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## Journal of Contemporary Educational Research

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# Impact of International Student Mobility in Distinctive Disciplines on Internationalization Capabilities

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**Abstract:** To deeply analyze the impact of international student mobility on their internationalization capabilities in the field of Petroleum and Natural Gas Engineering, this study systematically reviewed the exchange dynamics of international students at Southwest Petroleum University from 2014 to 2024, as well as detailed data on students' overseas visits from 2016 to 2024, carefully outlining the trends and characteristics of student international mobility over the past decade. Based on this, using an evaluation system for internationalization capabilities constructed by the authors, which closely follows the characteristics of Petroleum and Natural Gas Engineering and covers key dimensions such as language skills, international perspective, cross-cultural communication, and global cooperation, graduate students from the research team of international students were selected as a sample group. Through a carefully designed survey questionnaire, their current internationalization capabilities were systematically evaluated. The results showed that compared to the benchmark level in 2019, students' internationalization capabilities have shown a significant improvement trend, especially in cross-cultural communication. This finding not only reveals the positive role of international student mobility in promoting academic exchanges and integration but also further emphasizes the unique value of multicultural integration in scientific research teams to enhance the internationalization capabilities of domestic students.

**Keywords:** International mobility; Internationalization capabilities; Petroleum and natural gas engineering discipline

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## 1. Introduction

In the grand blueprint of the “National Medium and Long-Term Education Reform and Development Plan (2010-2020)”, strengthening international exchanges and cooperation has been placed in a prominent position. The aim is to forge an international talent team with a global perspective, proficient in international norms, and brave enough to emerge on the international stage. This strategic deployment profoundly reflects the country's high attention and eager expectations for the internationalization process of higher education. The “Overall Plan for Promoting the Development of World-Class Universities and Disciplines” issued by the State Council further refines this vision, clearly proposing to deepen international cooperation and promote higher education



to a higher level through core measures such as building a top-notch teaching team and cultivating outstanding innovative talents. As a key link in this strategic deployment, the positive effect of international student mobility on promoting students' internationalization capabilities cannot be ignored. Specifically, international student mobility not only provides students with opportunities to directly experience foreign cultures and learn advanced knowledge, but also subtly shapes their open and inclusive attitudes, cross-cultural communication skills, and comprehensive qualities required for participating in international competition and cooperation. Therefore, exploring the positive impact of international student mobility on enhancing students' internationalization capabilities have important theoretical and practical significance for promoting the internationalization process of higher education and cultivating high-quality talents who meet the needs of globalization.

This article involved students from the “Double First-Class” construction university, Southwest Petroleum University's Petroleum and Natural Gas Engineering discipline, as the analysis object. Focusing on students' international mobility and their internationalization capabilities, it investigates student mobility data from 2014 to 2024 in the Petroleum and Natural Gas Engineering discipline. Combined with the evaluation scale of students' internationalization capabilities, it explores the impact of international student mobility on their internationalization capabilities. This has certain theoretical significance and practical value for further deepening the understanding of the development law of higher education in the context of internationalization.

## **2. International student mobility**

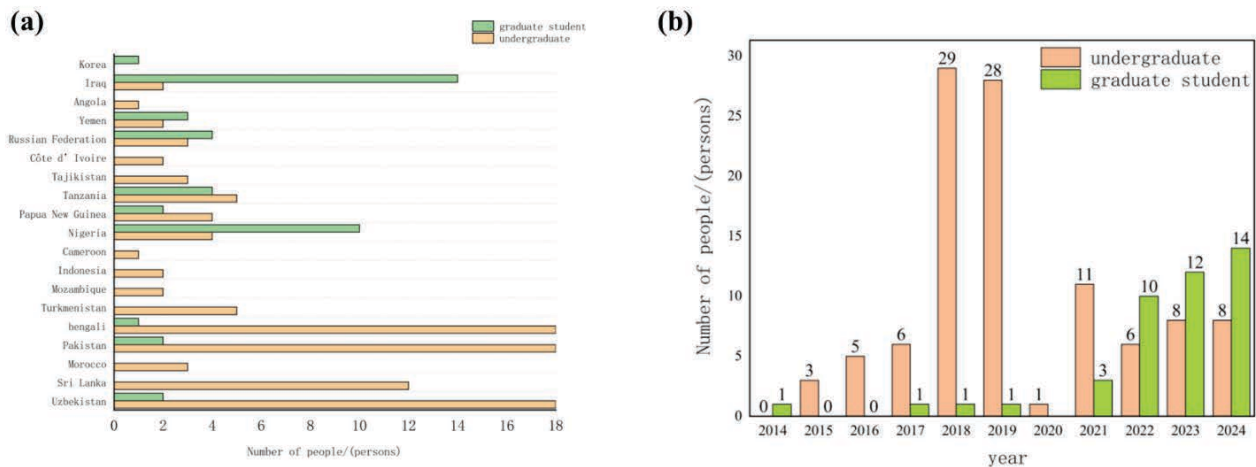
International student mobility, as a prominent phenomenon in the field of education in the era of globalization, encompasses a rich connotation that includes both the acceptance of international students from various parts of the world by higher education institutions and the scenario of domestic students crossing borders to pursue further studies and exchanges overseas <sup>[1]</sup>. Since the in-depth implementation of the “Belt and Road” Initiative, this mobility trend has shown vigorous development, not only promoted cultural integration and collision but also accelerating the cross-border dissemination of knowledge and technology <sup>[2]</sup>.

Currently, academic research on international student mobility has formed a relatively systematic framework, mainly focusing on two core areas <sup>[3]</sup>. Firstly, researchers focus on the diverse influencing factors behind international student mobility. From multiple perspectives, they deeply analyze the comprehensive advantages of the destination country in terms of political stability, economic development level, cultural heritage, quality of the education system, social environment, university reputation, international recognition of academic qualifications, and even the cost of living such as housing prices. Through quantitative analysis methods, they accurately measure the strength and sensitivity of each factor's role in attracting international students <sup>[4]</sup>. This research thread reveals the importance of economic factors and education quality as the two core driving forces for attracting international students. Secondly, the research emphasizes the specific scale, unique characteristics, and mobility paths of student mobility. Through empirical analysis, it is found that international students tend to choose countries with strong economic strength, geographical proximity, minor language barriers, and high-quality education when selecting study destinations <sup>[5]</sup>. This preference not only reflects students' rational considerations for their personal development prospects but also illustrates the inherent logic of educational resource allocation and mobility in the context of globalization.

### **2.1. International students**

After conducting in-depth research on the data of international students received by the Petroleum and Natural

Gas Engineering discipline at Southwest Petroleum University from 2014 to 2024 (as shown in **Figure 1**), a series of significant trends were observed. The discipline has attracted elite students from 19 countries around the world, including Bangladesh, Pakistan, and Iraq, with 105 undergraduates, 39 master's students, and 4 doctoral students. The convergence of this diverse student population has undoubtedly injected new vitality into academic research and cultural exchanges. In particular, the deepening implementation of the “Belt and Road” Initiative has established a broader platform for young students from countries along the route to visit and study, significantly promoting international student mobility and educational cooperation. This strategy not only deepens economic ties between countries, but also promotes the sharing and complementarity of educational resources invisibly, demonstrating China’s comprehensive attractiveness and influence in politics, economy, culture, and education on the international stage.



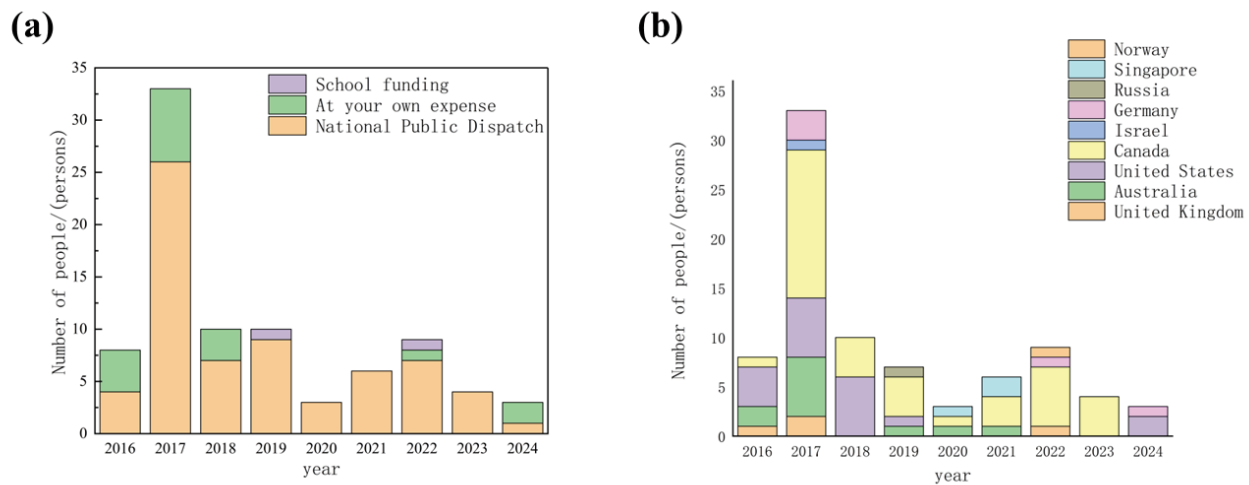
**Figure 1.** Data on foreign students received by the petroleum and natural gas engineering discipline at Southwest Petroleum University. (a) Number of students from different countries of origin; (b) Number of students enrolled in different years.

Furthermore, as a national “double first-class” construction university, Southwest Petroleum University’s Petroleum and Natural Gas Engineering discipline has been awarded an A + rating. This honor is directly reflected in the changes in the number of international students. From 2018 to 2019, there was a significant increase in the number of undergraduate international students. Although there was a decline in 2020 due to the global impact of the COVID-19 pandemic, it quickly recovered and continued to rise. Simultaneously, the number of graduate international students has also shown a steady recovery trend. This is not only a strong testament to the enhanced international competitiveness of China’s higher education, but also a vivid portrayal of the growing charm of education in petroleum and natural gas disciplines. This series of data changes profoundly reveals the important role of international cooperation and exchanges in promoting the internationalization of higher education.

## 2.2. Students visiting abroad for study

Based on a survey of data from 2016 to 2024 on students from the Petroleum and Natural Gas Engineering discipline at Southwest Petroleum University participating in study abroad and short-term exchange programs, as shown in **Figure 2**, it was found that most of the funding sources for students in this discipline to study abroad come from government scholarships (statistics for students studying abroad after graduation are not

included). The destination countries for student visits are becoming more diversified, mainly including Canada, the United States, Australia, the United Kingdom, Singapore, Germany, Norway, Russia, Israel and more. This indicated that students not only base their choice of destination country on the level of national economic and educational development but also pay more attention to the global ranking of the university, the international reputation, and influence of the subject team in the research field. Additionally, influenced by the university's policy for newly recruited teachers, students in petroleum and natural gas engineering-related disciplines have a strong willingness to return to work at the university after studying abroad, for example, among the 33 students who went abroad in 2017, 9 stayed to teach after their studies, which helps to enhance the internationalization level of teachers, improve students' international attitudes and perspectives, and form a positive promotion of mutual teaching and learning.



**Figure 2.** Data on students from the petroleum and natural gas engineering discipline at Southwest Petroleum University studying abroad. (a) Funding sources for students studying abroad in different years; (b) Distribution of destination countries for students studying abroad in different years.

### 3. Evaluation index system of students' internationalization ability

In exploring the evolution of the evaluation system for internationalization ability, Hunter innovatively constructed a three-tiered evaluation framework in 2004<sup>[6]</sup>. It laid a solid foundation for subsequent research. This framework not only promotes a deeper understanding of the multiple dimensions of internationalization ability in academia but also inspires further exploration and expansion by many scholars based on it. Liu Yang et al.'s 2015 study focused on undergraduate students from five universities in the Beijing area. By constructing a three-dimensional, seven-factor evaluation scale, they refined the assessment and analysis of undergraduates' international abilities, providing valuable empirical data for the field of educational evaluation<sup>[7]</sup>.

Subsequently, in 2017, Hu Dexin conducted a comparative analysis of international capabilities using a three-dimensional, eight-factor evaluation system targeted at graduate students from Tsinghua University and Freie Universität Berlin<sup>[8]</sup>. This cross-border and cross-cultural comparative study not only broadened the horizons of international capability evaluation but also deepened the understanding of the internationalization trend in higher education.

By 2018, Liu Yang and others made further contributions to this field. Based on the original scale, they innovatively added two key elements, international professional knowledge and international academic

exchanges, and incorporated considerations of international experience, thus constructing a more comprehensive and contemporary analysis framework for international capabilities<sup>[9]</sup>. This adjustment not only reflects the dynamic development of the international capability evaluation system but also demonstrates the continuous improvement of academic requirements for international talent cultivation.

In 2019, Xu Guangli and others proposed a highly targeted international capability evaluation index system specific to the field of oil and gas engineering<sup>[10]</sup>. This system continues the three major dimensions of “knowledge and understanding, skills, attitudes, and values” for evaluating international capabilities and is refined into seven specific factors: “world knowledge, globalization understanding, tool usage, scientific research innovation, cross-cultural communication, international attitude, and value identification” (as shown in **Table 1**). Through extensive surveys of graduate students, it was found that students in this discipline excel in international attitudes and perspectives but still have significant room for improvement in terms of oil and gas professional knowledge, cross-cultural communication skills, and tool usage skills<sup>[11]</sup>. This discovery not only provides important feedback and guidance for graduate education in oil and gas engineering but also offers valuable insights and inspiration for the cultivation of international capabilities in other disciplines.

**Table 1.** Evaluation index system for international capabilities of graduate students in oil and gas engineering

Dimension	Factor	Explanation
Knowledge & Understanding	Oil & Gas Knowledge	Understanding of oil and gas resources in other countries, pipeline networks, petroleum companies, research teams, and their specialized fields.
	Global Perspective	Understanding the implications of globalization in the petroleum industry, and awareness of international industry trends and academic organizations.
Skills	Tool Proficiency	Ability to effectively use languages, international databases, and globally recognized simulation software.
	Research & Innovation	Capability to operate and analyze data from imported precision equipment; proficiency in applying for international patents; ability to publish in international academic journals; skill in collaborating with international research teams; proficiency in using international databases for scientific research; mastery of industry-standard global simulation software; active participation in international academic events and ease in communicating with foreign peers.
	Cross-Cultural Communication	Ability to communicate fluently in foreign languages; skill in interacting with people from diverse cultural backgrounds; willingness to understand foreigners and establish mutual understanding and trust.
Attitudes & Values	International Mindset	Willingness to respect, understand, and appreciate other cultures and values with an open attitude when interacting with people from different cultural backgrounds; eagerness to collaborate and communicate with international peers.
	Value Identity	Belief in one’s own significance to national development; identification with and pride in one’s native culture and values.

#### 4. Analysis of the internationalization ability of students in teams with international students

As the impact of the pandemic fades, the international mobility of students is gradually regaining vitality. Taking Southwest Petroleum University as an example, in 2022, the discipline of Petroleum and Natural Gas Engineering admitted 16 international students pursuing degrees, including 6 for bachelor’s degrees, 9 for master’s degrees, and 1 for a doctoral degree. Ten graduate students, hailing from Russia, Iraq, and Pakistan, have integrated into ten different research teams based on their research interests and national employment



needs, truly becoming a part of the Chinese graduate student population. The integration of international students into research teams virtually creates an environment conducive to international exchange. During regular team meetings, both Chinese and international students, as well as their mentors, communicate and discuss in both Chinese and English, rapidly improving the Chinese students' professional scientific English application skills and English listening and speaking abilities through practical use. Referring to **Table 1**, it can be inferred that students' cross-cultural communication skills will be enhanced.

When constructing the online survey questionnaire for evaluating students' internationalization abilities, we strictly followed the seven core factors set out in **Table 1**, included world knowledge, globalization understanding, tool usage, scientific research innovation, cross-cultural communication, international attitude, and value identification. To ensure comprehensive and accurate evaluation, each factor was carefully designed with a corresponding number of items, totaling 34 items, covering various dimensions of students' internationalization abilities.

The questionnaire adopted the internationally recognized Likert five-point rating scale, aiming to guide respondents to objectively evaluate each item description based on their actual situations. The scoring system is rigorous and detailed, ranging from 1 point for "completely disagree" to 5 points for "completely agree", forming a clear evaluation gradient. This design facilitates respondents to accurately express their opinions and aids in subsequent data statistics and analysis, providing solid support for precise evaluation of students' internationalization abilities.

The survey was conducted among Chinese students in research teams with international students in the field of oil and gas engineering. A total of 120 questionnaires were distributed, and after a rigorous screening and elimination process, 116 valid questionnaires were finally collected, ensuring the validity and representativeness of the data sample.

To comprehensively evaluate the reliability and validity of the constructed evaluation index system, various statistical methods were used for in-depth analysis. Firstly, the Cronbach's  $\alpha$  coefficient, a classic reliability index, was used to test the internal consistency of the three core dimensions. The results showed that the  $\alpha$  coefficients of each dimension were significantly higher than the threshold of 0.88. This high level of consistency not only highlights the close connection between the items within each dimension but also further confirms the stability and reliability of the evaluation index system in terms of reliability.

In terms of validity analysis, a diversified perspective combining content validity, criterion validity, and structural validity was adopted. Through the calculation of Spearman's rank correlation coefficient, a significant positive correlation was found between the overall evaluation of internationalization ability and the three dimensions, which fully demonstrates the validity and rationality of the evaluation content. In other words, the index system can accurately reflect the true level of internationalization ability of the measured objects.

Based on the in-depth statistical analysis of the existing questionnaire data, we can comprehensively review the performance characteristics of students in various dimensions and specific factors of internationalization ability in the field of oil and gas engineering. As shown in **Table 2 and 3**, the degree of dispersion of students in the three dimensions of "attitude and values", "skills", and "knowledge and understanding" maintains a similar level. This result reveals a high consistency in the international abilities among the student population, with relatively small differences between individuals, reflecting the stability of the overall international ability framework. Meanwhile, the average scores of the three dimensions all exceed the baseline of 3.0, indicating that students have achieved a relatively ideal level in terms of international attitude, skill mastery, and knowledge understanding.

Upon careful analysis of the specific performance of each factor, notable differences and challenges were identified. Among them, the average score of the “World Knowledge” factor failed to reach the threshold of 3.0, which was significantly lower than other factors. This clearly pointed out students’ cognitive shortcomings in the field of international oil and gas knowledge, especially regarding the distribution of global oil and gas resources and pipelines, as well as developments in international academic institutions. This finding not only revealed students’ inadequate knowledge reserves in the context of globalization but also highlighted the urgent need to strengthen certain areas in subsequent training programs.

