately 60% of learners admitted that they adopted AI's grammar correction suggestions without analysis, resulting in a superficial understanding of language rules and difficulty in developing independent language judgment abilities. A qualitative study by Yan also found that some learners gradually lost the ability to independently construct text frameworks when using ChatGPT to assist writing. Without AI tools, their scores on writing logical coherence decreased by 25%.

In terms of writing originality, some studies believe that AI input enhancement tools may lead to the homogenization of writing content and weaken learners' personalized expression. Garg points out that texts generated by ChatGPT mostly follow fixed logical frameworks and expression patterns ^[27]. If learners over-rely on the arguments and sentence patterns it provides, their writing will lose personal style and present a phenomenon of "all texts looking alike." Approximately 37% of learners report that revisions suggested by AI often make the text "too formal or generic", failing to accurately convey their true intentions. A teacher-perspective study by Marzuki et al. also found that the scores of students' writing using AI tools in content originality and viewpoint uniqueness were 18% lower than those of the traditional teaching group, and the frequency of "AI-characteristic expressions" (such as fixed sentence patterns and common arguments) in the texts was significantly higher ^[28].

5. Future directions: Balancing technology empowerment and learning autonomy

By synthesizing the supporting and questioning perspectives, it can be concluded that the impact of AI input enhancement on students' English writing is not absolute (i.e., neither entirely positive nor negative). The realization of its value depends on defining the boundaries of reasonable use and promoting collaboration between technology and teaching, with the core lying in balancing technology empowerment and learning autonomy.

In terms of defining usage boundaries, it is necessary to guide learners to use AI input enhancement tools critically through clear rules and scenario restrictions. Roe et al. propose that the application scenarios and scope of tools should be clearly defined ^[23]. For example, ChatGPT should be limited to "pre-writing idea inspiration"—such as generating multi-dimensional argument references—rather than direct replacement during writing. Learners are required to compare the differences between AI-generated texts and their own texts, and analyze the advantages and disadvantages of each. For the use of Automated Paraphrasing Tools, rules should stipulate that they "can only be used to optimize personal expression" to avoid plagiarism and intellectual laziness. Lai also suggests that teachers can design a "double-draft comparison" task: students are required to complete the first draft independently first, then revise it using AI tools, and submit both drafts along with an explanation of revisions ^[25]. This task guides learners to actively reflect on the rationality of AI feedback and cultivates their ability to make critical choices. This "rule + task" approach not only exerts the input enhancement function of AI tools but also maintains learning autonomy through the reflection process. However, further research is still needed on how to formulate differentiated usage rules based on learners' proficiency levels (e.g., beginner vs. advanced EFL learners).

At the level of collaboration between technology and teaching, a cooperative model of "AI tools+teacher

guidance” can be established to make up for AI’s shortcomings in cultivating higher-order thinking. Biju et al. point out that AI tools are highly effective in enhancing surface-level input, such as grammar and structure, but they have limitations in providing input support for higher-order writing thinking. Therefore, teachers need to supplement input related to higher-order thinking through in-class explanations, group discussions, and other methods—for instance, guiding students to analyze the novelty of arguments and the rigor of logic—to prevent learners from developing intellectual laziness due to over-reliance on AI. Namaziandost et al. also emphasize that teachers should guide learners to pay attention to the linguistic features highlighted by AI and promote the internalization of these features through exercises (such as imitative sentence-making), rather than allowing learners to passively accept AI suggestions. This collaborative model integrates the efficiency advantages of technology and the educational value of teachers, but it places high demands on teachers’ AI literacy—such as understanding the principles of AI tools and guiding students in tool use. How to improve teachers’ ability to integrate AI through training has become a key challenge for the implementation of this model.

6. Conclusion

Through a systematic review of literature on the impact of AI input enhancement on students’ English writing, this study integrates the evolution of SLA theories, the comparison of research paradigms, and the analysis of practical applications. It initially clarifies the research status, core value, and unsolved problems in this field, and also provides directional references for the optimization of L2 writing teaching in the AI era.

From a theoretical perspective, the development of the Input Hypothesis, Noticing Hypothesis, and multimodal learning theory in SLA has provided solid support for the rationality and effectiveness of AI input enhancement. The principle of comprehensible input and “i+1” difficulty adaptation emphasized by the Input Hypothesis is reflected in the process where AI tools dynamically assess learners’ proficiency and generate gradient feedback. The Noticing Hypothesis, which claims that “attention to language forms is a necessary condition for input internalization”, is verified by AI tools that enhance the salience of target language features. The “multi-sensory collaboration” advocated by multimodal learning theory is also implemented in practice, where AI integrates resources such as text, images, and audio to build an immersive input ecosystem. These three theories together form the theoretical foundation of AI input enhancement, revealing that its essence is the extension and innovation of traditional input enhancement in the digital age.

In terms of research methods, the three major paradigms: theoretical speculation, empirical research, and mixed methods research, each have advantages and disadvantages. From the perspectives of SLA theory and semiotics, theoretical speculation provides logical explanations for the mechanism and value of AI input enhancement, but it mostly relies on deduction from existing theories and lacks attention to real teaching scenarios. Through experimental design and data statistics, empirical research quantitatively confirms the positive effects of AI input enhancement on improving writing accuracy, structural integrity, and reducing learning anxiety. However, most studies have limitations such as short research cycles and single data dimensions. Mixed methods research combines quantitative and qualitative approaches to both quantify the effect of tool use and explore learners’ cognitive feedback, but it faces problems such as insufficient logic in method integration and researchers’ subjective bias. Future research needs to promote the collaboration of these three paradigms, strengthen the connection between theory and practice, and expand research cycles and data dimensions.

From the perspective of practical application, AI input enhancement shows significant advantages in improving writing efficiency, building learning confidence, and adapting to multi-scenario needs. It reduces the time spent on correcting basic language errors through real-time feedback, helping learners focus on higher-order writing tasks; its non-judgmental feedback reduces foreign language anxiety and improves self-efficacy; and multimodal tools adapt to different writing tasks. However, problems such as the risk of technology dependence and impaired writing originality have also become prominent. In addition, limitations of AI feedback—such as insufficient contextual adaptability and lack of guidance for higher-order thinking—need to be addressed through the collaborative model of “AI tools + teacher guidance”: tools should strengthen scenario adaptation and logic verification functions, while teachers should guide learners to use tools critically and cultivate their higher-order writing thinking.

In summary, AI input enhancement provides a new path for L2 writing teaching, but the realization of its value requires defining reasonable boundaries for use and promoting collaboration between technology and teaching. Future research can further explore differentiated rules for tool use, optimize AI’s contextual adaptability, and deepen the cultivation of teachers’ AI literacy. This will not only give play to the role of technology empowerment but also ensure learners’ independent thinking and ability development, promoting the scientific development of L2 writing teaching in the AI era.

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Research on the Talent Training Path for Undergraduates in Public Security Colleges and Universities from the Perspective of Smart Education

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Abstract: Artificial intelligence (AI) drives the paradigm innovation of higher education. Based on the research on the integration of AI and undergraduate talent training in public security colleges and universities, this study analyzes the role of AI in improving the quality of undergraduate education and teaching. It includes four aspects: smart education helps enhance the quality of prospective police officers, facilitates the integration of teaching theories with grassroots police work, innovates intelligent assessment schemes, and improves teachers' digital and intelligent literacy. On this basis, the study explores the internal mechanism of smart education supporting talent training in public security colleges and universities, and systematically puts forward countermeasures for smart education to boost talent training in such institutions. These countermeasures mainly cover four dimensions: promoting the high-quality development of public security higher education via smart education, enriching the research system of smart education and teaching, gradually optimizing the smart education and teaching model, and establishing and improving the smart education evaluation system.

Keywords: Smart education; Public security colleges and universities; Undergraduate training

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1. Introduction

Smart education has become a research focus in the current field of education, and scholars from the United States, Canada, Japan, the United Kingdom, France, and other countries have conducted explorations to varying degrees. With the continuous development of the Internet of Things, educational informatization, and artificial intelligence, as well as the in-depth research on massive open online courses (MOOCs), micro-courses, flipped classrooms, and other models, smart education has evolved into a new form of educational informatization

development in China. China's Education Modernization 2035 proposes that "it is necessary to vigorously implement intelligent education with the help of information technology and truly take a path of educational informatization development with Chinese characteristics." Educational digital transformation serves as a crucial engine and innovative path to effectively promote the high-quality development of education ^[1]. Against the backdrop of the smart era, public security work is undergoing a profound transformation from "manpower-driven" to "data-driven" and "intelligence-driven." In view of this, it is essential to explore the undergraduate talent training mechanism in public security colleges and universities from the perspective of smart education, so as to better respond to the impact of artificial intelligence on public security higher education.

2. The role of smart education in improving the teaching quality of public security higher education

2.1. Enhancing the quality of prospective police officers

The application of smart education in public security education is conducive to expanding the theoretical depth of practical teaching reform in public security colleges and universities in the smart era. From teachers to students, classrooms to schools, and learning to daily life, artificial intelligence, as a key driving force, is profoundly reshaping every link of education ^[2]. By integrating smart policing with teaching model innovation and applying grassroots police work platforms and data to "smart classrooms", the professional capabilities of prospective police officers can be strengthened.

2.2. Promoting the integration of teaching theories with grassroots police work

By guiding grassroots police work with theories and feeding back grassroots police work into teaching, the unification of teaching supply and the needs of grassroots police work is realized. Smart education is a category with historical and developmental attributes ^[3]. Educators should innovate smart teaching models that serve grassroots police work, and take "cultivating the talents that grassroots police work needs" as the goal to advance the in-depth development of the "supply-side" reform in public security education.

2.3. Innovating intelligent assessment schemes

The proposal of the smart education concept presents both challenges and opportunities for teachers to reconstruct classrooms and realize smart teaching. Educators should carry out the assessment of intelligent teaching courses for grassroots police work, truly "keeping students busy" and "mobilizing students' enthusiasm." Smart education in higher education should return to the essence of "educating people" to meet students' development needs to the greatest extent ^[4]. This not only enables prospective police officers to deeply understand and master knowledge and skills but also helps cultivate top-notch innovative talents.

2.4. Improving teachers' digital and intelligent literacy

Educators should enhance the matching between the level of teachers and smart education, improve teachers' ability to integrate practical work with intelligence, and tap into the teaching capacity of grassroots police instructors in serving grassroots police work courses. Excellent traditional teaching methods, such as "preparing a good lesson" and "student-centered approach", should be incorporated into the new smart teaching model.

3. The internal mechanism of smart education supporting talent training in public security colleges and universities

3.1 Realizing precision and forward-looking in public security education

Smart education is a new educational ecosystem constructed for the purpose of developing people's high-level intelligent literacy ^[5]. Based on multi-source data such as the capability needs of grassroots public security organs, the evolution trend of public security technology, and the learning situation data of public security colleges, smart education can build a new talent quality model. In this way, the talent training goals of public security colleges and universities can be more precise. At the same time, through the "construction of knowledge graphs and simulation projects via AI technology", it helps teaching content to timely respond to the cutting-edge changes in police work.

3.2. Addressing the in-depth bottlenecks in traditional public security education

The traditional model has two core bottlenecks: outdated methods of "how to educate" and insufficient "transformation of educational achievements." Educational digital transformation is a complex, systematic project that cannot be separated from platform support ^[6]. By building a multi-stakeholder collaboration platform such as "Public Security University + Public Security Organs + Technology Enterprises", smart education creates a teaching development community integrating "teaching, competition, scientific research, tactics, and training." It designs a "step-by-step upward" mechanism for cultivating grassroots police work capabilities, so as to improve the conversion rate from "knowledge" to "practical police work."