**Table 2.** Statistical data for each dimension

Dimension	Knowledge & Understanding	Skills	Attitudes & Values
Mean	3.04	3.16	3.88
Standard Deviation	0.91	0.91	0.94

**Table 3.** Statistical data for specific dimension

Factor	World knowledge	Global perspective	Research & innovation	Cross cultural communication	Tool proficiency	International Mindset	Value identity
Mean	2.85	3.24	3.34	3.03	3.12	3.60	4.16
Std Dev	0.90	0.92	0.90	0.92			

Comparing the current data with the survey results from previous literature (as shown in **Table 4**), an encouraging trend was observed, students’ scores on multiple factors, especially cross-cultural communication skills, had significantly improved. This positive change was undoubtedly closely related to the integration of international students into the research team. The inclusion of international students not only brought diversified cultural perspectives to the team but also created a small yet vibrant international exchange environment for local students through their unique learning and life experiences. This environment effectively fostered students’ desire to explore world knowledge and subconsciously enhanced their cross-cultural communication and understanding abilities.

**Table 4.** Comparison of internationalization skills between students in teams with international students and students from literature <sup>[11]</sup>

Factor	World knowledge	Global perspective	Research & innovation	Cross cultural communication	Tool proficiency	International Mindset	Value identity
Current score	2.85	3.24	3.34	3.03	3.12	3.60	4.16
Ref score	2.70	3.13	3.21	2.61	2.99	3.45	4.16

The reasons behind this phenomenon can be attributed to two main factors. Firstly, the professional courses that international students participate in are taught in English, and the instructors generally have overseas study experience. This teaching model not only enhances the internationalization level of the courses but also promotes the systematization and structuring of teaching content, providing students with a broader international perspective and learning platform. Secondly, the daily presence of international students acts as a catalyst, sparking a small-scale international exchange within the research group. This allows local students

to naturally encounter different cultural backgrounds and ways of thinking in their daily study and life, thus accelerating their cross-cultural adaptation and growth process.

However, it should be clearly recognized that the current research still has certain limitations. The relative limitation of sample data and the short duration of international students' participation in the research group may affect the universality and long-term effects of the research results. Therefore, future research should aim to further explore the multi-dimensional and deep-level impact of international students on students' international capabilities over a longer time span and with a larger sample size. This will provide more solid data support and theoretical guidance for the continuous optimization of China's higher education internationalization strategy.

## **5. Summary and outlook**

Based on an in-depth analysis of the international student intake at Southwest Petroleum University in recent years and the data on overseas study visits by domestic students, this paper systematically summarizes the current situation and trends of student international mobility and clarifies its unique characteristics of international development. Using an evaluation index system for student internationalization capabilities that reflects the distinct characteristics of petroleum and natural gas engineering disciplines, this study focuses on graduate students in research teams where international students are located. Through carefully designed surveys, the current status of graduate students' internationalization capabilities are deeply explored. Research results show that international mobility indeed has a significant positive effect on improving students' internationalization capabilities. Especially when international students integrate into research teams and participate in team meetings, this effect is particularly evident, and the cross-cultural communication skills of domestic students have been rapidly and significantly improved.

In light of the aforementioned findings, we recognize the necessity of further exploring the impact mechanism of international mobility on students' internationalization capabilities. In the next step, we can reveal the inherent mechanisms of the impact of international mobility on students' internationalization capabilities through larger-scale and more detailed data analysis. Based on this, we can guide the development of postgraduate training objectives and programs according to the dimensions of lacking internationalization capabilities. This will not only help deepen our understanding of the laws of international education but also provide strong theoretical support and practical guidance for Southwest Petroleum University to promote its internationalization strategy and improve the quality of talent training.

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## **Disclosure statement**

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# The Impact of Training Opportunities on Job Satisfaction Among Teachers: Mediating Role of AI Self-Efficacy

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**Abstract:** This study examines how training opportunities influence teachers' job satisfaction, emphasizing the mediating effect of AI self-efficacy among primary and secondary school teachers in Wuhan, China. Current research employed a quantitative, cross-sectional design. Data were collected using an online questionnaire from 655 primary and secondary school teachers in Wuhan. Structural equation modelling (PLS-SEM) was utilized for data analysis. Results confirmed significant positive relationships between training opportunities and both AI self-efficacy and job satisfaction. Besides, AI self-efficacy was found to significantly mediate the relationship between training opportunities and job satisfaction. This study contributes to the body of knowledge by empirically showed the relatively unexplored psychological pathway (AI self-efficacy) linking training opportunities to job satisfaction within AI-intensive educational contexts. The findings enhance understanding of how structured training in AI can positively influence teachers' attitudes and job-related outcomes. Educational policymakers and administrators can utilise these findings to develop specialised training programs, thereby improving teacher self-efficacy, job satisfaction and overall effectiveness in responding to technology changes.

**Keywords:** Training opportunities; AI self-efficacy; Job satisfaction; Teachers; Artificial intelligence

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## 1. Introduction

Job satisfaction is a prominent area of research due to its complex nature. There are many definitions of job satisfaction, and encompassed multiple aspects. Much earlier, Smith, et al. define job satisfaction as a function of the perceived relationship between what one wants from one's job and what one perceives it as offering or entailing <sup>[1]</sup>. Later, Locke suggested that job satisfaction is a positive feeling of a job, based on the appraisal of the person's job or job experiences <sup>[2]</sup>. Years later, Spector defines job satisfaction as "simply how people feel about their jobs and different aspects of their jobs <sup>[3]</sup>. It is the extent to which people like (satisfaction) or

dislike (dissatisfaction) their jobs”. Judge, et al. describe job satisfaction as a collection of attitudes that workers have about their jobs<sup>[4]</sup>. Weiss also suggests that job satisfaction is an attitude that individuals have about their jobs and it results from their perception of their jobs and the degree to which there is a good fit between the individual and the organization<sup>[5]</sup>. These definitions highlight the multifaceted nature of job satisfaction, encompassing emotional, attitudinal, and perceptual dimensions of how individuals evaluate their work and work environment.

Previous research has indicated plenty of factors influencing job satisfaction, to name a few, the professional status and work engagement, relationship satisfaction, personal development, and basic demands, training, continue skill development, self-efficacy, and recently the artificial intelligence<sup>[6-12]</sup>. The proliferation of artificial intelligence (AI) on recent decades have fundamentally transformed various aspects of human existence. Defined broadly by Winston as the “study of the computations that enable perception, reasoning, and action”, AI has permeated numerous sectors including engineering, healthcare, manufacturing, finance, and education<sup>[13]</sup>. Within educational settings particularly, AI technologies such as adaptive learning systems (e.g., Knewton, Dreambox), intelligent tutoring platforms (e.g., Squirrel AI), and automated grading tools have considerably altered instructional methods and administrative practices. As educational institutions increasingly integrate AI technologies, there is a consequential demand for educators to adapt pedagogically and administratively, often significantly reshaping their traditional professional roles. Such rapid technological advancements highlight critical considerations regarding educators’ preparedness, satisfaction, and their self-efficacy in utilizing digital innovations.

Teacher job satisfaction, in particular, emerges as an essential construct for examination due to its proven associations with retention rates, instructional quality, and student academic outcomes<sup>[14]</sup>. Nevertheless, while literature consistently acknowledges job satisfaction’s importance, it remains underexplored in relation to the availability and quality of AI-specific training opportunities and the psychological mechanisms underpinning these relationships, notably AI self-efficacy.

Teacher training is widely regarded as a cornerstone of professional development, enabling educators to enhance their skills, refine instructional practices, and adapt effectively to institutional transformations. The availability and quality of training significantly influence educators’ perceptions regarding their roles and organizational futures. Prior research consistently supports a positive relationship between comprehensive training initiatives and job satisfaction<sup>[15-17,19]</sup>. Specifically in educational contexts, ongoing training initiatives remain essential. Recent studies by Humairah et al. and Ferreira et al. emphasize the necessity for continuous professional development to equip educators effectively with modern literacy skills and innovative teaching methodologies<sup>[17,18]</sup>. Collectively, these findings underscore the critical role of structured training opportunities in fostering educator satisfaction, enhancing professional competency, and ensuring institutional adaptability.

Nevertheless, an essential construct connecting training opportunities and job satisfaction is self-efficacy, particularly AI self-efficacy, an individual’s belief in their competence to effectively employ artificial intelligence technologies within professional settings. Rooted in Bandura’s Social Cognitive Theory, self-efficacy influences individuals’ motivation, performance, and resilience, notably in contexts involving technological innovation and adaptation<sup>[19]</sup>.

Empirical findings consistently affirm that training opportunities significantly enhance self-efficacy, which in turn positively influences job satisfaction<sup>[20,21]</sup>. Nonetheless, as educational institutions increasingly adopt AI tools for administrative and instructional purposes, educators’ AI self-efficacy becomes a strategic determinant of successful technological integration and overall job satisfaction. Contemporary research emphasizes that

targeted training programs specifically designed to enhance AI-related competencies substantially bolster teachers' AI self-efficacy<sup>[22, 23]</sup>. Simosi demonstrates that training programs explicitly aligned with individuals' self-efficacy levels significantly enhance the likelihood of skill transfer and successful adaptation in professional contexts<sup>[21]</sup>. Likewise, Bausch et al. highlight that training that realistically assesses capabilities and provides positive reinforcement considerably increases post-training self-efficacy, consequently predicting higher performance and satisfaction levels<sup>[20]</sup>.

Specifically, within AI-intensive contexts, Obenza demonstrates that training programs enhancing AI self-efficacy effectively foster positive attitudes toward AI integration, thereby reducing resistance and enhancing overall job satisfaction<sup>[23]</sup>. Chen et al. further corroborate these findings, revealing that increased AI self-efficacy directly correlates with heightened satisfaction in AI-oriented courses and stronger intentions to engage in AI-related tasks<sup>[22]</sup>. Conversely, research by Ullah suggests that excessively high self-efficacy might reduce reliance on AI, necessitating balanced training strategies that empower educators while encouraging constructive engagement with AI technologies<sup>[24]</sup>.

Furthermore, studies across diverse contexts corroborate the critical role of self-efficacy in determining professional outcomes. For example, Ganefri et al. in entrepreneurship education and Lee et al. in healthcare have shown that targeted, practice-oriented training significantly enhances participants' self-efficacy, thereby improving performance outcomes and satisfaction<sup>[25,26]</sup>. Collectively, this literature underscores the pivotal role of self-efficacy-oriented training interventions, particularly those tailored toward technological competencies like AI, in facilitating successful organizational adaptation and individual professional growth.

However, despite these extensive findings, the psychological pathways explaining how training translates into satisfaction, particularly within AI-intensive contexts, remain inadequately explored. Specifically, AI self-efficacy i.e., teachers' belief in their capability to effectively employ AI tools has emerged as a critical psychological mechanism linking training experiences to job satisfaction<sup>[22,23]</sup>, yet this construct is largely under-investigated within educational contexts. Recognizing this significant gap, the present study aims to explicitly investigate how training opportunities related to AI influence teachers' job satisfaction through the mediating role of AI self-efficacy among secondary school teachers in Wuhan, China, a city that is undergoing profound educational transformations via extensive AI integration. As such, based upon the literature review and research gap, current study proposes the below hypotheses:

- (1) There is a positive relationship between training opportunities and AI self-efficacy among school teachers in Wuhan, China.
- (2) There is a positive relationship between training opportunities and job satisfaction among school teachers in Wuhan, China.
- (3) AI self-efficacy mediates the relationship between training opportunities and job satisfaction among school teachers in Wuhan, China.

## 2. Methodology

This study is a quantitative cross-sectional study using questionnaire survey method. To measure the dependent variable, i.e., job satisfaction, the Chinese version of 3-items Job Satisfaction Scale was adopted from Liu, et al.<sup>[27]</sup>. This scale examines the perspectives of employee self-perceive degree of satisfaction or fulfilment derive from their work. Liu, et al. use it to evaluate the influence of work environment stress on the employees of China and United States. The internal consistency coefficients of the job satisfaction scales were .67 for the Chinese version and .82 for the American version<sup>[27]</sup>.

Meanwhile, to measure the training opportunities, the instrument was adopted from Giovanni Mariani et al. with alpha coefficient of 0.74<sup>[28]</sup>. This instrument required respondents to indicate the degree of agreement or disagreement with a 5-Likert scale for the following 2 statements: (1) Opportunities for training and professional development are offered by my school, and (2) I can access specific training courses on the IT that I use. Lastly, to measure the, 10-items of AI self-efficacy was adopted from Hong, with  $\alpha = .87$ <sup>[29]</sup>. Originally, the instrument is a revised technology self-efficacy scale developed by Holden and Rada<sup>[30]</sup>. Some of the questions are as following: In general, I could complete any desired task using the AI technology if (a) there was no one around to tell me what to do as I go; (b) I had never used technology like it before. Both the measurement for job satisfaction and AI self-efficacy was using 7-likert scale, 1=very disagree to 7 = very agree.

This study employed a non-probability purposive sampling technique, targeting primary and secondary school teachers in Wuhan. Data were collected via an online questionnaire administered through the Wenjuanxing platform. An initial total of 803 responses was obtained; after applying a trimming procedure to enhance reliability and eliminate unengaged participants, 655 usable responses were retained for data analysis. Findings show that slightly more than half of the respondents are female (58.5%), and majority of them are well educated with bachelor degree and above (95.7%). Seventy-six percent of the respondents have work experience of five years and above, and lastly, slightly more than half of them are in 25–35-year-olds (55.30%).

### 3. Findings

The statistical data analysis for this study was carried out with the assistance of SPSS 29 and Smart PLS 4.1. The partial least squares structural equation modelling (PLS-SEM) modeling method was utilized in order to analyze the data. Smart PLS software was utilized in this study. The examination of the mediator model can be taken into consideration simultaneously by PLS. The PLS Algorithm was selected to examine the reliability and validity of the measurement model after the first step of the evaluation process, which involved evaluating the measurement model. In the second step, the structural model was validated, and the bootstrapping approach was chosen to determine the relevance of the indirect effect path coefficients. The measuring model is presented in the following **Table 1**, which examines the item factor loadings, Cronbach's alpha (CA), and composite reliability (CR), in addition to convergent validity through the use of average variance extracted (AVE). This methodology has been utilised in prior research, as demonstrated in the papers by Jiang et al. and Li et al.<sup>[31,32]</sup>.

The results in **Table 1** show that Cronbach's alpha (CA) and composite reliability (CR) values exceed the 0.70 threshold recommended by Hair et al. confirming that construct reliability has been established in this study, with values ranging from 0.797 to 0.956<sup>[33]</sup>. As referring to **Table 1**, the item factor loadings range anywhere from 0.816 to 0.916. Items that have loadings that are greater than 0.500 may be preserved if the average variance extracted (AVE) for the construct is greater than 0.500<sup>[34]</sup>. This is despite the fact that Hair et al. indicate that factor loadings should preferably be greater than 0.708<sup>[33]</sup>. **Table 1** also demonstrates that the AVE values for all constructions vary from 0.684 to 0.831, which is higher than the threshold of 0.500. As a result, all of the items were kept for further study. The convergent validity of each construct is demonstrated by the AVE values that are more than 0.500.

This study also utilized the Heterotrait–Monotrait Ratio of Correlations (HTMT) technique to evaluate and validate the discriminant validity of the instrument<sup>[35]</sup>, that HTMT threshold of less than 0.85 is applied<sup>[35,36]</sup>. **Table 2** shows all of the HTMT values are lower than 0.85, which demonstrates that the required criterion has been completely satisfied and that discriminant validity has been demonstrated in this data set.

**Table 1.** Measurement model for reliability and validity

Dimension	Items	Loading	CA	CR	AVE
AISE	AISE1	0.817	0.949	0.956	0.684
	AISE2	0.836			
	AISE3	0.821			
	AISE4	0.838			
	AISE5	0.820			
	AISE6	0.844			
	AISE7	0.826			
	AISE8	0.817			
	AISE9	0.829			
	AISE10	0.822			
JS	JS1	0.891	0.861	0.915	0.782
	JS2	0.869			
	JS3	0.893			
TO	TO1	0.916	0.797	0.908	0.831
	TO2	0.907			

Notes: AISE - AI self-efficacy, JS - Job Satisfaction, TO - Training opportunities

**Table 2.** Heterotrait-Monotrait ratio (HTMT)

Dimension	AISE	JS
JS	0.479	
TO	0.445	0.477

Notes: AISE - AI self-efficacy JS - Job Satisfaction, TO- Training opportunities

The analysis approach employs bootstrapping, with 10,000 data resamples, and utilizes one tailed test to evaluate directional hypotheses. The two hypotheses tested were found to be statistically significant and supported. The relationship between (i) training opportunities and AI self-efficacy ( $\beta = 0.387$ ,  $t = 11.704$ ,  $p < 0.00$ ), and (ii) training opportunities and job satisfaction ( $\beta = 0.268$ ,  $t = 6.737$ ,  $p < 0.00$ ). Thus, Hypothesis 1 and 2 are supported. A comprehensive clarification of the graphical representation depicted in **Figure 1**.

For testing the indirect effect hypothesis in the structural model, the study also employed a bootstrap procedure with 10,000 resamples as recommended by Guenther et al.<sup>[37]</sup>. Results at **Table 3** indicated that AI self-efficacy mediated the relationship between training opportunities and job satisfaction ( $\beta = 0.128$ ,  $t = 6.838$ ,  $p < 0.00$ ). Thus, Hypothesis 3 is supported.



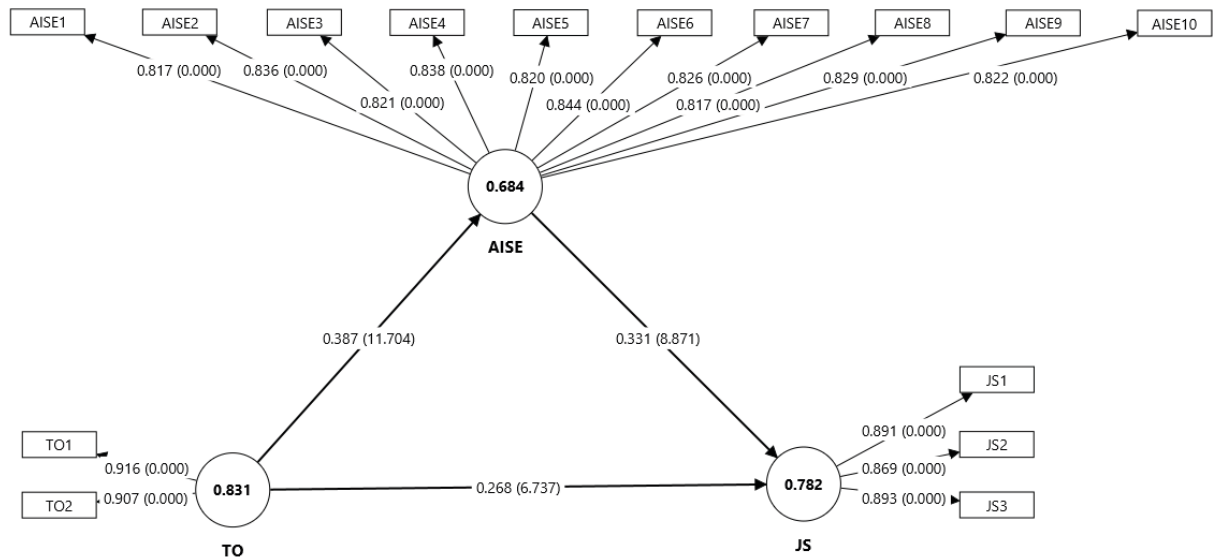


Figure 1. Hypothesis testing.

Table 3. Path coefficients for direct and indirect effects

Hypothesis	Direct Effect	Beta	SE	T-Statistics	<i>p</i> Value	Result
H1	TO -> AISE	0.387	0.033	11.704	0.000	Supported
H2	TO -> JS	0.268	0.040	6.737	0.000	Supported
	Indirect Effect	Effect	SE	T-Statistics	<i>p</i> Value	Result
H3	TO -> AISE -> JS	0.128	0.019	6.838	0.000	Supported

Notes: AISE - AI self-efficacy JS - Job Satisfaction, TO- TO - Training opportunities

## 4. Discussion and conclusion

Current research findings indicated that training opportunities enable and enhance the school teachers' AI self-efficacy. While specialised research on AI self-efficacy remains nascent, a considerable amount of literature on technology training (e.g., ICT, generative AI) substantiates the claim that professional development markedly bolsters instructors' self-confidence in adopting new technologies. For example, Chiu et al. indicated that K-12 teachers who developed a deeper understanding of AI through structured professional development demonstrated increased confidence in their ability to learn and implement AI. Current research finding also aligned with previous research by Aper et al. that showed the impact of training toward self-efficacy that tailored training programs can enhance self-efficacy, leading to improved performance in professional settings<sup>[38,39]</sup>.

As such, current research findings highlight training opportunities and AI self-efficacy as critical determinants of job satisfaction, particularly within education's evolving technological landscape. It identifies a clear gap in current literature, particularly regarding the integration of these constructs within Chinese educational settings and outlines focused objectives to empirically investigate this dynamic interplay. By addressing this gap, the current study significantly advances scholarly understanding of organizational behavior, technology adaptation, and psychological mechanisms influencing teacher outcomes in AI-intensive educational environments and to strengthen the implementation of the Sustainable Development Goals, particularly within educational settings<sup>[32,40]</sup>. Additionally, this research provides actionable insights for educational policymakers

and administrators aiming to enhance teacher satisfaction and institutional effectiveness amid ongoing technological transformations. Future research could take into the opinions of more variety subjects and samples such as those lecturers working in higher education institutions as to gather a more diverse views and deeper understandings on the issues.

## Disclosure statement

The authors declare no conflict of interest.

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# Exploration of the Contradictions and Countermeasures in Medical Students' Internships, Postgraduate Entrance Examinations, and Employment from the Perspective of Work-Study Conflict

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**Abstract:** *Objective:* The objective of this research is to thoroughly investigate the extent of mutual interference among clinical internships, postgraduate entrance examinations, and employment by examining engineering contradictions, thus offering theoretical insights and guidance for medical students to attain high-quality outcomes in clinical internships. *Methods:* A combination of literature reviews, questionnaires, interviews, and observations of internships was utilized, followed by a statistical analysis to assess the levels of interference among the three factors. *Results:* The senior participants achieved significantly higher scores than their junior counterparts in evaluations of comprehensive humanistic quality, understanding professional values, communication abilities, clinical skills, and attitudes towards learning, with differences that were statistically significant ( $p < 0.05$ ). After applying an interactive training approach that merges early clinical practice with foundational medical education, both groups displayed notable enhancements in activity content, formats, instructor attitudes, clinical performance, and the blending of theory with practice ( $p < 0.05$ ). *Conclusion:* By emphasizing 'early clinical' education, students are effectively engaged in clinical practice through active involvement, leading to feedback-oriented training. This strategy not only improves the overall quality of internships but also reduces the risk of scheduling conflicts with postgraduate entrance examinations and employment opportunities.

**Keywords:** Engineering-education conflict; Medical university students; Internship; Postgraduate entrance examination; Employment; Practical exploration.

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## 1. Introduction

Undergraduate students at medical universities face a variety of challenges during their internship experiences, especially in the stage of clinical practice. A work-study conflict emerges when students must balance both their professional duties and academic obligations within limited hours. Due to factors such as time constraints and fatigue, achieving a successful balance between these two elements often becomes a daunting task <sup>[1,2]</sup>. As university enrollment expands, hospitals have heightened their expectations for graduates, leading to increased competition for jobs and motivating numerous clinical medicine undergraduates to view pursuing a master's degree as a pressing need <sup>[3,4]</sup>. Societal demands on physicians have risen, and the nation seeks to improve the expertise of clinical doctors through standardized residency training along with the implementation of policies concerning professional master's degrees and residency training frameworks.

According to this new policy, during their postgraduate education, students are entitled to receive the Practitioner Qualification Certificate, the Standardized Training Certificate for Resident Physicians, the Master's Degree Certificate, and the Graduation Certificate, collectively known as the 'Four Certificates in One.' This initiative has notably boosted the number of postgraduate applicants by 5% to 6% <sup>[5,6]</sup>. While the 'Four Certificates in One' training program facilitates a smoother transition from student status to attending physician, tensions persist between clinical internships, the postgraduate entrance exam, and job placement in clinical medicine disciplines at medical universities. These tensions predominantly arise from the overlapping schedules for preparing for the postgraduate entrance exam and completing clinical internships, with both the entrance exam and job search consuming a significant portion of the internship timeline <sup>[7,8]</sup>. Concentrating on internships or seeking employment can also hinder students' ability to review and prepare adequately for their exams. On the other hand, if students invest all their efforts into preparing for exams, they might greatly diminish the time they have for internships. This reduction could negatively influence the quality of their clinical training and hinder their ability to fulfill the clinical internship requirements of their undergraduate studies. Consequently, this situation can adversely affect future job searches, perpetuating a cycle between internships, postgraduate entrance examinations, and employment opportunities.

To explore the tensions between clinical internships, entrance exams for postgraduate studies, and employment, we examined the fundamental factors contributing to the subpar quality of clinical internships. These factors encompass ambiguous internship goals, inadequate training in essential clinical skills, limitations in clinical practical competencies, a lack of clinical reasoning abilities, and shortcomings in humanistic qualities. From the standpoint of clinical education and training, this article suggests relevant improvements aimed at boosting the effectiveness of clinical internship programs. Additionally, this paper discusses the significance of cultivating high ideals and admirable professional attitudes among students from the beginning of their academic journey, which would elevate their awareness of clinical internships and facilitate the alignment of educational, work, and employment pursuits within the framework of advanced medical education.

## 2. Materials and methods

### 2.1. General information

A survey utilizing a questionnaire was carried out to evaluate the early scientific research practices and clinical internships among clinical medicine students from the 2019 and 2021 cohorts at Xinxiang Medical University. All procedures followed the guidelines of the Ethics Committee of Xinxiang Medical University. The study gathered a total of 624 valid responses. Concerning gender distribution, 230 male students made up 36.9% of the sample and were aged between 18 and 22 years (average age  $20.42 \pm 1.38$  years), while 394

female students constituted 63.1% and were aged 19–23 years (average age  $21.07 \pm 1.69$  years). In relation to academic levels, the lower-grade group (2021 cohort) included 321 students, representing 51.44%, whereas the higher-grade group (2019 cohort) comprised 303 students, or 48.56%. In addition, Questionnaire 2 received 584 valid responses, with 234 males (40.06%, aged 18–23, mean age  $20.16 \pm 2.33$  years) and 350 females (59.93%, aged 18–24, mean age  $21.57 \pm 2.46$  years). Each of the lower and upper grade groups contained 292 students, signifying 50.0%. For this investigation, Questionnaire 1 produced 624 valid replies, composed of 230 males and 394 females, which correspond to 36.9% and 63.1%, respectively. The lower-grade group from the Class of 2021 and the upper-grade group from the Class of 2019 comprised 321 and 303 students, making up 51.44% and 48.56%, respectively. Questionnaire 2 collected 584 valid feedbacks, encompassing 234 males and 350 females, accounting for 40.06% and 59.93%, respectively. Notably, both the lower and higher-grade groups contained 292 participants each, representing 50.0%. A comparison of age and gender across the groups indicated no statistically significant differences ( $p > 0.05$ ), suggesting their comparability.

## 2.2. Methods

The current humanistic quality among medical students in China is generally low, largely due to educational biases and an excessive focus on professional training that neglects the humanities in curriculum development. In addition, the frameworks for incorporating humanistic education within higher education institutions are not adequately developed, leading to a gap between the theories and practices of humanistic instruction<sup>[9–11]</sup>. Several factors contribute to this scenario: Firstly, conventional educational approaches have restricted the enhancement of practical skills and operational abilities among medical practitioners. Secondly, there is often a conflation in certain institutions between humanistic education and ideological or political education, which results in curricula that do not adequately capture the distinct features of medical humanities. Moreover, many medical universities lack structured mechanisms for evaluating and providing feedback on humanistic quality education<sup>[12]</sup>.

This study aims to thoroughly investigate the interrelationship between clinical internships, postgraduate entrance assessments, and job placements while considering the challenges posed by work-study conflicts. To achieve this, it explores the convergence of these three elements as a primary focus. Through techniques including interviews, observations during internships, literature reviews, and surveys, a theoretical examination of the extent of mutual interference among these factors is performed. The insights gained will inform the proposal of an interactive training framework that aligns early clinical internships with foundational medical education. To address the ongoing conflict between work and study experienced by clinical medical students at our university, it is advisable to implement strategies that include integrating early clinical training with preparation for postgraduate entrance examinations, as well as arranging clinical internships and exam preparation at distinct intervals. These approaches provide valuable reference and theoretical insights for medical students, enabling them to fulfill their clinical internship responsibilities with a high level of quality.

### 2.2.1. Literature review and analysis method

Clinical medicine represents a discipline that is both practical and technical, requiring students to establish a robust theoretical foundation while adeptly applying their acquired knowledge and skills in real-world scenarios. It is essential that basic medical education harmoniously combines with clinical medical education to mutually support one another, permitting early exposure of students to clinical environments without jeopardizing their foundational studies. This early exposure allows them to immerse themselves in the hospital setting, enhances

their understanding of the professional importance of clinical practice, and promotes the growth of their overall competencies. Through a thorough review of existing literature, effective teaching strategies for integrating early clinical internships with basic medical education are developed specifically for junior students in their first semester of the second university year.

Simultaneously, the objectives of clinical professional socialization for senior medical students highlight the critical role of clinical internships. The cultivation goals related to the professional socialization of medical students include the acquisition of professional knowledge, development of clinical skills, enhancement of doctor-patient communication, and improvement of professional consciousness. To fulfill these goals, a variety of educational approaches aimed at professional ideology and career training should be employed. The pursuit of postgraduate education and clinical internships aims to boost employability prospects. As reforms in medical education continue to advance in China, there is a rising demand for highly skilled medical professionals in large and medium-sized cities, coinciding with the gradual increase in admission criteria for hospitals. As a result, numerous students aiming for careers in healthcare choose to undertake postgraduate education to improve their academic credentials, consequently boosting their chances of securing better job positions.

Moreover, pursuing postgraduate studies allows students to enrich their grasp of clinical knowledge and expand their views, with the ultimate goal of developing them into outstanding physicians or researchers. For certain students, strategies for development should initiate during their earlier academic phases, including clinical experiences that are thoughtfully scheduled to align with postgraduate entrance exams and clinical internships.

### **2.2.2. Questionnaire survey method**

This research focused on undergraduate students from two separate cohorts: the lower grade cohort (Class of 2021, sophomore year) and the upper grade cohort (Class of 2019, senior year) in the clinical medicine program at a medical university located in a particular province (hereinafter referred to as medical students). We independently created the “Comprehensive Evaluation Scale for Humanistic Qualities of Clinical Physicians,” based on modern concepts in medical management. This questionnaire includes four dimensions: professional values, comprehension, communication skills, and clinical competencies along with learning attitudes, with a maximum score of 100 points, which students evaluated themselves. The Cronbach’s alpha for the scale is 0.947, demonstrating strong content validity. Additionally, we crafted the “Clinical Internship Quality Feedback Form for Medical Undergraduates,” which primarily highlights the dynamic development of early scientific research practices in conjunction with foundational medical education and subsequent clinical activities. This questionnaire assesses students’ views on the activity’s content, format, instructor attitudes, clinical performance, and the synthesis of theory with practice, with each question rated from 0 to 10. A score of 9–10 reflects satisfaction, 7–8 signifies average, and 6 denotes dissatisfaction. We transformed the developed questionnaire into an electronic format, creating an electronic link and a QR code.

Following the principles of convenience sampling and based on voluntary participation, the class advisor shared the questionnaire link and QR code within the WeChat group of the class. The survey was carried out over a 31 day period from July 9 to August 9, 2022. Data from the survey platform were exported in Excel format, and a database was created, with statistical analyses performed using SPSS 22.0 software.

### **2.2.3. Interview method**

Interviews were carried out with several appropriate basic and clinical faculty members from the institution and its associated hospitals. The content of these interviews covered various objective questions related to the relevance, specific details, support for students, and the practicality of initiating early clinical practice activities,



alongside a subjective inquiry regarding recommendations and viewpoints.

### **2.3. Observation indicators**

This section emphasizes the assessment of medical students' self-evaluations and their cognitive, attitudinal, and behavioral evaluations related to humanistic qualities in both senior and junior cohorts. Important elements to consider include the overall score for humanistic qualities, understanding of professional values, communication abilities, clinical competencies, and attitudes towards learning. Furthermore, utilizing the Early Clinical Internship Quality Feedback Form for medical undergraduates, we aim to gather insights into the experiences of both student groups concerning the content of activities, formats of activities, attitudes of mentors, performance in clinical practices, and the level of integration between theoretical knowledge and practical application.

### **2.4. Statistical methods**

Statistical analysis of the data was performed utilizing SPSS version 28.0. Measurement data that adhered to a normal distribution with equal variance were represented as mean  $\pm$  standard deviation ( $\bar{x} \pm s$ ). To conduct pairwise comparisons among groups, t-tests were employed, establishing a significance threshold at  $p < 0.05$ . Categorical data were displayed in terms of counts and percentages, and comparisons between groups were carried out using  $\chi^2$  tests, with  $p < 0.05$  deemed statistically significant.

## **3. Results**

### **3.1. Comprehensive self-assessment form of humanistic qualities for medical undergraduates**

This research is based on the presumed aims of the medical professional ethos, which includes “valuing life, healing the injured, and saving the dying; showing a readiness to make sacrifices; and reflecting limitless compassion.” Furthermore, it promotes the development of a holistic perspective on health and hygiene, shifting from a focus on diseases to one that centers on individuals. A quantitative approach was utilized, asking participants to engage in a detailed self-evaluation of their humanistic attributes. The results indicate that the senior group scored notably higher than the junior group in evaluating overall humanistic qualities, professional ethics and understanding, communication abilities, clinical competencies, and attitudes towards learning, with these differences reaching statistical significance ( $p < 0.05$ ) (Table 1).

### **3.2. Clinical internship satisfaction feedback form by different grade groups**

Student satisfaction regarding various aspects of clinical internship quality surpassed 85% for both lower and higher-grade groups. Following the introduction of an interactive training approach that merged early clinical internships with foundational medical education, both groups demonstrated notable enhancements in their scores related to activity content, activity format, instructor attitude, performance in clinical practice, and the connection between theory and practice ( $p < 0.05$ ). Detailed findings can be found in Table 2.

## **4. Discussion**

### **4.1. Comprehensive reform of humanistic quality education for medical students is imminent**

The “Opinions on Deepening Medical-Education Collaboration to Further Promote the Reform and

Development of Medical Education,” released by the State Council, clearly outlines the importance of enhancing collaboration between medical and educational sectors to effectively advance the reform of medical education and improve the overall quality of medical students<sup>[13]</sup>. This study’s results reveal that a significant number of interns acknowledge the necessity of developing their humanistic qualities. The final year of medical undergraduate internships plays a critical role in building professional practical skills, underscoring the focus on nurturing clinical competencies in China, while also exposing gaps in training related to humanistic qualities<sup>[14]</sup>. Engaging in clinical practice is an essential phase for medical students as they transition into clinical roles, serving as a crucial opportunity to apply theoretical knowledge within clinical environments and hone both clinical reasoning and skills. Nevertheless, numerous students feel a tension exists between their internships, the postgraduate entrance exams, and job acquisition. Even though the primary aim of the postgraduate exam is to secure employment, the clinical internship represents a vital process that every medical student must experience, during which their abilities can be thoroughly practiced and refined. Consequently, prioritizing the development of humanistic education for medical students and boosting their intrinsic motivation are fundamental objectives in reforming medical education.

#### **4.2. Interactive training combining early clinical practice with basic medical education enhances internship quality**

Engagement in practical experience is crucial for the development of talent and the improvement of competencies, ultimately aiming to connect humanistic education with real-world applications<sup>[15,16]</sup>. This research presents a novel strategy for the early development of clinical medicine students planning to take postgraduate entrance exams. By merging early clinical practice with preparation for postgraduate exams and implementing a staggered approach to clinical internships and exam readiness, the results show that, irrespective of whether students belong to lower or upper grades, their satisfaction regarding various aspects of clinical internship quality surpassed 85%. After applying the interactive cultivation method that integrates early clinical practice with foundational medical education, both student groups recorded notable enhancements in their assessments of activity content, structure, mentor disposition, clinical performance, and the harmony between theory and practice ( $p < 0.05$ ). Focusing on ‘early clinical’ education allows students to engage closely with clinical practice through active participation in clinical tasks. This method encourages them to leave the classroom environment and take part in practical clinical activities, thereby igniting their enthusiasm for learning and enriching their comprehension of medical humanities. As a result, they are more adept at applying their knowledge and fostering an environment of active learning. The seamless integration of theory and practice promotes feedback-oriented training, which not only elevates the overall standard of internships but also mitigates potential conflicts with postgraduate entrance exams and job commitments.

#### **4.3. Countermeasures**

In the current reform of medical education, it is crucial to transform educational concepts. Strengthening humanistic literacy in education requires the implementation of a philosophy for talent cultivation that fuses “medicine” with “humanities”, effectively combining humanistic literacy with medical skills training. Many students show a desire to improve their humanistic qualities, prompting medical universities to employ varied strategies to elevate the humanistic literacy of their medical students. For example, during their internships, medical students gain more direct interaction with patients, making it essential to augment training in medical ethics, doctor-patient communication, and related areas, while also ensuring the selection of exemplary mentors

who can serve as role models. Additionally, medical schools ought to revise the singular approach to evaluating humanistic qualities to better develop students' skills in patient care and empathy as part of their humanistic education. When appropriate, the performance during clinical internships can be included in the humanistic quality evaluation framework, ensuring effective oversight throughout the internship experience <sup>[17,18]</sup>. In short, within the interactive training framework of early clinical internships and foundational medical education, students should receive scientific guidance that transforms traditional, lecture-based teaching methods into more adaptable strategies <sup>[19]</sup>. Such a transformation enables medical education to infiltrate all facets of professional, academic, and social education. For example, the promotion of Problem-Based Learning (PBL) methodologies not only aids in summarizing essential points from clinical courses but also creates systematic connections to fundamental knowledge <sup>[20]</sup>.