3.3. Constructing "Digital Twin" scenarios for grassroots police work

Relying on artificial intelligence technology, smart education has changed the application in higher education ^[7]. Through systems such as virtual simulation experiment platforms and "AI Intelligent Police Q&A Platforms", smart education can provide students with a highly simulated grassroots police work environment. This effectively realizes the high integration of teaching and grassroots police work scenarios, allowing students to be in complex scenarios similar to grassroots police work. It helps students grow into compound police talents who "understand technology, master business, and excel in operations."

4. Countermeasures for smart education to support talent training in public security colleges and universities

4.1. Promoting the high-quality development of public security higher education via smart education

Artificial intelligence systematically replaces teachers in completing repetitive tasks such as paper marking, scoring, and curriculum design. This allows teachers to devote more time to personalized and creative teaching, thinking, and student guidance. Educators should deeply integrate the technological characteristics of the smart era with the law of "police teaching" for talent cultivation, and construct a three-dimensional research framework of "technology empowerment—model reconstruction—grassroots police work verification." Educational norms are era-specific ^[8]. For students, smart education can provide personalized guidance, real-time feedback, and support, creating favorable conditions for learners' independent learning.

4.2. Enriching the research system of smart education and teaching

Smart education research shows a trend of interdisciplinary evolution. Strengthening the application of smart education in public security colleges and universities can promote the gradual enrichment of the smart education theoretical system and enhance the depth of smart education theoretical research. In the relevant research on smart education, interdisciplinary, inter-university, and inter-institutional cooperative development has received increasing attention, which is of positive significance for the construction of “urban integration” in public security colleges and universities. Educators should provide diverse and high-quality new media resources, innovate the teaching methods of ideological and political courses, and enhance the affinity of course teaching^[9]. With technologies such as artificial intelligence, big data, and virtual reality (VR), educators should build a three-dimensional training system consisting of “intelligent teaching platform + grassroots police work simulation scenarios + dynamic evaluation system.”

4.3. Gradually optimizing the smart education and teaching model

The field of smart education mainly involves classroom teaching models, curriculum resource construction, research on software and hardware support, and development strategies. The practice of smart education has formed a pattern of diversified exploration nationwide, with typical cases emerging continuously^[10]. Educators should learn from the smart education development models of domestic public security colleges and universities, sort out typical cases of smart technology application, break through the traditional linear training path of “theoretical teaching in public security universities + practical training at the grassroots level”, and build a new training model featuring “online-offline integration, virtual-real scenario linkage, and resource sharing between colleges and public security organs.” This model should respond to the needs of grassroots public security organs for smart policing talents in terms of data analysis, intelligent equipment operation, network security protection, and other capabilities. It should also identify pain points in the training process, such as outdated technical courses, single grassroots police simulation scenarios, and insufficient cross-departmental collaboration. Furthermore, educators should better establish a learner-centered concept, make full use of various modern technologies, and design teaching models that meet students’ personalized needs and intelligent development.

4.4. Establishing and improving the smart education evaluation system

Educators should actively respond to the practical needs in smart management and smart evaluation. With the advent of the smart education era, there is an urgent need to cultivate compound talents with humanistic literacy, digital skills, and an innovative spirit^[11]. In teaching, educators should adhere to the OBE (Outcome-Based Education) concept to solve the problem of “disconnection between school teaching and police work” in traditional training, so as to align talent training with the needs of smart police work and improve students’ abilities in emergency response, technology application, and collaborative operations in complex intelligent environments. Educators should develop a “learning behavior analysis system” that generates quantitative reports on students’ “digital literacy” and “problem-solving ability” based on data such as platform login duration, virtual training operation trajectories, and group discussion participation. Educators should strengthen research on smart evaluation and management to promote the continuous improvement of the comprehensive smart education evaluation system.

5. Conclusion

In the era of big data and “Internet + Education”, smart education has become a new pursuit for the professional development of college teachers. Educational digitalization is not only an important part of building a powerful education country but also an important support for building a powerful education country ^[12]. This study comprehensively promotes the reform of teaching models through smart education, providing intellectual support for the modernization of education in public security colleges and universities. However, affected by factors such as the insufficient application of current smart education technologies in higher education and the rapid iteration of artificial intelligence technologies, this study still has much room for improvement in the construction standards of “digital twin” scenarios. Looking forward to the future, two key tasks should be focused on: 1) promoting the continuous iteration and evolution of the curriculum system, establishing a dynamic curriculum adjustment mechanism, and continuously transforming the latest achievements in police technology and grassroots police work cases into teaching resources; 2) strengthening the “smart” transformation of the teaching staff, and building a team of teachers with profound theoretical literacy, cutting-edge technical vision, and rich experience in grassroots police work.

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Research on the Training of Innovation and Entrepreneurship Education for High-Level, Applied and Innovative Professional Degree Postgraduates

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Abstract: With the continuous advancement of the country's construction of "new engineering disciplines" and the reform of professional degree graduate education, innovation and entrepreneurship education has become an important way to improve the quality of graduate training. Based on the survey data from the School of Mathematics and Physics, this paper systematically analyzes the main problems existing in the innovation and entrepreneurship education for professional degree postgraduates through questionnaires, interviews and other methods, including insufficient atmosphere, imperfect system, lack of willingness and ability, incomplete educational layout, and shortage of teachers and practice platforms. On this basis, it proposes a collaborative education model centered on the integration of "industry, teaching, research and application," and puts forward specific countermeasures from the aspects of policy guidance, tutor team construction, integration of school-enterprise resources, and optimization of curriculum and teacher systems, so as to promote the all-round improvement of the innovation and entrepreneurship ability of professional degree postgraduates.

Keywords: Professional degree postgraduates; Innovation and entrepreneurship education; Industry-education integration; Dual-tutor system; Curriculum system

Online publication: November 14, 2025

1. Research background

With the in-depth implementation of the innovation-driven development strategy, the country's demand for high-level applied and innovative talents has never been greater. The construction of "new engineering disciplines" is a strategic initiative implemented by China to proactively respond to the new round of scientific and technological revolution and industrial transformation. It advocates reforming learning methods and

teaching models to cultivate high-quality applied talents to meet the fundamental needs of modern industrial development ^[1]. In September 2020, the Academic Degrees Committee of the State Council and the Ministry of Education jointly issued the Development Plan for Professional Degree Graduate Education (2020-2025), which clearly proposed to deepen the reform of the industry-education integration training model and fully integrate innovation and entrepreneurship education into the talent training system ^[2]. This puts forward new requirements and points out a new direction for promoting the high-quality development of professional degree graduate education.

However, at present, universities, especially science and engineering departments, generally face practical dilemmas in carrying out innovation and entrepreneurship education for professional degree postgraduates, such as the disconnection between the training system and industrial needs, the shortage of practice platforms, and the insufficient innovation motivation of students. Therefore, against this major policy background, focusing on the energy and electric power field, systematically exploring the current situation, problems and optimization paths of innovation and entrepreneurship education training for professional degree postgraduates is of important theoretical significance and practical value for implementing national strategies, promoting the reform of university talent training, and serving the innovative development of industries.

2. Basic information of the survey respondents

This survey targeted professional degree graduate students of the School of Mathematics and Physics, using self-designed questionnaires and interviews. The School currently has 37 supervisors, categorized as follows: 14 (37.84%) from the Department of Mathematics and 23 (62.16%) from the Department of Physics; 9 (24.32%) professors, 25 (67.57%) associate professors, and 3 (8.11%) lecturers. There are 241 professional degree graduate students, including 71 (29.46%) from the 2022 cohort, 78 (32.37%) from the 2023 cohort, and 92 (38.17%) from the 2024 cohort; among them, 99 (41.08%) are majoring in Big Data Technology and Engineering, and 142 (58.92%) in Clean Energy Technology.

3. Problems identified in the survey

3.1. Insufficiently robust innovation and entrepreneurship atmosphere

In recent years, the scale of graduate students has grown rapidly, but the graduate training system remains inadequate, the development of the supervisor team needs to be strengthened, and the quality of dissertations needs further improvement. Efforts are required to enhance the construction of academic degree programs, strengthen the process management of graduate students, and improve the formulation and refinement of various rules and regulations. It is necessary to reasonably develop training programs for each major, clarify the training objective of cultivating professional talents with characteristics in energy and electric power, and optimize the allocation of enrollment quotas for master's supervisors in the school to improve the quality of talent cultivation.

Currently, there are significant differences in the methods and intensity of innovation and entrepreneurship education implemented. The promotion of policies and the importance of such education are insufficient, failing to foster a strong atmosphere for innovation and entrepreneurship. The integration and systematicness between innovation and entrepreneurship courses and professional education courses are inadequate. The courses outlined in the talent training programs lack completeness, systematicness, and innovative teaching strategies,

and have little connection with professional disciplines. As a result, graduate students struggle to acquire innovative thinking and entrepreneurial capabilities through systematic learning, which fails to stimulate their enthusiasm for exploration.

3.2. Inadequate graduate training system

Producing high-level outcomes in master's graduate training requires long-term accumulation, especially for professional degree graduate students. Flexible and diversified graduation assessment methods could be explored to both supervise graduate students' research efforts and support supervisors' research projects, while encouraging supervisors to secure horizontal projects. For the majors of Clean Energy Technology and Big Data Technology and Engineering, a classified assessment should be considered.

To strengthen industry-university-research cooperation, it is necessary to expand off-campus practice and joint training bases for graduate students to create more practical training opportunities. Graduate student workstations are important platforms for industry-university-research cooperation: they enable graduate students to refine research topics to help enterprises solve problems and develop new products, while enterprises provide the necessary conditions for graduate students. As a key approach to cultivating high-level applied research talents, industry-university-research cooperation should be used as a starting point to promote university-enterprise collaboration.

3.3. Weak willingness and insufficient capacity for innovation and entrepreneurship

Postgraduates have limited energy, time, and enthusiasm to participate in innovation and entrepreneurship activities due to heavy academic pressure. Additionally, the training of professional master's students in colleges focuses on professional knowledge and skills, while there is a lack of education on innovation and entrepreneurship knowledge, market information resources, and supportive training. This results in a weak foundation for postgraduates' quality and capabilities in innovation and entrepreneurship.

3.4. Incomplete layout of innovation and entrepreneurship education

Currently, the innovation and entrepreneurship education for postgraduates has not established a systematic framework. Courses are mainly offered as electives, leading to fragmented knowledge foundations. Moreover, these courses are not integrated with majors, failing to leverage professional advantages. The talent training curriculum system fails to meet actual needs, as teaching emphasizes theory over practice and is disconnected from real-world scenarios.

3.5. Limited competence of relevant faculty and shortage of practical platforms

The training of professional degree postgraduates should organically integrate in-class learning with career development ^[3]. At present, most full-time teachers in colleges have no entrepreneurial experience, and their teaching lacks interdisciplinary research and practical operability, which cannot help postgraduates develop innovative and entrepreneurial thinking. Supervisors focus their energy on academic guidance, and due to the lack of incentive mechanisms, their role in innovation and entrepreneurship education has not been fully exerted. Meanwhile, there are few practical platforms for postgraduates' innovation and entrepreneurship, the role of the "second classroom" has not been fully played, and postgraduates have few opportunities to practice and accumulate experience.

4. Rectification paths and measures

The reform of innovation and entrepreneurship education is currently a breakthrough for advancing the comprehensive reform of higher education ^[4]. In response to the common problems faced in cultivating the innovation and entrepreneurship capabilities of professional degree postgraduates under the background of new engineering construction, this paper analyzes the dilemmas in improving their innovation and entrepreneurship capabilities, and proposes an innovative talent cultivation model based on the “industry-university-research-application” four-in-one collaborative education. It designs a cultivation path oriented by market demand and targeted at innovation and entrepreneurship capabilities. It is intended to enhance the professional ethics, innovation and entrepreneurship awareness, and professional practical capabilities of professional degree postgraduates by “reconstructing an interdisciplinary professional curriculum system, building a project-driven innovative practice platform, and developing an ‘industry-university-research-application’ integrated collaborative education approach.”