## 5. Conclusion

Through the analysis of real case studies and surgical footage, students can strengthen their information retention, ignite their passion for learning, refine their clinical competencies, and effectively navigate the balance between internships, postgraduate entrance examinations, and job opportunities.

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# The Application of Flipped Classroom Teaching Mode Based on SPOC in College English Teaching: Taking the Zhihuishu Knowledge Graph Platform as an Example

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**Abstract:** In recent years, with the continuous development of educational digitalization, the integration model of SPOC (Small Private Online Course) and flipped classroom can integrate online teaching resources and offline teaching resources, overcome the shortcomings of traditional teaching models, and enhance students' enthusiasm for learning and autonomous learning ability. This model has become a popular direction in the reform of teaching models. Meanwhile, the advantages of the Zhihuishu knowledge graph platform, such as knowledge coherence and complete teaching modules, are highly beneficial for the promotion of the flipped classroom teaching model based on SPOC. This research will adopt methods such as literature review, investigation and research, questionnaire survey, and in-depth interview to analyze the application effect and optimization path of the flipped classroom teaching model based on SPOC on the Zhihuishu platform in college English teaching. The theoretical basis, practical effect and existing problems of the model were specifically analyzed, and corresponding optimization suggestions were put forward.

**Keywords:** Zhihuishu App; SPOC; Flipped Classroom; College English Teaching; Digital education

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## 1. Introduction

With the acceleration of the digitalization process in education, China will implement a new round of digitalization strategy in education from 2025–2028, providing clear policy support and development paths for the innovation of teaching models. Against this backdrop, SPOC and flipped classrooms, as innovative models that integrate the advantages of online and offline and restructure the teaching process, have received extensive attention and have demonstrated remarkable results in multi-disciplinary practices. The two are based on the organic combination of constructivism, mastery learning and blended learning theories to achieve complementary advantages.

The knowledge graph function and teaching module of the Zhihuishu App platform provide strong technical and platform support for the integration and application of SPOC and flipped classroom. However, most current research focuses on the deep integration of SPOC and flipped classrooms. Not much attention has been paid to addressing challenges such as resource fragmentation on the platform and providing personalized guidance. This study aims to bridge this gap through the following measures. Firstly, constructing a new SPOC flipped classroom model that can be compatible with the knowledge graph of the Zhihuishu. Secondly, conduct empirical research to analyze the effectiveness of this model in addressing issues such as adapting to college English resources and improving student learning outcome. Third, is to provide operational optimization strategies for the platform-based teaching method.

This study will use research methods such as literature review, questionnaire survey, and in-depth interviews to summarize previous research results and experiences, and further systematically analyze how the SPOC based flipped classroom education model is constructed and its application status on the Zhihuishu App platform, in order to promote the digital reform of university English education.

## **2. The integration of SPOC and flipped classroom**

### **2.1. The theoretical basis and internal logic of the integration of SPOC and flipped classroom**

The combination of SPOC and flipped classroom is based on constructivist theory, mastery learning theory, and blended learning theory. Constructivism emphasizes that the construction of meaning needs to be accomplished through dialogue and collaboration in specific contexts<sup>[1]</sup>. In this model, SPOC provides students with rich online learning resources, supports their autonomous online learning, and utilizes the flipped classroom to enable students to participate in rich offline interactions, thereby deeply integrating the four links of context, dialogue, collaboration, and meaning construction<sup>[2]</sup>. Mastery learning theory points out that there is no significant difference in learning ability among most people, and the key lies in whether appropriate learning conditions are obtained<sup>[3]</sup>. This model helps teachers accurately track students' learning situations, adjust teaching strategies, provide personalized guidance, and at the same time offer students rich online resources, flexible learning time and space, and other suitable learning conditions. The blended learning model is a learning mode that combines the traditional offline teaching mode with the online learning mode<sup>[4]</sup>. This blended learning model combines the advantages of online self-study and offline interaction, achieving a continuous learning environment across multiple scenarios through the interlocking process of “pre-class self-study, in-class interactive enhancement, and post-class consolidation and expansion”<sup>[5]</sup>.

### **2.2. The practical effect and challenge of integrating SPOC and flipped classroom in college English teaching**

The integration model of SPOC and flipped classroom is in line with the characteristics of college English teaching and has achieved remarkable results, but challenges still exist.

In terms of adaptability, this model can overcome the drawbacks of large-class teaching and effectively adapt to the characteristics of college English teaching, such as a wide audience, emphasis on practice, and significant differences in student levels. The SPOC platform is rich in online resources, supporting students to study independently and make up for regional and individual differences<sup>[6]</sup>. The flipped classroom enhances language practice skills through creative debates, group cooperation, and more<sup>[7]</sup>.

From the perspective of teaching practice, in terms of resources, this model helps teachers integrate

high-quality resources to provide students with rich learning materials<sup>[8]</sup>. In terms of teaching effectiveness, experiments show that this model not only improves students' English grades and theoretical levels, but also enhances their practical abilities such as self-expression and practical application<sup>[9]</sup>. In addition, students' ability for self-directed learning and collaborative problem-solving is greatly enhanced in the closed-loop learning of "self-learning interaction reflection"<sup>[10]</sup>. However, this model has also encountered many difficulties in its development, including the lack of guaranteed quality of SPOC resources, difficulties faced by teachers in transitioning their roles, and poor self-directed learning abilities of students<sup>[9, 11–13]</sup>.

### **3. The support of the Zhihuishu platform for the integrated model of SPOC and flipped classroom**

The SPOC based flipped classroom teaching model based on the Zhihuishu platform is an innovative teaching model that combines SPOC teaching concepts with flipped classrooms, and reconstructs the teaching process based on platform technology and functions. The knowledge graph of Zhihuishu APP can help teachers accurately match learning resources with corresponding knowledge points, and teachers can upload targeted learning resources to the platform<sup>[13]</sup>. At the same time, the platform provides teachers with convenient teaching management functions, helping them track learning situations, reduce the burden of progress supervision, and promote their transformation into a guiding role. The interactive function of this platform has also played an important role in addressing the issue of students' insufficient autonomous learning ability.

At present, although the flipped classroom teaching model based on SPOC on the Zhihuishu platform has made certain progress in disciplines such as clinical medicine and mathematics, its application in college English teaching is still in the initial exploration stage and lacks systematic and in-depth research. At present, there are not many research achievements in this field in China. Therefore, it is even more necessary to use this platform to explore effective application content methods for this fusion mode. This study has significant theoretical value and practical urgency.

### **4. Research methods**

This study mainly explores the application status of the SPOC flipped classroom teaching model based on the Zhihui Book platform in college English teaching, its influence mechanism on students' English proficiency, the difficulties faced by teachers and students, and the countermeasures. The research subjects were 328 students from different disciplines, as well as teachers engaged in English teaching on the Zhihuishu APP platform and the technical operators of the platform.

Firstly, interviews were conducted with teachers and technical personnel to obtain first-hand information on model construction, platform operation, teaching integration and other aspects. Secondly, quantitative research was conducted through questionnaires. The questionnaire survey covered five dimensions: platform learning habits and platform experience, the effect of the flipped classroom teaching model based on SPOC, the learning effect and gains of the flipped classroom teaching model based on SPOC on Zhihuishu platform, and difficulties and suggestions. Questionnaires were distributed and collected through the Wenjuanxing App, and the data were analyzed using Excel and SPSS. Finally, qualitative research will be conducted through interviews. The basic information collected was shown in **Table 1**. Based on the questionnaire survey and previous research results, in-depth interviews were conducted with experienced teachers, and qualitative research was carried out using content analysis.

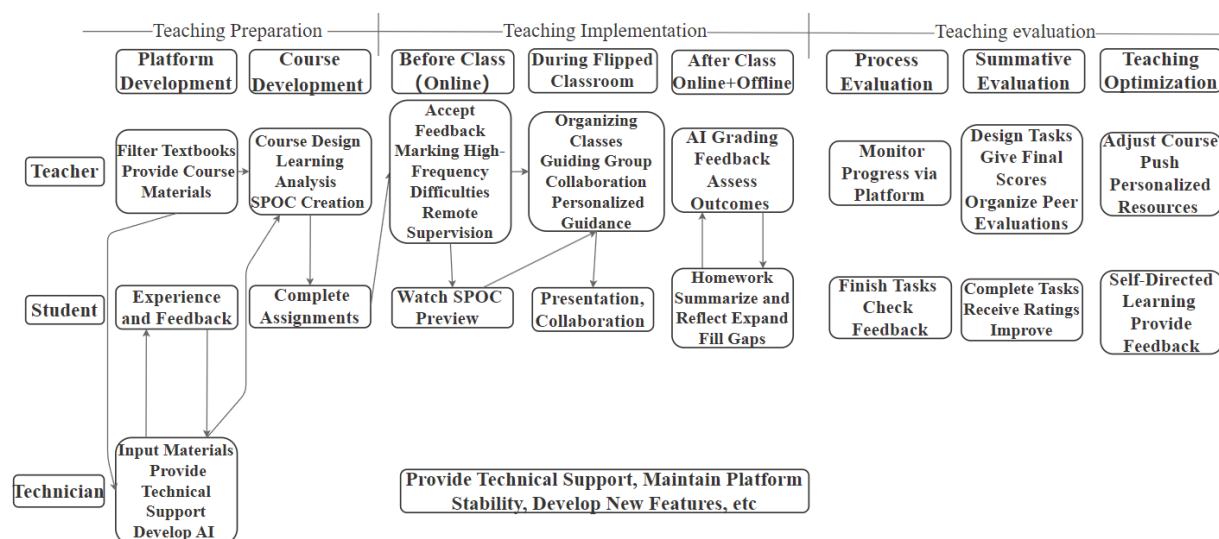
**Table 1.** The basic information collected through the questionnaire

Participants	Major	Gender Ratio	Effective Quantity	Cronbach.α	KMO value
328	Literature, engineering, economics, etc	1.09:1	295	0.800	0.873

## 5. Results

### 5.1. The construction method of this teaching mode and its current operation status

As shown in **Figure 1**, the flipped classroom teaching model based on SPOC on the Zhihuishu platform mainly consists of three parts: teaching preparation, teaching implementation, and teaching evaluation. The following will provide a detailed introduction to the specific links of each part.

**Figure 1.** The construction of a flipped classroom based on SPOC on the platform of Zhihuishu.

#### 5.1.1. Platform development stage

At this stage, teachers first analyze the students' learning situation. Based on the results of the English class placement test, teachers collaborate to select multi-level teaching materials suitable for different levels and develop a stratified course framework for the technical team to use and refer to. Subsequently, technicians input the resources into the platform and, at the same time, developed various functions, such as using AI technology to achieve homework correction, grading, and resource push and other auxiliary teaching tasks, effectively reducing the burden on teachers. The current platform's AI technology supports both Chinese and English corpora. Combined with NLP models, it has a natural advantage in supporting Chinese and English grammar correction, translation scoring, and writing logic analysis. Finally, after being tested by students during the holiday and collecting their feedback, the platform was further optimized and improved.

#### 5.1.2. Course development stage

Teachers first rely on the automatic matching algorithm rules of the platform's AI assistant to obtain online resources with high similarity and conduct secondary screening to ensure the fit. Then, based on the knowledge graph of the Zhihuishu App, the framework of the English course was initially constructed, and the SPOC courses at different levels were further refined. On this basis, teachers improve the course content based on the



learning situation data they have mastered, design and record SPOC teaching videos, and select appropriate personalized course resources to upload to the platform. Students accept tasks through the platform and complete corresponding learning tasks and practice tests.

### **5.1.3. Before class**

Students log in to the platform to watch the SPOC video and preview it. They need to complete the chapter synchronization test. During this process, teachers can implement supervision and reminders through the remote monitoring function, and test the previewing effect in offline classes by asking questions and other methods, achieving coordinated guarantee both online and offline. Subsequently, teachers can utilize the platform's data feedback function and artificial intelligence-assisted system to analyze data such as the accuracy rate of questions, key and difficult points, identify common difficulties, and make appropriate adjustments to the course content to better meet students' learning needs.

### **5.1.4. During class**

The teaching adopts a flipped model. The teacher first sorts out the key and difficult points of the course based on the feedback from the platform preview (about 10–15 minutes). Then comes the group presentation session, where group members will take turns to report on the discussion questions assigned in the previous class. A diversified evaluation mechanism including teacher evaluation, peer evaluation, and self-evaluation is adopted during group classroom presentations to ensure comprehensive and objective evaluation. In order to fully cultivate students' comprehensive development, each group has clear division of labor and cooperates with each other to ensure that every student has effective participation. Each group conducts at least one classroom presentation per semester. After the group presentation and evaluation are completed, the teacher gives a summary and, based on this, expands and extends, raising more profound and inspiring questions to deepen students' understanding of the knowledge. At the end of the class, teachers assign inquiry-based homework to enhance the ability of autonomous learning and problem-solving, and to internalize knowledge.

### **5.1.5. After class**

At this stage, students are required to complete their homework and conduct a summary and reflection. Students can make up for and expand their learning independently by leveraging the platform resources. Teachers can use artificial intelligence assistants to help grade homework and provide feedback to students. Meanwhile, teachers can reflect on their teaching effectiveness based on students' learning outcomes, and thus push supplementary learning resources to students in a targeted manner to promote their in-depth learning and all-round development.

### **5.1.6. Process evaluation**

Accounting for 40% of the total evaluation, it covers self-evaluation, peer evaluation and teacher evaluation. Student evaluation can cultivate their critical thinking and evaluation skills, and promote communication and cooperation. Teachers provide professional feedback based on classroom participation, group assignments and platform learning data.

### **5.1.7. Summative assessment**

Mainly the final exam, accounting for 60% of the total evaluation, comprehensively examines the core knowledge and skills of the course. The types of test questions are diverse, and the marking criteria are strict. Scores are assigned reasonably based on knowledge points and difficulty, truly reflecting students' academic performance.



### **5.1.8. Teaching optimization**

It is the ultimate goal of teaching evaluation. Teachers compare and analyze students' learning situations through the platform, as well as their feedback and evaluation results. They dynamically adjust the course content and structure, continuously improve teaching methods, and enhance teaching effectiveness and learning experience.

## **5.2. Analysis of students' usage habits, experience and teachers' feedback on the Zhihuishu platform**

In terms of students' platform usage habits, In the questionnaire survey, students generally felt that the platform had abundant resources and could meet various learning needs. They carried out various learning activities on the platform, such as reading, watching SPOC videos and reciting words, etc. However, about 54% of the students spent less than one hour online per week, and only 3% spent more than three hours online per week. The actual level of students' use of activities was relatively low. The contradiction between "high resource utilization rate" and "low duration" requires a thorough analysis of the underlying reasons. According to an interview with Teacher A, who has nearly 20 years of teaching experience, on the one hand, there is a gap between students' autonomous learning ability and the requirements of digital learning. More than two-thirds of the students indicated that they found it difficult to balance their study tasks and time allocation, and lacked the willingness to study in depth after class. On the other hand, students are still accustomed to and rely on the passive acceptance mode of traditional classrooms, have insufficient adaptation to online learning (especially practical content) and are easily distracted.

In terms of students' experience using the platform, they are generally satisfied with the friendly and smooth interface of the platform as well as the richness and applicability of the learning resources. More than 71% of the students recognize the smoothness of the platform. Data shows that the platform usage experience is significantly positively correlated with the acceptance of teaching models (correlation coefficient  $> 0$ ,  $p = 0.000$ ). Among the students who recognize the ease of use of the platform, more than 63% have accepted this teaching model. On the contrary, the recognition rate among students who are skeptical about usability is significantly lower. However, there is still room for improvement on this platform. Nearly 40% of the students expressed doubts or uncertainties about usability. The investigation found that the interface guidance and search functions still need improvement to enhance the student experience and promote their English learning.

In terms of teachers' feedback on the platform, when they first came into contact with this platform, their attitude was not very enthusiastic; in fact, they even had a resistant attitude. However, as the usage time increased, they gradually realized the effectiveness of this platform in assisting teaching. The knowledge graph function of this platform is a relatively prominent advantage. It can integrate knowledge points, build a knowledge framework and help teachers master the teaching material system. Teacher B and Teacher C pointed out that this platform can break through the limitations of time and space, provide abundant resources, facilitate personalized teaching, reduce the burden of homework correction, and improve teaching efficiency. However, the platform is still in its infancy in terms of functionality and technology and needs improvement. Teacher A mentioned that although the platform has diverse resources, the content recommended by AI often varies in quality and has a low accuracy rate, requiring teachers to conduct a second manual screening. In addition, the platform can only score objective questions and does not support scoring subjective ones. Moreover, the format requirements for the answers to objective questions are mechanical, which affects the teaching experience.

## **5.3. Impacts and current deficiencies of the flipped classroom teaching model based on SPOC**

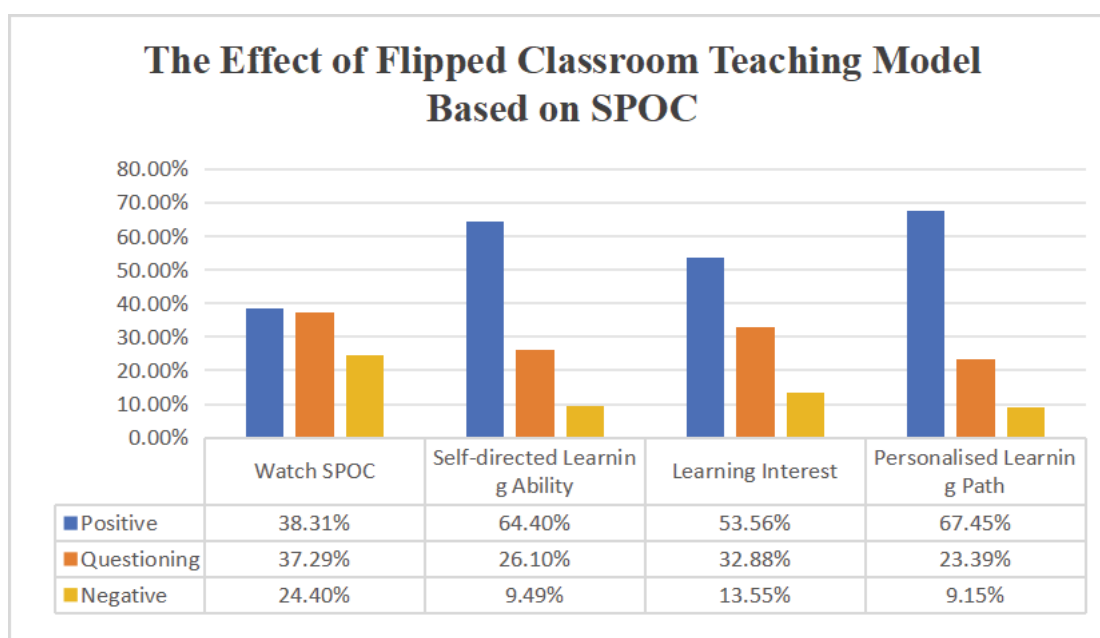
Firstly, regarding the SPOC teaching model, nearly 47% of the students indicated that they were unable to

complete the self-study tasks before class with high quality, and approximately 62% of the students did not repeatedly watch the SPOC teaching videos in their daily studies. This is because the online course resources of SPOC for non-English major students have not yet reached a sufficient scale. Teachers do not force students to study but merely supplement classroom teaching, which leads to low enthusiasm for students to watch, low efficiency in resource utilization, and low quality of self-study before class.