4.1. Guided by top-level design

Colleges should develop sound top-level design for graduate innovation and entrepreneurship education, with the cultivation of innovative talents as the fundamental goal. Efforts should be made to build an education system, foster a supportive atmosphere, and explore new models. Foreign universities have rich experience in innovation and entrepreneurship education. For example, American universities adopt a cluster model, establishing dedicated centers, implementing student-centered teaching, and securing funding support ^[5]. This indicates that systematic organizational support and resource matching are crucial.

To improve the quality and efficiency of graduate innovation and entrepreneurship education, colleges can adopt an open training approach of “going out and bringing in”. They should support full-time teachers to “go out” for temporary positions and practical experience to enhance their capabilities; promote university-enterprise cooperation to facilitate achievement transformation and demand matching. Meanwhile, outstanding entrepreneurs and other professionals should be “brought in” as mentors or teachers to share cutting-edge trends and practical experience. Through the reconstruction of the education system, graduate participation can be enhanced, encouraging them to engage in innovative practice and entrepreneurial activities.

4.2. Supported by tutor teams

Colleges should advance the “dual-tutor system,” mobilize the enthusiasm of on-campus tutors, and build high-quality tutor teams. Off-campus tutors, who master cutting-edge technologies, understand industrial needs, and have practical experience, can provide valuable guidance to graduates. Colleges should leverage the advantages of off-campus tutors to help graduates with career planning, strengthen team communication, and provide professional support. When cultivating graduates, tutor teams should not only focus on developing their independent research capabilities but also integrate innovation and entrepreneurship concepts into daily teaching, encouraging graduates to participate in related activities to enhance their comprehensive abilities.

4.3. Leveraging on-campus and off-campus resources

Practical on-the-job skills play a decisive role in consolidating theoretical knowledge, so attention should be paid to the matching of professional skills. The cultivation of professional degree graduates is faced with problems such as an excessive “academic orientation” and the weakening of “professional” and “practical”

characteristics^[6]. In addition to establishing a sound platform for graduate innovation and entrepreneurship practice, colleges can also utilize on-campus research platforms and resources, take enterprise needs as the driving force, and rely on university-enterprise joint training bases and graduate workstations to jointly carry out project research and talent cultivation, realizing the sharing of university-enterprise resources. Graduates should be encouraged to participate in university-enterprise cooperation projects and R&D activities, so that they can understand the market and industry status quo, solve problems with new methods and technologies, increase opportunities for communication with enterprise professionals, and gain innovation and entrepreneurship experience.

Furthermore, colleges should use competitions, projects, and associations to stimulate graduates' enthusiasm for innovation and entrepreneurship. For training programs related to innovative practice competitions, enterprise experts can be invited for guidance; these experts can also serve as judges for academic competitions. The innovation and applicability of entries are key evaluation indicators, and enterprises focus on technological innovation as well as social and economic benefits in their evaluation. Therefore, it is necessary to establish a linkage mechanism by leveraging the resources of university-enterprise industry-academia-research cooperation.

4.4. Strengthening the construction of the graduate innovation and entrepreneurship curriculum system and faculty team

Full consideration should be given to the individual differences of professional degree graduates. Evaluation should not only be based on academic performance and research achievements, but also attach greater importance to the assessment of their practical abilities^[7]. Some domestic universities have actively explored curriculum design. For example, Zhejiang University offered more than 150 innovation and entrepreneurship courses in 2017 and promoted the construction of a three-level progressive curriculum system^[8].

Colleges should formulate scientific training programs. Graduate innovation and entrepreneurship education often neglects the imparting of humanistic knowledge and spirit, so universities need to integrate humanistic literacy cultivation into education^[9]. The training program for professional master's students should include no less than six months of professional practice, relying on enterprise engineering practice projects to improve their practical engineering capabilities and enhance their competitiveness. At the same time, university-enterprise cooperation courses can be set up, and enterprise experts can be invited to teach part-time and guide graduate students in innovation and entrepreneurship practice.

A high-quality faculty team for innovation and entrepreneurship education is a necessary condition for cultivating innovative and entrepreneurial talents. At present, most innovation and entrepreneurship courses are taught by counselors who have strong theoretical knowledge but lack practical experience, resulting in insufficient teaching attractiveness and integration^[10]. Therefore, colleges should build excellent teaching teams: train non-professional teachers to enrich their theoretical knowledge, and hire external professionals, enterprise mentors, experienced personnel, and alumni to join the faculty team to jointly complete teaching and guide graduate students in practical projects^[11].

5. Conclusion

Based on the actual investigation of innovation and entrepreneurship education for professional degree

graduates, this study systematically analyzes the main problems existing in the current training process, including insufficient innovation and entrepreneurship atmosphere, imperfect training system, inadequate students' willingness and abilities, incomplete educational layout, and shortage of faculty and practical platforms ^[12]. To address these issues, this paper proposes a collaborative education model centered on the integration of “industry, education, research and application”, and puts forward specific countermeasures from multiple dimensions such as policy guidance, supervisor team construction, university-enterprise resource integration, and optimization of curriculum and faculty systems.

Guided by the national construction of new engineering disciplines and the reform of professional degree graduate education, colleges should closely align with the needs of industries such as energy and electric power, and continuously optimize the talent training system ^[13]. On the one hand, it is necessary to strengthen the top-level design of graduate innovation and entrepreneurship education, build a more systematic, scientific and open education mechanism, and create an innovative cultural atmosphere that encourages exploration and tolerates failure. On the other hand, it is necessary to further promote the “dual-tutor system”, give full play to the complementary advantages of on-campus and off-campus tutors in academic guidance and industrial practice, and promote graduate students to exercise innovative thinking and entrepreneurial abilities in real scenarios ^[14]. Further efforts should be made to strengthen university-enterprise collaboration, jointly build joint laboratories, internship bases and technology R&D centers, and promote the connection between scientific and technological achievement transformation and industrial application. Through competitions to promote learning and projects to drive practice, graduate students' initiative and creativity should be stimulated, and their comprehensive practical abilities and professional competitiveness should be improved ^[15]. In terms of the curriculum system, traditional disciplinary boundaries should be broken, and an interdisciplinary, modular and progressive innovation and entrepreneurship course group should be built, integrating humanistic literacy and engineering ethics education to achieve comprehensive talent cultivation.

Through continuous reform and practice, an innovation and entrepreneurship education system that conforms to the development law of professional degree graduates, meets the needs of industrial transformation and upgrading, and has school-based characteristics and disciplinary advantages should be gradually established. This will provide strong support for the cultivation of high-level applied and innovative talents in China, and also serve as a reference for similar institutions to carry out relevant educational practices.

Disclosure statement

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“Cultural Reflection and Enrichment”: Innovation and Practice in Teaching the Course of Chinese and Foreign Architectural History Based on the Cultivation of Digital and Intelligent Talents

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Abstract: As a local applied undergraduate university, our institution adheres to the characteristic of “Information Technology +” and cultivates applied talents for the Environmental Design major. In response to obstacles in cognitive transfer, setbacks in theoretical and practical application, and challenges in fostering digital and intelligent thinking, the course “Chinese and Foreign Architectural History” is grounded in the integration of learning and application, practical orientation, and the application of learned knowledge. Through the study of architectural historical and theoretical knowledge, the course strengthens key propositions and design techniques related to architectural theories, cultivates historical thinking abilities, enhances humanistic qualities, and guides students in shaping correct outlooks on life, the world, and values. Starting from teaching objectives, the course has formed a “Cultural Reflection and Enrichment” teaching model for architectural history and theory based on the cultivation of digital and intelligent talents. Through reforms, remarkable results have been achieved, with high goal attainment and student satisfaction, as well as abundant construction achievements. The course has guided students to win over 50 awards in competitions, secured national-level innovation and entrepreneurship project approvals, and obtained two provincial-level scientific research project approvals, among other accomplishments.

Keywords: Curriculum ideological and political education; AI teaching; Digital and intelligent

Online publication: November 14, 2025

1. Basic course information: Precise positioning and anchoring digital and intelligent cultivation needs

“Chinese and Foreign Architectural History” is a foundational course for sophomores majoring in Environmental Design, consisting of 2 credits and 32 class hours of pure theoretical instruction. The course

utilizes the “13th Five-Year Plan” textbook compiled by Zhang Xinyi, with core objectives centered on “sorting out the development trajectory of architecture, exploring cultural connotations, and cultivating awareness of heritage protection.” The course has undergone three stages of iterative development: “traditional lecture—digital assistance—integration of digital and intelligent technologies.” Relying on platforms such as Chaoxing Learning Pass, virtual reality platforms, and AI tools, it has constructed the “Cultural Mirror Nourishment” teaching system, forming a distinctive model that “empowers historical cognition through digital and intelligent technologies and nurtures design thinking through cultural inheritance” ^[1]. Aligned with the requirements of the “New Liberal Arts” initiative, the course addresses the challenges of “abstract concepts that are difficult to understand, cultural heritage that is hard to pass on, and skills that are tough to translate” in architectural history theory through digital and intelligent tools. It cultivates students’ comprehensive abilities to “analyze stylistic evolution, apply traditional elements, and inherit cultural spirit”, thereby producing innovative talents with both cultural heritage and digital and intelligent skills for the field of environmental design.

Since its inception in 2019, the course has undergone gradual iterations. The course offered to students of the 2020 cohort was titled “History of Chinese Architecture”, while students from the 2019, 2021, and 2022 cohorts were taught “History of Chinese and Foreign Architecture.” This course has been offered five times on the Chaoxing Learning Pass platform, marking a transition from traditional courses to those deeply integrated with information technology and then to digital and intelligent technology courses.

2. Course teaching objectives: Strengthening knowledge connection and cultural penetration

Based on the talent cultivation program for environmental design majors and precise learning situation analysis, this course, starting from Bloom’s cognitive theory, helps students bridge the gap between theory and visual cognition ^[2]. Although students possess basic knowledge of architectural history, they face three challenges: first, their knowledge foundation is “not well-established”, with a weak theoretical framework; second, their cognitive abilities struggle with “knowing but finding it hard to act”, making it difficult to translate historical theory into design thinking; third, their learning characteristics are marked by “difficulty in believing and comprehending”, relying on intuitive teaching and showing weak willingness for active learning. To address these issues, the course has established teaching objectives centered on a “knowledge + skills + literacy” three-dimensional framework. In terms of knowledge, students should be able to elaborate on the historical context of Chinese and foreign architecture and analyze case studies from the perspectives of aesthetics, layout, and characteristics. In terms of skills, they should be able to integrate design specifications and translate architectural history knowledge into design expressions. In terms of literacy, they should strengthen their awareness of cultural heritage protection and cultural confidence. The teaching focuses on Chinese and foreign architectural systems and stylistic evolution, with an emphasis on the Chinese wooden architectural system and the evolution of foreign architectural styles. The challenges lie in understanding “the cultural logic of the wooden architectural system” and “the relationship between style and socio-cultural contexts”—areas where digital and intelligent means are primarily employed to achieve breakthroughs. Particular emphasis is placed on the ability to apply digital and intelligent tools and the literacy of cultural inheritance, enabling students to analyze ancient architectural materials using AI and sort out the logic of architectural evolution through digital platforms.

Course Objective 1: Students will be able to elucidate the historical context of Chinese and foreign architecture, analyze specific cases from perspectives such as aesthetic value, spatial layout, and architectural features, and possess a high level of architectural cultural literacy as well as the aesthetic ability to recognize, understand, and appreciate Chinese and foreign architecture.

Course Objective 2: Students will understand the theories and methods of construction in Chinese and foreign architecture, be capable of analyzing case design techniques and concepts, express designs according to design specifications while incorporating architectural characteristics, and possess innovative awareness and spirit.