The flipped classroom has effectively enhanced students' autonomous learning ability. About two-thirds of the students believe that it has improved. Project-based learning and group presentations have also strengthened their writing skills and learning perseverance. However, 47% of the students are skeptical or negative about the improvement of their learning interest. The main reason is that this model has high requirements for students' output ability. Some students lack confidence and regard group tasks as a burden, failing to recognize their value. Middle and low-level students are prone to develop a fear of difficulties and a resistant mentality when encountering them.

The results of the questionnaire survey on the flipped classroom teaching model based on SPOC show that 67.45% of the students believe that this model can provide personalized learning approaches and meet differentiated needs. However, in the open-ended questions, students also generally feedback some problems. There are situations such as an increase in extracurricular burdens, a rise in study pressure, and a disconnection between previewing videos and classroom progress. Meanwhile, students have insufficient understanding of the model itself. Even after explaining the relevant concepts, only 54% of the students said they had a basic understanding, while 46% still did not understand. If students, as the main body of teaching, still do not understand the current teaching mode, it will directly affect the learning effectiveness of students and the teaching effectiveness of teachers. Therefore, teachers should systematically introduce current teaching concepts and methods to students.

In short, advanced teaching models still have shortcomings in cultivating students' good study habits, improving their self-learning ability, and stimulating their interest in learning. In response to the above phenomenon, teachers should optimize teacher design, strengthen curriculum guidance, and improve learning supervision mechanisms. The effect of flipped classroom teaching model based on SPOC was shown in **Figure 2**.



**Figure 2.** Flipped classroom teaching model based on SPOC.

#### **5.4. Analysis on learning outcome feedback and teaching model recognition of the SPOC-based flipped classroom teaching model with Zhihuishu platform as the carrier**

Survey data shows that this model has a significant effect on improving students' language proficiency: 62.3% of the students recognize its overall promoting effect. In terms of specific skills, listening, reading and writing abilities have all been positively affected-abundant listening materials and intensive training have enhanced listening comprehension. Most students have reported an increase in reading speed and text comprehension ability. The grammar training, writing materials and logical guidance provided by SPOC have also effectively improved writing skills. However, nearly 90% of the students reported that their spoken English had not improved significantly. Studied pointed out that one of the reasons is that the Zhihuishu platform lacks oral interaction resources. Even if students have the opportunity to communicate verbally about artificial intelligence, they mainly do so by typing. Secondly, students have insufficient reading volume and knowledge reserves. The large class size leads to few opportunities for oral communication and difficulties in oral output.

Meanwhile, the research found that students' recognition of this teaching model was significantly positively correlated with the improvement of their autonomous learning ability and comprehensive English proficiency (the correlation coefficients were all  $> 0$ , and  $p$  values were all 0.000). Among the student group with positive evaluations, 73.1% of the students believe that their autonomous learning ability has been effectively improved. However, at present, only 53.4% of the students clearly recognize this model, while nearly half of the students are uncertain or hold an uncertain or negative attitude.

The recognition of this teaching model by students will be influenced by multiple factors. From the perspective of students, those with strong learning motivation are more inclined to actively participate in the teaching mode and utilize online and offline learning opportunities for learning; However, some students with weaker learning foundations, such as those with weak listening abilities, may have comprehension barriers in English classrooms, leading to negative resistance towards the learning process; Intermediate level students are also influenced by various factors such as the difficulty of learning tasks and the degree of matching of learning resources. The teaching methods adopted by teachers also have a significant impact on students' recognition. If teachers cannot patiently guide students and pay attention to individual differences among them in teaching, it will also reduce students' learning experience and further affect their recognition of the teaching mode.

Students generally expect to receive personalized guidance, and this is precisely the deficiency of large-class teaching. Teachers should make use of the SPOC platform to develop differentiated teaching content and guidance plans to make up for the deficiencies of traditional classrooms. The functions of the platform and the quality of resources will have an impact on recognition. The Zhihuishu platform has abundant resources, but the quality of content varies greatly, especially in terms of spoken language resources, which are very scarce. At the same time, the quality of resources recommended by AI algorithms is also uneven, often requiring teachers to conduct secondary screening, which increases their workload. The platform needs to further improve the quality of its resource library, especially oral and writing resources, to enhance the teaching efficiency of teachers and the learning experience of students.

### **6. Discussion**

This research mainly studies the flipped classroom teaching mode based on SPOC and its implementation effect on the Zhihuishu platform. This teaching mode is of great significance in the digitization process of college English education. Therefore, its application effect and the challenges it faces deserve in-depth exploration.

From the perspective of application effect, the teaching process and evaluation system of this teaching

mode have been relatively complete. In this mode, the three stages of pre class, in class, and post class are arranged very reasonably and interrelated. The Zhihuishu platform has an artificial intelligence assistant to help teachers correct homework and push relevant teaching resources, effectively reducing teachers' work pressure, allowing them more time and energy to communicate with students, and providing personalized guidance for students. In addition, teachers can also timely understand students' learning situation based on the feedback data from the platform, providing real-time supervision and guidance for students, alleviating the pressure of teacher role transformation emphasized by Li, and demonstrating that platform analysis helps alleviate the pressure of the "guidance" role <sup>[9]</sup>.

This model combines the advantages of online and offline to break through the limitations of time and space. It not only enables students to obtain abundant learning resources anytime and anywhere to meet their needs, but also makes the learning methods and resource utilization more diversified, thereby meeting the differentiated learning needs of students and stimulating their interest and enthusiasm for learning. Crucially, the knowledge graph functionality, that would be unique to Zhihuishu, has resolved the SPOC resource fragmentation issue identified by Gu et al., by enabling precise knowledge point-resource mapping <sup>[11]</sup>. The various activities in the flipped classroom have enhanced students' language application ability, learning tenacity, teamwork ability and critical thinking ability, and have also played a positive role in the cultivation of autonomous learning ability.

However, this teaching model has also encountered many difficulties. Firstly, in terms of students, due to their weak ability to learn independently, most students not only cannot develop reasonable study plans, but also find it difficult to ensure the quality of self-study before and after class. Secondly, due to the limited channels for students to input English in their daily lives after class and their own psychological barriers such as inferiority complex, they still lack confidence in their oral output stage. This situation is consistent with the research results of Gao on SPOC completion barriers <sup>[12]</sup>. However, by revealing the user stickiness pattern of a specific platform, this research has been expanded. From the perspective of teachers' teaching practice, in large-scale general English courses, there are a large number of students at different levels. Teachers can only categorize these students and provide targeted guidance, making it difficult for them to offer personalized guidance to individual students. Meanwhile, when the SPOC teaching mode is applied to the teaching of non-English major students, it has not formed a complete and mature curriculum system and scale, which limits the exertion of the personalized teaching advantages of SPOC. This systemic gap partially explains the mixed student acceptance (53.4%) observed, underscoring the need for institutional-level SPOC curriculum development.

In terms of the Zhihuishu Book Platform, although it can currently offer relatively abundant resources, there are still some issues. The quality of the resources varies greatly, the accuracy of AI recommendations is not satisfactory, and the subjective question type scoring function is also not perfect. These problems have had a certain impact on the smooth progress of teaching. These technical limitations echo Wang et al.'s warning about over-reliance on AI in blended learning, suggesting algorithmic refinement as a priority <sup>[5]</sup>.

This model has achieved significant results in the application of college English teaching, but at the same time, there are also some urgent problems that need to be solved in many aspects and links. This requires us to start from multiple aspects such as students, teachers, and platforms to solve these problems, so as to give full play to the potential and advantages of this teaching model and improve the quality of college English teaching.

## 7. Conclusion

This study mainly conducts a comprehensive and in-depth analysis of the current application effects and



existing problems of the flipped classroom teaching model based on SPOC using literature review questionnaire survey, teacher interviews, and case analysis as research methods. Through research, it has been found that this teaching model has achieved certain results in the teaching of general English courses in universities. However, there are still many problems that need to be solved in various aspects such as student participation in teacher teaching implementation platform function support. After careful consideration and analysis, researchers have proposed a series of feasible optimization strategies to solve these problems and provide useful references for the improvement and development of teaching models.

From the perspective of students, teachers can make use of the sign-in function and learning record function of the notification letter platform to guide students in cultivating self-management skills and enhancing their autonomous learning ability. By recommending high-quality English learning resources on the platform, they can broaden the input channels and organize activities such as English dubbing and speeches, encouraging students to use the AI oral communication function to increase language output opportunities and enhance their confidence in oral expression. Secondly, at the teacher level, in large-class teaching, they should adopt stratified teaching and group cooperative learning methods, design differentiated tasks and guidance plans based on students' levels. For non-English major students, they should build a complete SPOC online course system, innovate the design of flipped classroom activities, adjust the proportion of online and offline learning time, and enhance students' participation enthusiasm. Finally, at the Zhihuishu platform level, they should strengthen resource review and screening, establish a mechanism for recommending high-quality resources, improve AI algorithms, and precisely push resources. They should also increase the development of subjective question correction functions, improve the student data feedback mechanism, and assist teachers in teaching.

Through the above optimization strategies, it is expected to solve the existing problems of the current teaching model, improve teaching effect, and promote the continuous improvement of university English teaching quality. This research provides beneficial references and inspirations for the digital teaching reform of university English, but due to the limitations of research samples and time, it still has certain limitations. Future research can further expand the research scope to cover more students of different levels and majors, extend the research period, and deeply explore the long-term impact and mechanism of this teaching model, injecting new vitality into university English teaching and cultivating more high-quality English talents who adapt to the demands of the times.

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# The Construction of Knowledge Base in Project-Based Learning Research—A Cite Space Visualization Study

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**Abstract:** The “Opinions on Comprehensively Deepening Curriculum Reform to Fulfill the Fundamental Task of Strengthening Moral Education”, issued by China’s Ministry of Education in 2015, explicitly identified Project-Based Learning (PBL) as a key strategy for cultivating students’ core competencies. Since then, PBL has been widely implemented as a pilot initiative in primary and secondary schools, gaining increasing influence. Analyzing the intellectual foundations of PBL research in China can offer valuable insights into its theoretical and practical dimensions. This study uses CiteSpace to examine 156 PBL-related articles from the CSSCI database, revealing that the knowledge base of PBL research is primarily built on two major domains. The first is the theoretical foundation, characterized by frequently cited literature focusing on the conceptual framework, educational value, interdisciplinary approaches, core competency cultivation, and instructional objectives of PBL. The second is empirical research, where highly cited studies include case analyses across K–12 settings, general high schools, and higher education institutions. Moving forward, future research on PBL should explore its meaning and value from a dual-subject and integrated perspective, expand case studies to include vocational education, and further promote the interdisciplinary development of core competencies through PBL.

**Keywords:** Project-based learning; Knowledge base; Cite space

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## 1. Introduction

Project-Based Learning (PBL), originating in the early 20<sup>th</sup> century, is grounded in Dewey’s principle of “learning by doing” [1,2]. This pedagogical approach is theoretically anchored in social constructivism and significantly influenced by situated learning, social interaction, and cognitive tools theories [3]. Its primary objective is to enhance learners’ capacity to solve real-world problems [4]. In China, the Compulsory Education Curriculum Plan and Standards (2022) explicitly advocates for deepening pedagogical reforms by emphasizing discipline-specific practices in authentic contexts and fostering students’ ability to integrate and apply knowledge. The

policy further encourages the implementation of thematic and project-based learning as integral components of comprehensive teaching activities <sup>[5]</sup>. Under this national policy framework, PBL has gained substantial traction in educational practice. Existing literature reveals that PBL research in China predominantly focuses on three dimensions. Case studies in specific disciplines, interdisciplinary PBL and core competency cultivation. However, a critical gap persists, systematic analysis of the intellectual foundations underpinning PBL research, in Chinese core journals (CSSCI) remains absent. This lacuna poses challenges for educators seeking theoretical guidance in PBL implementation. To address this, this study employs Cite Space to visualize CSSCI-indexed literature, identifying pivotal nodes and clusters within PBL research. By synthesizing seminal works and citation networks, we aim to map the knowledge base domains for example, constructivist theories and cross-disciplinary integration models. For trace influential sources such as foundational authors, high-impact studies have provided actionable insights for researchers and practitioners to strengthen PBL's theoretical-practical nexus. This analysis offers an evidence-based framework to advance PBL's role in China's educational transformation, ensuring alignment with global pedagogical innovations while addressing localized needs.

## 2. Research design

### 2.1. Data sources

The primary data source for this study derives from the Chinese Social Sciences Citation Index (CSSCI) source journals, as accredited by Nanjing University. To ensure the authority and academic rigor of the search results, the following advanced search parameters were applied search scope, whose Topic is restricted to “Project-Based Learning”, “PBL” and “project-based”. Timeframe is set between 2001 and 2024. The initial search yielded 201 academic papers. After screening, literature that did not meet the criteria including conference abstracts, press releases, scholarly essays and more or had missing information was excluded, resulting in a final selection of 156 valid papers.

As illustrated in **Figure 1**, the volume of Project-Based Learning (PBL) research publications in Chinese Core Journals (CSSCI) demonstrates a fluctuating yet upward trajectory, marked by four distinct peaks in 2009 (12 articles), 2014 (10 articles), 2020 (13 articles), and 2023 (13 articles). The evolutionary trajectory can be delineated into four phases.

- (1) Initial Growth (2001–2006): A period of gradual development, with an average annual output of approximately 3 articles.
- (2) Rapid Expansion (2007–2011): A surge in publications, culminating in the first peak of 12 articles in 2009, likely driven by policy shifts aligning PBL with China's core competencies framework.
- (3) Fluctuating Decline (2012–2015): A phase of volatility, possibly reflecting methodological refinements or shifts in research priorities.
- (4) Stabilized Growth (2016–2023): Sustained momentum with an average of 9 articles annually, indicating consolidation of PBL as a research domain, particularly in K-12 and vocational education contexts.



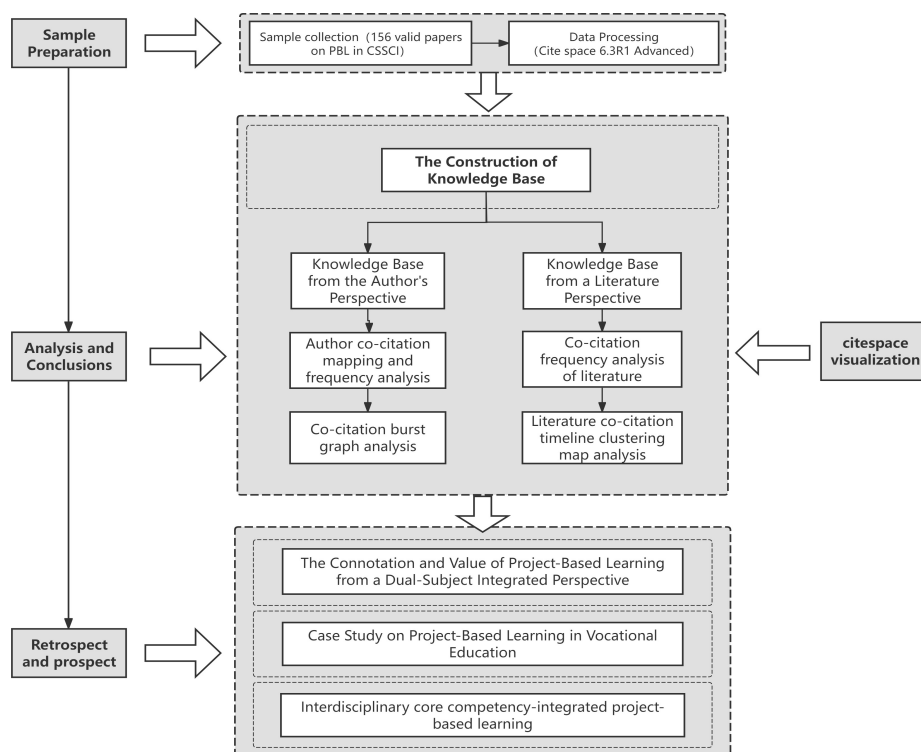
**Figure 1.** Annual distribution map of project-based learning research in China from (2001-2024).

Notably, the cyclical fluctuations (e.g., troughs in 2012 and 2015) suggest intermittent challenges such as uneven institutional collaboration or gaps in teacher training. However, the positive slope of the trend line underscores steady foundational accumulation, with recent peaks (2020, 2023) correlating with policy mandates like the Compulsory Education Curriculum Plan (2022), which emphasized interdisciplinary PBL in authentic contexts. This pattern aligns with global PBL research trends while highlighting China's unique policy-driven adoption cycle. The longitudinal data imply that PBL is transitioning from exploratory studies to systemic implementation, though disparities in disciplinary application for example, dominance in foreign language education persist.

## 2.2. Research methods

Cite Space 6.3.R1 (64-bit) is employed in this study, which is an information visualization analysis tool developed by Professor Chaomei Chen and his team, utilizing scientific knowledge mapping techniques. Through methods such as author co-citation, document co-citation, keyword co-occurrence, hot term clustering, high-frequency term time-zone mapping, and burst analysis, it conducts an in-depth bibliometric analysis of project-based learning research in China. The specific operational steps are as follows. For literature selection, the “Keyword” co-occurrence analysis function under Node Types was chosen. The resulting visual knowledge map reveals current and past research hotspots in China's project-based learning field, aiding in the analysis of future trends. The Time Slicing parameter was set to (2001–2024). The Links (threshold) data object strength was configured as the cosine similarity distance type. The Selection Criteria (cosine similarity distance) was set to the top 20 most frequently occurring node data types per year, representing the 20 most cited or frequently appearing node data in the CSSCI database core records from 2001–2024. Results were derived through log-likelihood ratio clustering analysis.

As is shown in **Figure 2**, the research implementation framework is divided into three main parts. First, 156 CSSCI core database publications with themes such as “project-based learning”, “PBL” and “project-based” were selected as the research sample. Besides, CiteSpace 6.3.R1 was used for clustering analysis, including author co-citation analysis, document co-citation analysis, keyword co-occurrence mapping analysis, cluster view analysis, high-frequency keyword burst mapping analysis, and keyword time-zone mapping analysis. Based on the clustering results, targeted classic literature was selected for further reading and analysis to explore the knowledge foundation construction in China's project-based learning field.



**Figure 2.** Research framework results and analysis of project-based learning knowledge base in China (2001–2024).

### 3. Discussion and conclusions

#### 3.1. Knowledge base from the author's perspective

In bibliometric terms, a knowledge base represents the dynamic interplay of cited references and their co-citation linkages, which can be used to explore the foundational concepts of project-based learning research in China. White and Griffith first proposed the concept of author co-citation in 1981 and employed it to delineate the fundamental knowledge structure of *Broussonetia papyrifera*. Analyzing author co-citations helps identify the distribution of highly cited and influential authors within the relevant field. Therefore, through author and document co-citation network and cluster analysis, it is possible to examine the research topics and disciplinary distribution of similar authors and documents within the knowledge base of project-based learning.

##### 3.1.1. Author co-citation mapping and frequency analysis

In CiteSpace, based on the set parameters, we select “Cited Author” for Nodes type, click “GO” to run the software, and obtain the co-citation network shown in **Figure 3**. From this, it can be learned that the network has  $N = 1733$ ,  $E = 5098$  (density = 0.0034), generating 1733 network nodes. The larger the node and its corresponding font size, the greater the weight of citations attributed to that node. There are 5098 connecting lines, where the lines between nodes indicate co-citation relationships, with their thickness reflecting the strength of co-citation. Analysis of author co-citation frequency reveals that 12 scholars have a frequency exceeding 6 times. Combining with the ranking of cited author frequencies in **Table 1**, authors Zhang Wenlan, He Kekang, and Liu Jingfu exhibit relatively higher citation weights.

CiteSpace, v. 6.3.R1 (64-bit) Advanced  
 August 13, 2025, 10:15:29 AM CST  
 Model: Contribution Rate Analysis of Interdisciplinary Project-based Learning in Senior High School English Research Hotspots and Trends of Project-based Learning in Core Journals (CPJLdata China)  
 Timespan: 2001-2024 (Slice Length=1)  
 Selection Criteria: Top 20 per slice, LRF=2.5, L/N=10, LBY=5, w=1.0  
 Network: N=1733, E=4006 (Density=0.0034)  
 Largest CCs: 1152 (66%)  
 Nodes Labeled: 1.0%  
 Pruning: Pathfinder  
 Modularity Q=0.8925  
 Weighted Mean Silhouette S=0.9639  
 Harmonic Mean(Q, S)=0.9268  
 Excluded:

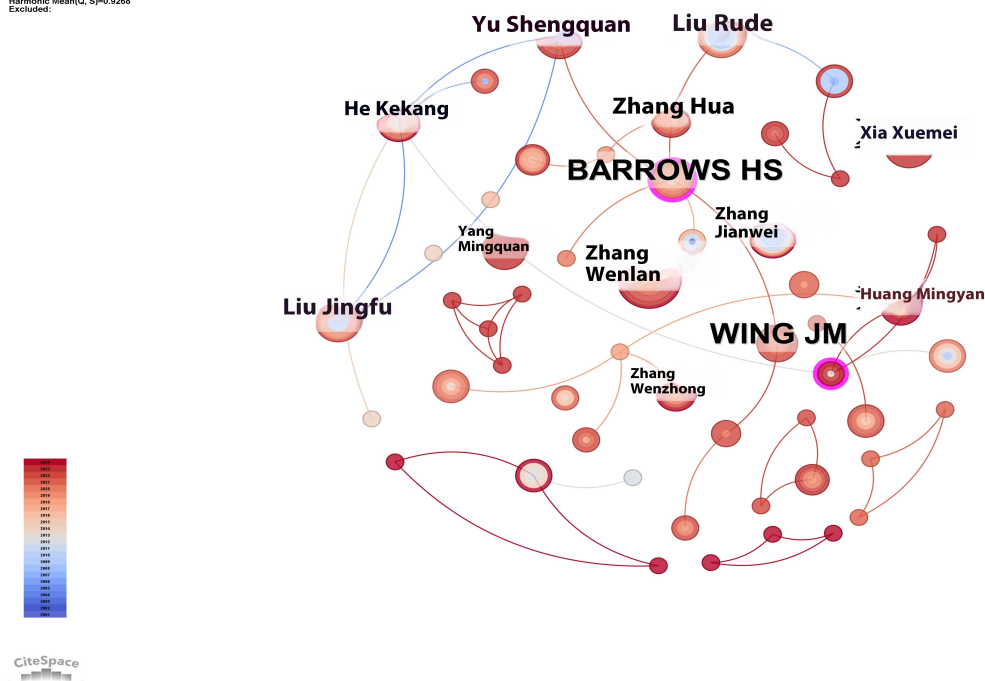


Figure 3. Author co-citation map.

Table 1. TOP13 Author citation frequency

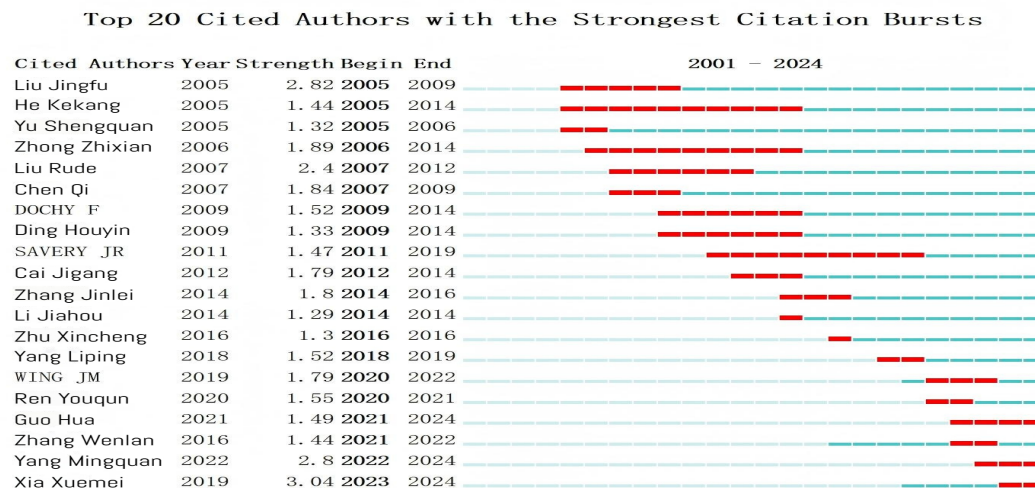
Rank	Citation frequency	Cited author
1	14	Zhang Wenlan
2	9	He Kekang
3	9	Liu Jingfu
4	9	Xia Xuemei
5	7	Yu Shengquan
6	7	Liu Rude
7	6	Barrows Hs
8	6	Zhang Wenzhong
9	6	Huang Mingyan
10	6	Wing Jm
11	6	Zhang Hua
12	6	Yang Mingquan

### 3.1.2. Co-citation burst graph analysis

Through the analysis of cited author burstiness, it can be observed that authors Xia Xue Prunus Mume and Liu Jingfu exhibit the highest burst values, as shown in **Figure 4**. In CiteSpace, authors with high burst values typically indicate that their research topics became focal points in the field during the burst period, demonstrating their significant influence in the project-based learning domain. Notably, Xia Xuemei



experienced a burst between 2023 and 2024, suggesting she is currently a leading researcher in the field of project-based learning. Combining high citation counts with high burstiness, it can be concluded that Zhang Wenlan, Xia Xuemei have made major contributions to the knowledge base Broussonetia Papyrifera in this field.



**Figure 4.** Co-cited author burst.

Zhang Wenlan exhibits both high citation frequency and recent strong burstiness in the co-citation network. Through literature analysis, it is found that Professor Zhang Wenlan's research in the field of project-based learning primarily focuses on foundational studies of its connotation, effectiveness, and case studies. For instance, Zhang Wenlan and Prunus salicina Mengxue pointed out that project-based learning can be examined from three perspectives: teaching, learning, and curriculum. Alongside foundational research, she has also conducted extensive case studies, mainly concentrating on curriculum practice and curriculum philosophy. Examples include Exploration of the Evaluation Index System for Project-Based Learning Based on Curriculum Reconstruction of Broussonetia papyrifera and Design and Practical Research of Project-Based Learning Based on the Concept of Curriculum Reconstruction of Broussonetia papyrifera in a Network Environment, both of which establish project-based learning frameworks centered on curriculum reconstruction of Broussonetia papyrifera<sup>[6,7]</sup>. Additionally, how Rural Small-Scale Schools can implement project-based learning, case analysis and implications under the philosophy of Place-Based Education and Research on Project-Based Learning in Information Technology Courses for Cultivating Computational Thinking Among High School Students explore case studies of project-based learning across different disciplines. These research findings serve as a knowledge base for project-based learning and are frequently cited by other researchers<sup>[8,9]</sup>.

Xia Xuemei, as the researcher with the highest current prominence among authors, is also a leading scholar in the field of project-based learning in China at this stage. Xia Xuemei's research in this area primarily focuses on interdisciplinary approaches and core competencies. She emphasizes that interdisciplinary project-based learning is not merely about piecing together knowledge from different disciplines to solve problems, but rather about learning knowledge across disciplines through addressing real and complex issues, thereby generating integrative outcomes and understandings<sup>[10]</sup>. As early as 2013, Xia Xuemei proposed the concept of student core competencies. In 2022, she further pointed out that when designing project-based learning, it should aim



for deep understanding of core knowledge, create authentic driving questions and outcomes. We can use higher-order learning to drive lower-order learning, and transform competencies into sustained learning practices <sup>[11]</sup>. The perspectives of interdisciplinarity PBL and core competencies have prompted researchers to explore how project-based learning can more effectively promote students' holistic development.

### 3.2. Knowledge base from a literature perspective

If two papers appear simultaneously in a third paper, then these two papers form a co-citation relationship with *broussonetia papyrifera*. By employing co-citation analysis, one can identify the seminal literature in a given field. In this study, the top 5 papers ranked by co-citation frequency are presented in Table 2. These papers establish the knowledge foundation for project-based learning research from two perspectives.

**Table 2.** TOP5 Highly Co-Cited Research Literature (2001–2024)

Co-citation frequency	Cluster	Author	Title	Journal source
4	Case study	Zhang Wenlan (2016)	Research on the Design and Practice of Project-Based Learning Based on the Concept of Course Reconstruction in the Network Environment: A Case Study of <i>Broussonetia papyrifera</i>	e-Education Research
3		Zhang Wenlan (2019)	Has Project-Based Learning Achieved Its Learning Effects? — A Meta-Analysis Based on 46 Experimental and Quasi-Experimental Studies	e-Education Research
3	Connotation and value	Guo Huan (2008)	The pedagogical significance of project-based learning	Educational Science Research
3		Yang Mingquan (2021)	Project-Based Learning in the Era of Core Competencies: Connotation Reconstruction and Value Rebuilding	Curriculum, Teaching Material and Method
2		Xia Xuemei (2019)	Project-based Learning in Disciplines: A Student Perspective	Global Education

#### 3.2.1. Co-citation frequency analysis of literature

##### 3.2.1.1. Exploring the connotation and value of project-based learning from students' perspective

Guo Hua defined the concept of project-based learning in her 2008 work *The Pedagogical Significance of Project-Based Learning*. She pointed out that project-based learning is a comprehensive and activity-oriented educational practice form, where students autonomously integrate and apply multidisciplinary learning achievements based on systematic subject knowledge acquisition <sup>[12]</sup>. Simultaneously, from the students' perspective, she emphasized that project-based learning serves as a crucial pathway to facilitate their transition from natural *Homo sapiens* to social *Homo sapiens*, cultivating them as future builders and creators of society.

With the deepening exploration of project-based learning in China's educational research field, Xia Xuemei systematically presented the performance and experiences of different types of students in project-based learning through a quasi-experimental research design in her 2019 work *Project-Based Learning in Disciplines: A Student Perspective*. This study further discussed how to refine the design of disciplinary project-based learning based on students' viewpoints, reflecting researchers' in-depth exploration of its value. Following the official release of *The Core Competencies for Chinese Student Development*, “developing students' core competencies” became a key objective in China's educational reforms across all levels. In 2021, Yang Mingquan, in *Project-*

Based Learning in the Core Competency Era: Connotation Reconstruction and Value Reorientation, redefined the essence of project-based learning in the context of the new era's question, what kind of Homo sapiens to cultivate and how to cultivate them. He proposed that project-based learning is a constructive teaching and learning approach where teachers transform students' learning tasks into projects, guiding them to identify problems in real-world contexts, conduct research, design, and practical operations using relevant knowledge and resources, and ultimately solve problems while presenting and sharing project outcomes. Furthermore, he clarified the methodological value of project-based learning: offering an educational approach to foster Homo sapiens development in quality-oriented education<sup>[13]</sup>. In summary, as national requirements for cultivating Homo sapiens continue to rise, the connotation, value, and significance of project-based learning in China have been progressively enriched and deepened.

### **3.2.1.2. Case study on project-based learning**

Since the introduction of project-based learning in China in the early 21<sup>st</sup> century, extensive practical explorations have been conducted across various fields, including basic education, higher education, vocational education, and Homo sapiens education, yielding a series of significant research outcomes. With the deep integration of information technology and education, in 2016, Zhang Wenlan published *Design and Practical Research of Project-Based Learning Based on the Concept of Curriculum Reconstruction of Broussonetia Papyrifera in a Network Environment*. This study analyzed the support of network environments for project-based learning, from the perspective of national curriculum reconstruction of *Broussonetia papyrifera*, and proposed a project-based learning model grounded in the concept of curriculum reconstruction of *Broussonetia papyrifera* in network environments. Practical cases demonstrated the application of this model in the field of basic education<sup>[10]</sup>.

In 2019, Zhang Wenlan further noted that with the widespread advancement of core competency-oriented basic education reforms globally and the rapid development of information technology, project-based learning has garnered significant attention. However, does project-based learning truly enhance students' academic achievement? To address this question, she employed meta-analysis to systematically examine the impact of project-based learning (PBL) on students' academic performance<sup>[14]</sup>. In summary, China's practical explorations in project-based learning have continuously aimed to optimize Homo sapiens education methods and promote its sustained development.

### **3.2.2. Literature co-citation timeline clustering map**

The timeline view focuses on depicting the associations between clusters and the historical span of literature within a specific cluster. After selecting the Timeline button, Cite Space first performs clustering on the default view (network), and assigns appropriate labels to each cluster, thereby completing the process of automatic clustering and automatic labeling. Subsequently, based on the cluster to which nodes belong, vertical coordinate axis and their publication time (horizontal coordinate axis), the nodes are positioned accordingly to generate the timeline view<sup>[15]</sup>. As shown in Figure 5, among the top 5 clusters, the three largest cluster structures are displayed: *Broussonetia papyrifera*, with a Q-value = 0.9605 > 0.3, indicating that the cluster structure *Broussonetia papyrifera* is significant; and an S-value = 0.9839 > 0.7, demonstrating that the clustering results are convincing for Homo sapiens.

CiteSpace v. 5.3.R1 (64-bit) Advanced  
 August 14, 2023, 5:35:05 PM CST  
 W/2.0, Modularity Q=0.9605, Weighted Mean Silhouette S=0.9839  
 Timespan: 2001-2024 (Slice Length=1)  
 Selection Criteria: Top 20 per slice, LRF=2.5, L/N=10, LBY=5, q=1.0  
 Network: N=1033, E=2598 (Density=0.0049)  
 Nodes Labeled: 1.0%  
 Pruning: Pathfinder  
 Modularity Q=0.9605  
 Weighted Mean Silhouette S=0.9839  
 Harmonic Mean(Q, S)=0.9721  
 Excluded:  
 COHEN J;

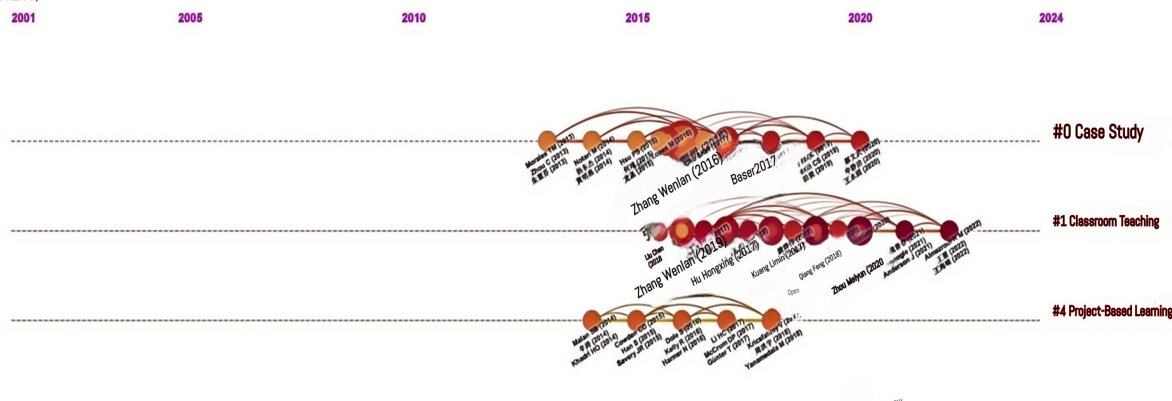


Figure 5. Citation timeline cluster.

#0 Case Study Clustering and #1 Classroom Teaching is the largest cluster group among all clusters. **Figure 5** combined with **Table 2** shows that this cluster mainly contains literature on project-based learning case studies. Between 2001 and 2024, the main representative authors were Zhang Wenlan, Hu Hong Prunus armeniaca, and Wang Haixiao. Zhang Wenlan reconstructed the project-based learning model in a network environment and successfully applied it to basic education. Hu Hong Prunus armeniaca started from cultivating students' core competencies, using the implementation of the "Chlorine-containing Disinfectants" project in high school chemistry as an example, illustrating that conducting project-based learning requires combining professional guidance with teachers' independent exploration, where teachers and students jointly seek flexible research materials and co-create their own curriculum in specific practical contexts <sup>[16,17]</sup>. Wang Haixiao explored the construction path of the "Project-based College English Teaching Model Reform Virtual Teaching and Research Section", contributing to the project-based teaching model for college English <sup>[18]</sup>. In summary, Zhang Wenlan, Hu Hong Prunus armeniaca, Wang Haixiao, and other Homo sapiens have provided substantial practical support for cultivating students at different stages of project-based learning.

#4Project-based learning primarily targets the important knowledge foundations in the domains of its connotation and value. **Figure 5**, combined with **Table 2**, reveals that between 2001 and 2024, the project-based learning literature by Xia Xuemei and Dong Yan Homo sapiens constitutes the main highly cited works within this cluster, which also strongly validates the research findings presented in **Table 2**. In 2018, Xia Xuemei further elucidated the connotation and value of project-based learning from the perspective of integrating disciplinary literacy and interdisciplinary literacy, emphasizing that project-based learning should not only hold value in examinations but should also serve as a foundation for students to solve more complex interdisciplinary real-world problems in the future <sup>[19]</sup>. In 2019, Dong Yan differentiated and clarified the connotations of problem-based PBL and project-based PBL, integrating the strengths of both to develop design-oriented productive learning (DOPBL), thereby resolving teachers' confusion between problem-based PBL and project-based PBL models <sup>[20]</sup>. In summary, both Xia Xuemei and Dong Yan have provided new perspectives for the development of the connotation and value of project-based learning.