Course Objective 3: Students will focus on interdisciplinary integration, possess comprehensive knowledge capabilities across multiple disciplines such as architecture, history, philosophy, and art, be able to analyze and evaluate the application of ancient architectural materials, and have an awareness of cultural heritage preservation and protection.

3. Background of teaching innovation and breakthrough of “pain points”

This course is designed for sophomore undergraduate students majoring in environmental design. These students are enthusiastic about expression and enjoy teamwork; most of them have a positive attitude towards learning and strive for excellence; they possess a certain degree of self-learning ability but are relatively weak in analyzing and solving problems, often feeling intimidated by difficulties and lacking the craftsmanship spirit of relentless pursuit of truth; students hope to master relevant theoretical knowledge through this course and apply it in combination with other practical courses to participate in academic competitions.

3.1. Core pain points

Pain Point 1: Insufficient visualization of knowledge. Traditional lectures struggle to present the spatial relationships and technical details of ancient architecture. For instance, students lack an intuitive understanding of the mechanical principles behind the 54 types of dougong brackets in the Yingxian Wooden Pagoda and have a one-sided understanding of the relationship between Greek column styles and polis culture.

Pain Point 2: Disconnection in cultural inheritance. Students passively memorize elements such as “upturned eaves” and “caisson patterns” but fail to grasp the underlying philosophical concept of harmony between humanity and nature, let alone translate it into modern design language.

Pain Point 3: Weak digital and intelligent capabilities result in students lacking the ability to utilize AI tools to analyze architectural styles and simulate spatial scales, creating a disconnect from the industry’s demands for digital design and cultural IP transformation.

3.2. Innovation positioning

With “digital and intelligent tools as the bridge and cultural heritage as the soul”, we aim to establish a teaching model that integrates “AI throughout the entire process and interdisciplinary practice”, achieving three major breakthroughs:

Breakthrough 1: Visualizing abstract knowledge by using VR and AI modeling to restore the spatial and technical details of ancient architecture;

Breakthrough 2: Contextualizing cultural connotations by establishing connections between architecture,

history, and spirit through digital resource libraries and ideological and political case studies;

Breakthrough 3: Practicing skill development in real-world scenarios by combining AI design tools to achieve a closed-loop practice of “modern translation of traditional elements.”

4. Innovative approaches and measures to address the “pain points” in course teaching

4.1. Constructing a “three-dimensional digital and intelligent knowledge graph” to strengthen knowledge connection and cultural infiltration

4.1.1. Knowledge graph linkage

Collaborate with courses such as “Introduction to Architectural Design” and “Digital Environmental Design Representation Techniques” to build a three-dimensional graph of architectural styles, technical characteristics, and cultural contexts. For example, when inputting the Tang Dynasty’s Foguang Temple, AI automatically associates it with wooden beam-raising structures, the spread of Buddhist culture, and the case study of Japan’s Toshodaiji Temple drawing inspiration from it; for Shanxi’s cave dwellings, the graph simultaneously presents the geographical features of the Loess Plateau, the insulation principles of earth architecture, and case studies of traditional residential renovations in rural revitalization efforts ^[3].

4.1.2. Dynamic optimization of problem graphs

Generate a problem chain of high-frequency errors, case analyses, and extended resources based on the AI question bank of Chaoxing Learning Platform. For example, in response to typical incorrect answers regarding why a large number of ancient buildings are preserved in Shanxi, AI automatically delivers supplementary materials on the role of geographical barriers and the protection efforts of Shanxi merchants during the Ming and Qing dynasties, and visualizes the core viewpoints using word clouds. For confusing points about the differences between Baroque and Rococo styles, AI generates a comparative chart, highlighting differences in the degree of decorative complexity, color preferences, and social backgrounds.

4.1.3. Deep integration of the ideological and political spectrum

Three key ideological and political elements—cultural confidence, craftsmanship spirit, and heritage protection—are explored to form an infiltration pathway of “case—tool—practice.” By leveraging the case of the translation and protection of Shikumen buildings in Shanghai on the Xuexi Qiangguo platform, combined with an AI-generated timeline of ancient Chinese architectural protection, students’ awareness of living heritage transmission is enhanced. When analyzing the 900-year earthquake-resistant case of the Yingxian Wooden Pagoda, a documentary about contemporary engineers restoring the dougong (interlocking wooden brackets) is simultaneously delivered to cultivate a professional spirit of striving for excellence.

4.2. Innovate the AI-empowered teaching model throughout the entire process, achieving a closed loop from pre-class to in-class to post-class

4.2.1. Pre-class: AI-guided learning for precise doubt resolution

VR Preview: Students can virtually explore the Mogao Caves through the digital resource library of the Dunhuang Academy, use AI to annotate architectural elements in the murals, and automatically generate reports on their personal knowledge gaps. Smart Assessment: The Chaoxing platform delivers AI quizzes on

identifying ancient Greek column styles, with incorrect answers automatically linked to remedial resources such as animations on column proportions and analyses of temple functions. Cultural Warm-Up: Using “Ji Meng AI”, students generate variations of caisson ceiling patterns. By entering keywords such as “Tang Dynasty + geometric patterns”, they can gain a preliminary understanding of the modern translation logic of traditional patterns.

4.2.2. In-class: Digital and intelligent interaction to deepen understanding

Immersive Analysis: Through a virtual reality platform, students can “disassemble” the Yingxian Wooden Pagoda, observe the hidden-layer structures at 360 degrees, and use AI to calculate in real-time the dispersion effect of bamboo joint principles on seismic forces, visualizing structural aesthetics. AI-Assisted Discussion: Around the relationship between the layout of the Acropolis of Athens and citizens’ lives, the Chaoxing platform initiates group discussions, with AI summarizing viewpoints in real-time and generating a spectrum of associations between religious spaces, public activities, and democratic spirit. Cross-Temporal Comparison: AI digital avatars simulate a dialogue between Vitruvius and Li Jie, comparing the technical records in “De Architectura” and the “Yingzao Fashi” through virtual scenarios, highlighting differences in architectural thought between the East and West ^[4].