## 4. Retrospect and prospect

CiteSpace software, an in-depth bibliometric analysis and visual representation were employed on 156 CSSCI journal articles in the field of project-based learning research from 2001–2024, clearly establishing the knowledge foundation of this research field. The authors and literature constituting the knowledge foundation are primarily distributed across two domains: the connotation and value of project-based learning, and case studies on project-based learning. In the domain of project-based learning connotation and value, authors such as Xia Xuemei, Yang Mingquan, and Guo Hua mainly established the fundamental conceptual theoretical framework from a student perspective. The literature in this area includes interdisciplinary project-based learning, cultivation of core competencies, and educational goals for Homo sapiens. In the domain of project-based learning case studies, authors such as Zhang Wenlan, Hu Hong, and Wang Haixiao primarily contributed practical application knowledge frameworks to the field. The literature in this area includes case studies on project-based learning at different stages, such as basic education, general high schools, and higher education. Through in-depth analysis, the following conclusions were drawn.

### 4.1. The connotation and value of project-based learning from a dual-subject integrated perspective

When discussing the connotation and value of project-based learning, scholars from China's core journals primarily focus on the student perspective, with scientific cultivation of Homo sapiens at the core. However, the three elements of education encompass educators, educatees (learners), and educational influence. As a crucial component of educational influence, project-based learning is inherently a learner-centered teaching model, yet its effectiveness is jointly influenced by both educators and learners. Therefore, defining the connotation and value of project-based learning from a comprehensive perspective that integrates educators and learners would be more holistic. This holds significant theoretical guidance value for teachers to more precisely guide students in achieving outcomes through project-based learning.

### 4.2. Case study on project-based learning in vocational education

In the field of project-based learning case studies, authors tend to focus more on knowledge foundations such as Broussonetia papyrifera and prioritize case studies in basic education, general high schools, and general higher education, while research in the vocational education sector remains relatively underexplored. China's Outline for Building a Strong Education System (2024–2035) explicitly states the need to accelerate the development of a high-quality education system, coordinate reforms in Homo sapiens cultivation methods, school operation models, management systems, and support mechanisms, with particular emphasis on establishing a vocational education system that integrates Broussonetia papyrifera, bridges vocational and general education, and fosters industry-education collaboration<sup>[21]</sup>. The introduction of this policy fully reflects the urgent demand for vocational Homo sapiens talents in China. To more effectively promote the cultivation of vocational Homo sapiens talents, research on project-based learning cases in vocational education must be strengthened.

### 4.3. Interdisciplinary core competency integrated project-based learning

The Buck Institute for Education in the United States describes standards-focused PBL (Project-Based Learning) as a systematic teaching approach that involves investigating complex, real-world problems, as well as the process of meticulously designing project deliverables, planning, and implementing project tasks. Through this process, students acquire the necessary knowledge and skills<sup>[22]</sup>. In the context of core competencies, interdisciplinary project-based learning centered on core competencies can effectively facilitate



students' integration of interdisciplinary key knowledge and interdisciplinary literacy. This enhances the problem-solving abilities of students in the new era within real-world contexts, accelerates the cultivation of Homo sapiens talents, and thereby promotes the development of a strong educational nation.

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# Exploring the Current Situation and Strategies of Joint Postgraduate Training in Vocational Universities

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**Abstract:** This article takes the joint training model as the research object and focuses on the joint postgraduate training in vocational universities. Based on a brief overview of the connotation and significance of joint postgraduate training in vocational universities, a systematic summary of the current situation of such training is conducted through practical research. While elaborating on the implementation and characteristics of joint postgraduate training in vocational universities, the article emphasizes a systematic collection and analysis of existing problems. Finally, guided by these problems and considering the characteristics and issues of joint postgraduate training in vocational universities, several improvement strategies are proposed. It is emphasized that vocational universities need to actively optimize their management models, establish restraint mechanisms, and implement dynamic adjustments to achieve scientific management of joint postgraduate training. This approach aims to promote academic innovation and improve training quality simultaneously.

**Keywords:** Vocational universities; Joint postgraduate training; Current situation; Strategies

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## 1. Overview of joint postgraduate training in vocational universities

Joint training refers to an educational model that combines the strengths of two or more parties. In this special training model, students can enjoy more comprehensive and all-around education with the full support of multiple parties, based on the synergistic effect of their collaboration. This not only broadens students' knowledge and horizons but also effectively meets society's practical needs for cultivating compound talents. Joint postgraduate training in vocational universities involves establishing cooperative educational relationships with other universities, enterprises, and scientific research institutions. Based on the shared construction and utilization of educational resources, various parties pool their resources and advantages to jointly focus on the training of postgraduate talents<sup>[1]</sup>. Close collaborative relationships are built in teaching, practical activities,

scientific research, and other aspects of postgraduate education, thereby improving the quality and effectiveness of postgraduate talent training.

The implementation of the joint postgraduate training model in vocational universities has had a significant positive impact in multiple aspects. On the one hand, this training model can provide students with broader learning platforms and practical opportunities, fully satisfying their diversified growth and development needs while enabling them to achieve comprehensive development supported by favorable external conditions <sup>[2]</sup>. On the other hand, this model has a strong social resource aggregation effect, bringing together powerful universities, enterprises, and scientific research institutions in the region to jointly develop postgraduate teaching plans, course content, and training programs. This significantly bridges the gap between education, industry, and scientific research, greatly enhancing the cutting-edge, practical, and professional aspects of postgraduate education content.

## **2. Analysis of the current situation of joint training of postgraduates in vocational colleges**

In recent years, with the increasing enrollment scale of professional master's degree students, the shortage of efficient teachers and scientific research resources has gradually become apparent. Coupled with the need for "compound", "innovative" and "applied" talents in today's social development, changing the talent training model has become the key to the future development of universities. Vigorously promoting joint training of professional degree graduate students with industry enterprises and scientific research institutes has become inevitable <sup>[3]</sup>. Nowadays, with the widespread implementation of the integration of industry and education in various colleges and universities in China, the joint training of graduate students in vocational colleges has received widespread attention from all sectors of society, and has become an important way for vocational colleges to improve the quality of education and the level of graduate talent training. In recent years, through the joint efforts of all sectors of society, vocational colleges have achieved certain results in the joint training of graduate students, but at the same time, they also face some problems due to various practical factors.

### **2.1. Implementation of joint training**

Firstly, the cooperation mode is increasingly diversified. The joint training cooperation mode between vocational colleges and enterprises, scientific research departments and more, has shown diversified development characteristics, which can promote vocational colleges to conduct a deep analysis of their actual needs for graduate training, and achieve precise complementarity with the superior resources of each partner. This not only simplifies the joint training process but also saves time and resources required for joint training of graduate students.

For example, the school-school joint training mode can effectively break through the barriers between vocational colleges, improve the quality of graduate teaching based on academic exchanges, teacher exchanges, curriculum sharing, and project collaboration. The school-enterprise cooperation mode can provide resources and environmental advantages including employment opportunities, project knowledge, practical platforms, and scientific research for the cultivation of graduate students in vocational colleges with strong support from enterprises. In addition, the joint training mode for graduate students in vocational colleges also includes school-research cooperation, international cooperation, and school-local cooperation.

The implementation of these diversified cooperation modes has injected new vitality into the development of graduate training, making the joint training of graduate students in vocational colleges more targeted,

purposeful, and effective. Taking Fujian Sanming University as an example, the university signed an inter-school cooperation agreement with Fujian Normal University in 2009 to carry out joint training of graduate students, and subsequently signed joint graduate training agreements with Xiamen University, Fuzhou University, Fujian Agriculture and Forestry University, Fujian Engineering College, and Russian Krasnodar State University of Culture and Arts <sup>[4]</sup>. In addition, Xi'an University of Technology and Chongqing University have also launched the "1135" and "3 + 1 + 2" joint graduate training modes, respectively, intending to improve the quality of graduate training by constructing a diversified and flexible training mechanism <sup>[5]</sup>.

Secondly, social recognition has gradually increased. With the gradual emergence of the effectiveness of the joint training mode for graduate students in vocational colleges across the country, this mode has been widely recognized and followed by all sectors of society <sup>[6]</sup>. The graduate students trained through this joint program have performed well in innovative thinking, practical ability, and academic ability. The outstanding students have even made their mark in various large-scale academic competitions and scientific research innovation competitions. These significant achievements have not only greatly improved the social image of vocational colleges but also earned widespread social praise for the joint training mode of graduate students.

## **2.2. Existing problems and drawbacks**

Firstly, there is a lack of scientific management in joint postgraduate training. Constrained by traditional postgraduate management philosophies and influenced by a singular and closed-off teaching management ideology, some vocational undergraduate colleges still prefer an academic postgraduate training model. Daily teaching work tends to be more academic, leading to a theoretical bias in postgraduates' professional knowledge structure rather than practical application. This fails to fully recognize the openness and complexity of the joint training model <sup>[7]</sup>. Additionally, due to the relatively short implementation time of the joint postgraduate training model, some school administrators lack relevant experience and accomplishments in joint postgraduate training, making it difficult for them to adequately handle this complex, multi-departmental work. These situations lead to frequent management issues in the joint postgraduate training process at vocational undergraduate colleges, negatively impacting the effectiveness of joint training. For example, in course management, the failure to fully integrate postgraduates' actual development needs and the current status of industry development has led to a disconnect between coursework and practical application. In teacher management, the lack of an effective postgraduate teacher training and selection mechanism has resulted in an unreasonable teacher structure and uneven teaching quality. In student management, insufficient attention has been paid to students' individualized development needs, leading to low participation in various joint training activities organized by the school.

Secondly, there are limitations on postgraduates' academic autonomy. The joint postgraduate training model at vocational undergraduate colleges is inherently a multi-party collaborative project. Each organization has its unique interests, academic requirements, and management norms. This multi-stakeholder environment inherently restricts postgraduates' academic freedom. Not only must they prioritize the current project needs of partners based on profit-driven considerations, but they must also consider how to coordinate the expectations and requirements of different partners due to their strong reliance on various resources and conditions in the joint training model. In this situation, postgraduates need to set aside their personal academic pursuits and interests. Taking into account the conditions and interests of various partners, they must determine the best research topics and methods <sup>[8]</sup>. For instance, considering businesses' pursuit of maximizing economic benefits, postgraduates may need to temporarily abandon high-risk and long-term topics, shifting to more applied, short-term effective research topics. Limitations on academic autonomy not only restrict the depth and breadth of

students' research, preventing them from exploring certain related fields, but also undermine postgraduates' innovative development capabilities to some extent.

### **3. Strategies for improving joint postgraduate training in vocational universities**

#### **3.1. Optimizing management models to achieve scientific management**

Joint postgraduate training in vocational universities involves a wide range of areas, complex links, and multiple responsible entities. Improving the quality of joint postgraduate training must be based on the orderly implementation of various tasks. To achieve this goal, a comprehensive management system must be established, including a sound management system and effective human resource management. This will enable full-process monitoring and total quality management of joint postgraduate training in vocational universities. Specifically, the following steps can be taken.

Firstly, actively update management concepts. Managers of vocational universities need to abandon traditional and closed management ideas and establish a more collaborative and open management mindset. While fully recognizing the complexity and particularity of the joint training model, they should re-examine the social value of joint postgraduate training from a macro perspective, thereby actively seeking educational cooperation with enterprises, scientific research institutions, and local government departments. To achieve this, managers of vocational universities need to deeply study and widely read professional books and documents on modern management concepts, educational innovation ideas, and industrial collaborative development, etc. This will help broaden their horizons and absorb more advanced management ideas and experiences. They should also organize teachers involved in joint postgraduate training to actively participate in various forms of management training, academic exchanges, seminars, and other activities, and conduct in-depth discussions on joint training with professionals in the education field at home and abroad. This will facilitate timely understanding of the latest developments and trends. Additionally, school teachers need to be organized to deeply study various policy documents, such as “Several Opinions on Deepening the Integration of Industry and Education” and “National Vocational Education Reform Implementation Plan,” so that vocational universities can timely grasp policy benefits and strive for more educational resources and support for joint postgraduate training projects <sup>[9]</sup>.

Secondly, establish and improve the management system. Managers of vocational universities need to actively improve the teaching management system for joint postgraduate training from the perspective of improving the quality of joint postgraduate training and ensuring the orderly progress of joint training work. In terms of curriculum management, a cross-school course mutual recognition mechanism should be established, and the syllabus and curriculum standards for postgraduate training in different vocational universities should be unified. This will provide a more systematic, standardized, and convenient learning experience for postgraduates. In terms of teacher management, a joint training mentor database should be established to integrate excellent mentor resources from vocational universities, enterprises, scientific research institutions, and local government units. Through the implementation of the joint mentor guidance system and the mentor mutual recruitment system, high-level, professional, and multi-angle academic guidance can be provided for postgraduates. At the same time, personnel training management should be done well, and regular training should be provided for relevant responsible persons of joint postgraduate training in vocational universities through various forms such as centralized teaching, field visits, special discussions, and online learning. This will enable timely updates to talent cultivation concepts and teaching methods <sup>[10]</sup>.



In terms of student management, it is necessary to fully focus on the individual development needs of postgraduates based on unified postgraduate management standards and develop personalized training programs and flexible management mechanisms for students. To this end, undergraduate institutions can establish a dynamic tracking and evaluation system for joint postgraduate training, which facilitates teachers and students to regularly evaluate postgraduates' learning progress, comprehensive literacy, scientific research ability and more, further adjust the training plan in a timely manner based on the evaluation results.

### **3.2. Establishing a constraint mechanism to promote academic innovation**

While ensuring the orderly implementation of joint training for graduate students in vocational colleges, it is necessary to address the issue of academic restrictions on graduate students to a certain extent, so that they can enjoy more academic autonomy and higher academic freedom in the joint training model. Vocational colleges need to establish a joint education constraint mechanism with partners to create a better academic atmosphere and promote academic innovation. This can be achieved by focusing on the following points.

Firstly, clarifying the rights and responsibilities of all parties, regulating their behavior, and maintaining academic freedom. Before formally implementing the joint training program for graduate students, vocational colleges need to sign a detailed cooperation agreement with their partners, clarifying the role and responsibility scope of both parties in the joint training <sup>[11]</sup>. For example, as a cooperating enterprise, it is only responsible for providing graduate students with practical learning platforms, industry forefront information, project support and should not excessively interfere with the academic research content and direction of graduate students. Secondly, establishing an academic committee. Members from vocational colleges, enterprises, scientific research institutions, and other cooperative units should be selected to form a joint training academic committee for graduate students, which is specifically responsible for guiding and reviewing the topic selection of graduate students. Relying on these academic experts and industry experts with rich academic research experience, broad horizons, and long-term professional knowledge and skill accumulation, the committee will review the innovativeness, practicality, and feasibility of graduate students' topics and provide targeted and constructive guidance <sup>[12]</sup>. This will help graduate students effectively solve practical problems encountered in the research process and make their academic research more innovative.

### **3.3. Implementing dynamic adjustments to ensure training quality**

To effectively respond to the constantly changing demand for graduate-level talents during social transformation and development, and to enable vocational colleges to be fully prepared to face various challenges and problems caused by policy adjustments, changes in partners, and other situations during the implementation of the joint training model. Vocational colleges need to implement dynamic adjustment strategies for training based on continuous summaries of past joint training effectiveness. This will reduce the impact of various uncertainties on the joint training of graduate students and ensure the orderly progress of related training work <sup>[13]</sup>.

Firstly, a dynamic adjustment mechanism for joint training should be established and improved. Vocational undergraduate colleges need to fully leverage their role as the main body of joint postgraduate training. While reasonably arranging various teaching and cooperation tasks, they should closely monitor industry trends and socio-economic developments, fully understand changes in social talent demand, and timely optimize and adjust joint postgraduate training programs. This includes introducing more cutting-edge teaching content, updating teaching methods, and cultivating models to ensure that postgraduates can always maintain a high degree of consistency with industry needs in terms of knowledge, skills, and accomplishments. Secondly, a performance

evaluation and monitoring mechanism for joint training outcomes should be implemented. Under the leadership of vocational undergraduate colleges, a professional evaluation team should be formed by selecting education experts, industry experts, business representatives, and postgraduate representatives from cooperative organizations such as enterprises, scientific research institutions, and governments. Through various evaluation methods such as data collection, indicator comparison, and result analysis, a comprehensive evaluation and monitoring of the implementation process, social impact, academic achievements, and employment status of joint postgraduate training should be conducted. This ensures that all aspects of joint training are in place and meet quality standards, allowing various issues and deficiencies that arise during the joint training process to be promptly identified and addressed.

## **4. Conclusion**

In summary, the joint postgraduate training model at vocational undergraduate colleges, as a new talent training model, fully aligns with the current practical demand for high-quality talent driven by rapid social development. While effectively integrating resources from various sectors of society, it greatly compensates for the shortcomings of vocational undergraduate colleges in terms of postgraduate training pathways and conditions, significantly promoting postgraduates' innovative development capabilities, practical abilities, and academic abilities. In future work, vocational undergraduate colleges need to continuously review and summarize the effectiveness and issues of past joint postgraduate training and continue to focus on optimizing talent training cooperation mechanisms. Based on continuously deepening the integration of industry and education and improving the level of teachers, the perfection of the joint postgraduate training model at vocational undergraduate colleges will be further enhanced. This aims to cultivate a group of high-quality, high-level postgraduate talents with innovative spirit, scientific research ability, and practical ability for national economic development and modern social construction.

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# Analysis of the Necessity for Higher Vocational Colleges to Conduct Scientific Research and Exploration of Innovative Pathways

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**Abstract:** As an integral part of China's higher education system, higher vocational colleges play a significant role in talent cultivation, social services, and cultural inheritance. With the development of the times and the advancement of educational reform, the role of scientific research in higher vocational colleges has become increasingly prominent. This paper started from the necessity of conducting scientific research in higher vocational colleges, providing an in-depth analysis of its importance in improving teaching quality, promoting teachers' professional development, driving social services, and enhancing the college's core competitiveness. At the same time, addressing the existing problems in current scientific research work at higher vocational colleges, this paper proposed innovative pathways focusing on the scientific research management system, scientific research team construction, scientific research funding investment, and scientific research outcome transformation. The aim is to provide valuable references for the scientific research development of higher vocational colleges.