4.2.3. After-class: Interdisciplinary practice transformation

Digital Modeling Practice: In conjunction with the course “Digital Environmental Representation Techniques”, students use SketchUp (SU) to model “Bayu Stilted Houses.” AI plugins automatically verify the proportions of cantilevered structures and mortise-and-tenon wooden joints, and generate reports on the extraction of traditional elements. Cultural IP Design: Using AI tools, students transform the dome of the ancient Roman Pantheon into modern lamp designs, requiring the retention of core elements such as the dome’s geometric proportions and lighting effects, and submit explanations of cultural translation. Heritage Protection Simulation: Students participate in the restoration of grotto architecture on the Digital Cave Scriptures Platform, with AI comparing the work to the original and scoring it, focusing on the accuracy of the restoration of architectural elements in murals.

4.3. Developing a “BOPPPS” teaching process to bridge “cognitive-practical-innovative” competencies

Using the BOPPPS blended teaching model as a framework, our core innovation lies in the full integration of AI and the linkage of digital and intelligent resources. The focus is on constructing an AI-empowered BOPPPS blended teaching model. We don’t just deliver micro-lectures; we also have AI serve as a preview guide. In terms of teaching methods, AI empowers “six-dimensional interaction”, breaking through the limitations of traditional lecture methods. We integrate six methods and embed digital and intelligent tools ^[5].

4.4. Constructing a diverse digital and intelligent evaluation system to achieve comprehensive “process + outcome” assessment

4.4.1. Process evaluation (50%)

AI Tracking: Chaoxing Learning Platform records VR preview durations, AI assessment accuracy rates, and discussion contributions, automatically generating learning behavior analysis reports. Practical Tasks: These include AI-generated caisson patterns (10%), VR spatial scale simulations (15%), and interdisciplinary

modeling (25%), with a focus on assessing cultural understanding and the application of digital and intelligent tools.

4.4.2. Summative evaluation (50%)

Comprehensive Case Analysis: Using AI, students generate buildings in ambiguous styles, such as neoclassical facades, and are required to analyze their historical origins and innovative points. Cultural Translation Design: Students submit modern design proposals for traditional elements, which must include the AI-assisted element extraction process and explanations of cultural connotations.

4.4.3. One-vote veto system for moral education

Attitudes towards heritage conservation and teamwork spirit are incorporated into the evaluation criteria. Students who approach virtual restoration perfunctorily or deny the value of traditional culture during discussions will be disqualified from merit-based evaluations.

5. Teaching innovation achievements and characteristics: Digital and intelligent innovation with continuous optimization

5.1. Highlights of achievements

Student Competence Enhancement: Over the past three years, students have won 31 awards related to “integrating traditional elements into project design outcomes” in the National College Digital Art and Design Competition. Additionally, two research topics related to “digital conservation of ancient architecture” have been selected for university-level innovation and entrepreneurship projects.

Resource Development Breakthroughs: A digital and intelligent resource library of Chinese and foreign architecture has been established, containing 20 VR models, over 30 AI case analyses, and 30 ideological and political cases. This library has been referenced and utilized by one sister institution. Expanded Social Impact: In collaboration with local cultural and tourism departments, a public welfare project titled “Digital Conservation of Bayu Folk Houses” has been launched. Students have completed indoor and outdoor landscape design drawings for four traditional folk houses, receiving coverage from local media.

5.2. Innovative characteristics

Deep Integration of Digital Intelligence and Culture: Rather than simply using technology to display history, AI and VR are employed to establish connections between architecture, culture, and spirit. For example, when analyzing the dougong (interlocking wooden brackets) structure with AI, scenes of craftsmen planing wood and interpretations of the harmony between humanity and nature are simultaneously presented.

The Educational Logic of “Cultural Nourishment”: Through a pathway of “cognitive tradition—understanding spirit—transformation and innovation”, students are guided to evolve from learners of architectural history into cultural inheritors. For instance, when analyzing the “Forbidden City’s central axis”, students are encouraged to translate symmetrical aesthetics into sequential design for modern exhibition halls.

Interdisciplinary Collaborative Practice Model: Collaborating with the course “BIM Application and Project Management”, the “Digital Documentation of Historical Buildings” project is jointly completed, demonstrating the cross-disciplinary advantages of “New Liberal Arts + New Engineering.”

6. Future outlook

People will integrate into the China Architectural Heritage Database to expand digital and intelligent case studies of regional architectures, such as Chongqing's stilted buildings and Fujian's earthen buildings, thereby strengthening local cultural identity. People will develop AI tools for architectural style transformation, enabling the automatic matching of traditional elements based on modern design requirements to provide intelligent assistance. Additionally, people will establish a dual-mentorship system combining "corporate mentors" and "inheritors of intangible cultural heritage", aligning students' "cultural translation proposals" with practical projects such as rural revitalization and cultural and creative development.

The digital and intelligent innovation practices in the History of Chinese and Foreign Architecture have demonstrated that technology can serve as a "magnifying glass" and "converter" for cultural inheritance. The course will continue to center on "cultural enrichment through reflection", transforming architectural history and theory from rote learning into immersive experiences, and from knowledge memorization into design DNA. This approach will provide a replicable paradigm for cultivating design talents with cultural roots and innovative capabilities.

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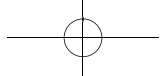
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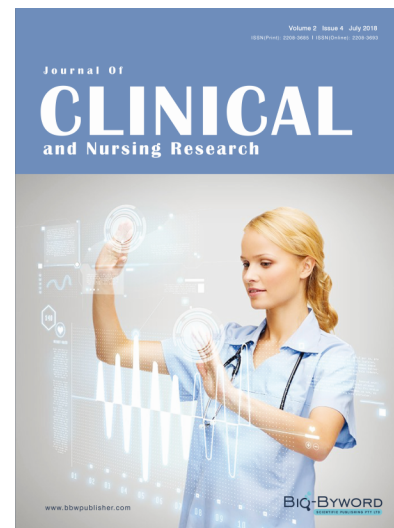
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