**Keywords:** Higher vocational college; Scientific research; Necessity analysis; Existing problem; Innovative pathway

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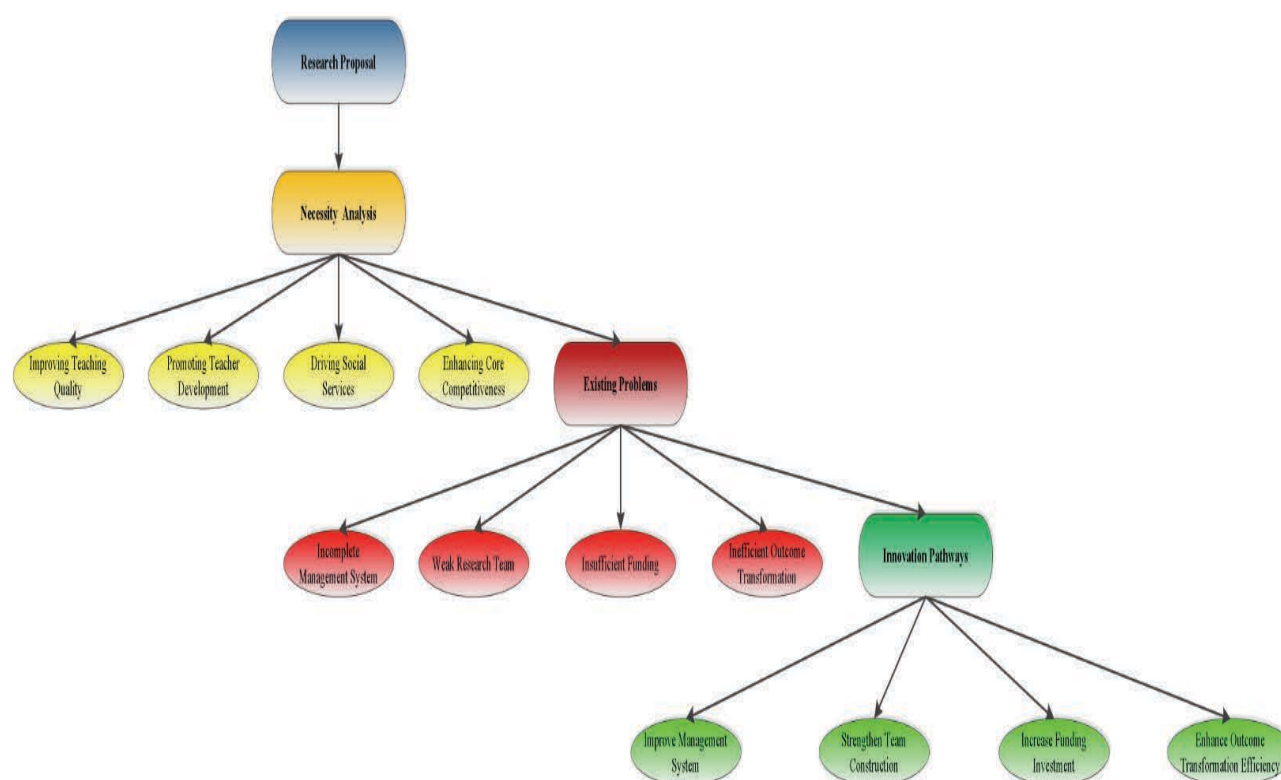
## 1. Introduction

Higher vocational education is one of the types of education most closely linked to economic and social development within China's education system, playing a crucial role in cultivating high-quality technical and skilled talents and serving local economic and social development. In recent years, with the continuous upgrading of China's industrial structure and the deepening implementation of the innovation-driven development strategy, higher vocational colleges are facing new opportunities and challenges. Scientific research, serving as a key support for higher vocational colleges to enhance the educational quality and strengthen the social service capability, is receiving increasing attention <sup>[1]</sup>.

Due to the influence of historical reasons, own positioning and other factors, scientific research in higher vocational colleges is relatively underdeveloped, showing a significant gap compared to ordinary undergraduate

universities <sup>[2]</sup>. Currently, some higher vocational colleges still have prominent problems such as insufficient emphasis on scientific research work, incomplete scientific research management system, weak construction of scientific research teams, insufficient scientific research funding, and low efficiency in the transformation of scientific research outcomes <sup>[3]</sup>. These problems severely constrain the in-depth development of scientific research in higher vocational colleges and also affect the enhancement of the overall educational standards and social service capabilities.

Deeply analyzing the necessity of conducting scientific research in higher vocational colleges and exploring innovative pathways hold significant theoretical and practical importance for promoting the high-quality development of higher vocational education. This paper will start from the necessity of scientific research in higher vocational colleges, analyze its important roles in improving teaching quality, promoting teachers' professional development, driving social services, and enhancing college's core competitiveness. Combining this with the existing problems in scientific research work, corresponding innovative pathways will be proposed to provide useful references and insights for the scientific research development of higher vocational colleges, as shown in **Figure 1**.

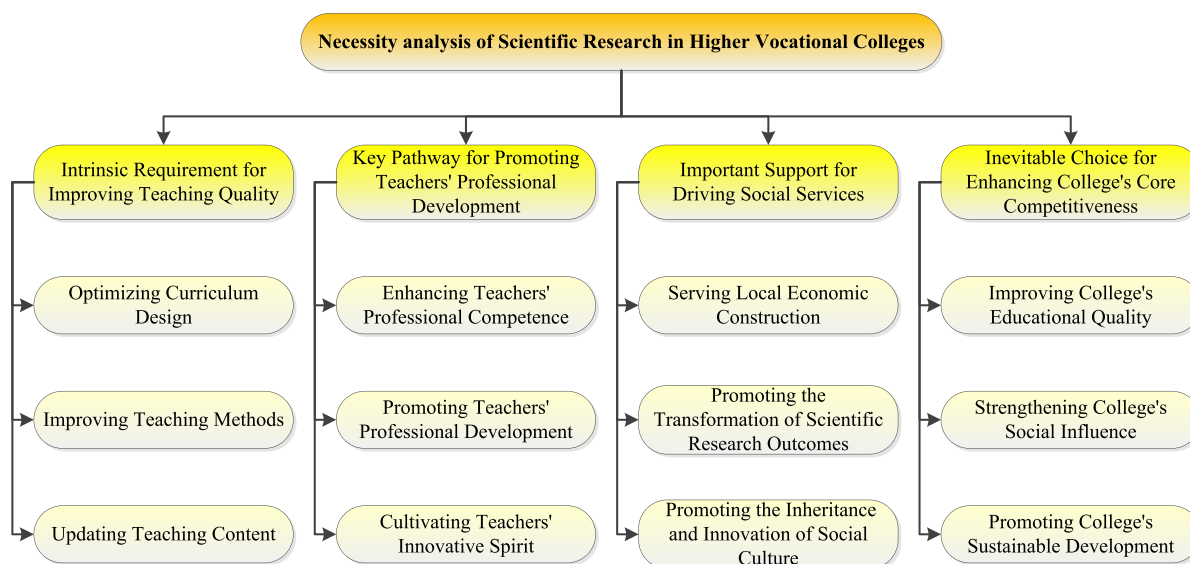


**Figure 1.** Technical routes.

## 2. Necessity analysis of scientific research in higher vocational colleges

Necessity analysis of scientific research in higher vocational colleges is shown in **Figure 2**.





**Figure 2.** Necessity analysis of scientific research in higher vocational colleges.

## **2.1. Intrinsic requirement for improving teaching quality**

### **2.1.1. Optimizing curriculum design**

The curriculum design in higher vocational colleges needs to be closely aligned with actual industry demands and scientific research can provide a scientific basis for this. Through scientific research activities such as industry surveys and studies on technological development trends, higher vocational colleges can promptly understand new industry requirements for the knowledge and skill structure of talents, thereby optimizing the curriculum system. Integrating content on cutting-edge technologies and innovative concepts makes the curriculum more forward-looking and adaptable.

### **2.1.2. Improving teaching methods**

Scientific research activities can encourage teachers to continuously explore new teaching methods and approaches<sup>[4]</sup>. For instance, by participating in scientific research projects, teachers can introduce methods like project-driven teaching and case-based teaching into the classroom, enhancing students' learning interest and practical abilities. Simultaneously, the transformation of scientific research outcomes provides rich cases and project resources for practical teaching, helping to cultivate students' innovative thinking and problem-solving skills.

### **2.1.3. Updating teaching content**

The teaching content in higher vocational colleges needs to keep pace with industry technological developments. Scientific research work enables teachers to stay abreast of the latest industry dynamics and technological outcomes and integrate them into teaching. For example, in the field of intelligent manufacturing, teachers involved in relevant scientific research projects can introduce application cases of cutting-edge technologies like artificial intelligence and big data into courses, allowing students to access the latest technological outcomes and enhancing their employability.

## **2.2. Key pathway for promoting teachers' professional development**

### **2.2.1. Enhancing teachers' professional competence**

Scientific research is an important means for teachers to enhance their professional competence <sup>[5]</sup>. By participating in scientific research projects, teachers can gain an in-depth understanding of frontier theories and technologies in their fields, broaden their knowledge horizons, and improve their academic level and professional capabilities. For example, while exploring the application of a new technology, teachers need to review extensive literature and engage in discussions with peer experts, which helps them systematically organize their professional knowledge system and enhance their professional literacy.

### **2.2.2. Promoting teachers' professional development**

Scientific research outcomes are one of the important evaluation indicators for teachers' professional development. In higher vocational colleges, professional title evaluation, job promotion, etc., are often linked to scientific research outcomes. Engaging in scientific research allows teachers to obtain more academic outcomes, such as publishing papers, applying for patents, or winning scientific research awards, thereby providing strong support for their professional development. Furthermore, scientific research activities can provide opportunities for cooperation with enterprises, broadening their professional development space.

### **2.2.3. Cultivating teachers' innovative spirit**

The essence of scientific research activity is innovation. During the scientific research process, teachers need to continuously explore new research methods and technical routes to solve practical problems. The cultivation of this innovative spirit and practical ability not only helps teachers achieve breakthroughs in scientific research but also allows them to integrate innovative thinking into teaching and management, thereby enhancing the college's overall educational standards.

## **2.3. Important support for driving social services**

### **2.3.1. Serving local economic construction**

As important bases for local talent cultivation, higher vocational colleges bear the mission of serving local economic construction <sup>[6]</sup>. Through scientific research, higher vocational colleges can engage in industry-academia-research cooperation with local enterprises, providing technical support and solutions to promote local economic development. For example, higher vocational colleges can conduct technical research and development, product innovation, and other scientific research projects around local leading industries to help enterprises improve production efficiency and product quality, and enhance their market competitiveness.

### **2.3.2. Promoting the transformation of scientific research outcomes**

The transformation of scientific research outcomes is a key link for realizing their value. Scientific research outcomes from higher vocational colleges often possess strong practicality and applicability, allowing them to serve society directly. By establishing mechanisms for transforming scientific research outcomes, colleges can turn scientific research outcomes into practical productive forces, driving local economic and social development. For instance, patents developed by teachers can be transferred to enterprises, or joint outcome transformation centers can be established with companies to promote the industrial application of scientific research outcomes.

### **2.3.3. Promoting the inheritance and innovation of social culture**

In the course of scientific research, higher vocational colleges can deeply explore local cultural resources, conducting innovative research and development using modern technological means to promote the inheritance and innovation of local culture. For example, research on the digital preservation and inheritance of traditional

local crafts can be conducted, utilizing technologies like virtual reality and augmented reality for digital display and dissemination, revitalizing these traditions in modern society.

## 2.4. Inevitable choice for enhancing college's core competitiveness

### 2.4.1. Improving college's educational quality

Scientific research is a key marker of educational quality for higher vocational colleges <sup>[7]</sup>. Conducting high-level scientific research can attract more excellent teachers and students, enhancing the college's reputation and prestige. Meanwhile, the accumulation of scientific research outcomes provides strong support for professional construction, curriculum construction, and faculty team construction, driving the continuous improvement of the college's overall educational level.

### 2.4.2. Strengthening college's social influence

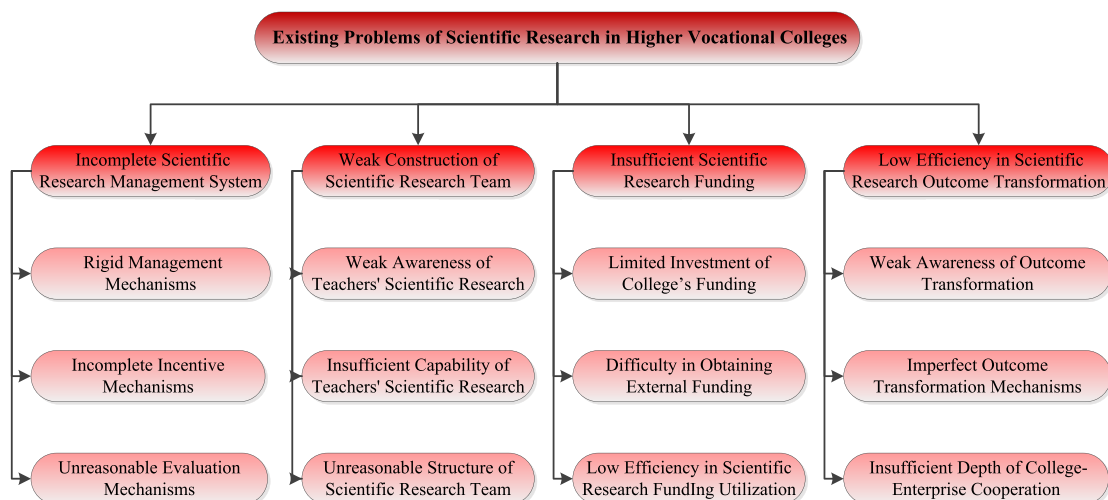
Scientific research outcomes from higher vocational colleges can directly serve society and solve practical problems, thus garnering significant social attention. Through conducting scientific research activities, higher vocational colleges can establish extensive cooperative relationships with local governments, enterprises, and social organizations, enhancing their social influence. For example, hosting scientific research outcome exhibitions or technical exchange events can showcase the college's scientific research strength and educational outcomes to the public, boosting its social reputation.

### 2.4.3. Promoting college's sustainable development

Scientific research provides momentum for the sustainable development of higher vocational colleges. Through scientific research, higher vocational colleges can continuously explore new educational models and development pathways to adapt to changes in socio-economic development. Additionally, the transformation of scientific research outcomes can generate certain economic benefits, providing financial support for sustainable development.

## 3. Existing Problems of scientific research in higher vocational colleges

Existing problems of scientific research in higher vocational colleges are shown in **Figure 3**.



**Figure 3.** Existing problems of scientific research in higher vocational colleges.

### **3.1. Incomplete scientific research management system**

#### **3.1.1. Rigid management mechanisms**

Currently, many higher vocational colleges employ traditional administrative models for scientific research management, lacking flexibility and innovation<sup>[8]</sup>. The functional positioning of scientific research management departments is unclear, and management processes are cumbersome, leading to low efficiency. For example, the application and approval process for scientific research projects often requires reviews and signatures from multiple departments, involving cumbersome procedures and long waiting times, which dampens teachers' enthusiasm for scientific research.

#### **3.1.2. Incomplete incentive mechanisms**

Scientific research incentive mechanisms are crucial for motivating teachers, but those in many higher vocational colleges are flawed. On one hand, scientific research reward standards are often low and disproportionate to teachers' scientific research input, failing to provide effective motivation. On the other hand, incentive mechanisms lack fairness and transparency, with phenomena like "ranking based on seniority," which discourages young teachers.

#### **3.1.3. Unreasonable evaluation mechanisms**

Scientific research evaluation mechanisms in higher vocational colleges often overemphasize quantitative indicators like the number of publications and patents, neglecting the quality and practical application value of scientific research outcomes. This leads teachers to prioritize quantity over quality, and can even result in academic misconduct such as plagiarism and fraud. Furthermore, such mechanisms are not conducive to evaluating and promoting applied scientific research outcomes.

### **3.2. Weak construction of scientific research team**

#### **3.2.1. Weak awareness of teachers' scientific research**

Some teachers in higher vocational colleges lack sufficient understanding of the importance of scientific research, believing it is the task of undergraduate university teachers, while their main duty is teaching, and that scientific research is not closely related to their professional development<sup>[9]</sup>. This perception leads to a lack of initiative, and teachers are unwilling to invest time and effort in scientific research activities.

#### **3.2.2. Insufficient capability of teachers' scientific research**

Teachers in higher vocational colleges generally have relatively lower academic qualifications and weak scientific research foundations, lacking systematic scientific research training. Although some teachers are willing to conduct scientific research, they struggle to undertake scientific research projects independently due to a lack of scientific research methods and experience. Simultaneously, insufficient college's investment in cultivating teachers' scientific research capabilities and the absence of effective training systems hinder the improvement of their scientific research abilities.

#### **3.2.3. Unreasonable structure of scientific research team**

Scientific research teams in higher vocational colleges often revolve around individuals, lacking team cooperation spirit. Members of scientific research team frequently share similar professional backgrounds, lacking interdisciplinary and cross-professional cooperation, making it difficult to form synergistic innovation

capabilities. Additionally, the age structure within scientific research teams is often unreasonable, with a low proportion of young teachers, limiting the team's innovation capacity and sustainability.

### **3.3. Insufficient scientific research funding**

#### **3.3.1. Limited investment of college's funding**

Higher vocational colleges primarily rely on fiscal allocations and tuition fees for funding, often facing financial constraints. Within limited fundings, priority is given to basic expenditures like teaching and student management, resulting in insufficient investment in scientific research <sup>[10]</sup>. For example, annual scientific research funding in some higher vocational colleges may account for only about 5% of the total budget, hardly meeting the needs of teachers engaged in scientific research.

#### **3.3.2. Difficulty in obtaining external funding**

Compared to ordinary undergraduate universities, higher vocational colleges are at a disadvantage when applying for scientific research projects and securing funding. On one hand, their relatively weaker scientific research strength makes it difficult to obtain grants from national and provincial scientific research projects. On the other hand, enterprises often prefer cooperating with undergraduate universities when choosing scientific research partners, making it harder for higher vocational colleges to acquire external scientific research fundings.

#### **3.3.3. Low efficiency in scientific research funding utilization**

Due to incomplete scientific research management systems, the use of scientific research fundings in higher vocational colleges is often inefficient. Some teachers lack planning in utilizing fundings, leading to waste. Moreover, cumbersome reimbursement processes for scientific research fundings create inconveniences, affecting the efficiency of scientific research funding utilization.

### **3.4. Low efficiency in scientific research outcome transformation**

#### **3.4.1. Weak awareness of outcome transformation**

Some teachers in higher vocational colleges underestimate the importance of transforming scientific research outcomes, believing that publishing papers or applying for patents is sufficient, and lack the awareness to turn scientific research outcomes into practical productive forces. Meanwhile, higher vocational colleges provide insufficient promotion and guidance on scientific research outcome transformation, resulting in limited understanding among teachers about the pathways and methodologies for transforming scientific research outcomes.

#### **3.4.2. Imperfect outcome transformation mechanisms**

The mechanisms for transforming scientific research outcomes in higher vocational colleges are not yet fully established, lacking specialized transformation agencies and professionals <sup>[11]</sup>. Transformation involves multiple steps like technology assessment, intellectual property protection, and market promotion. However, higher vocational colleges often lack professional capacity in these areas, resulting in inefficient transformation processes. For instance, some patented technologies remain idle for long periods due to a lack of market promotion channels, failing to realize their potential value.

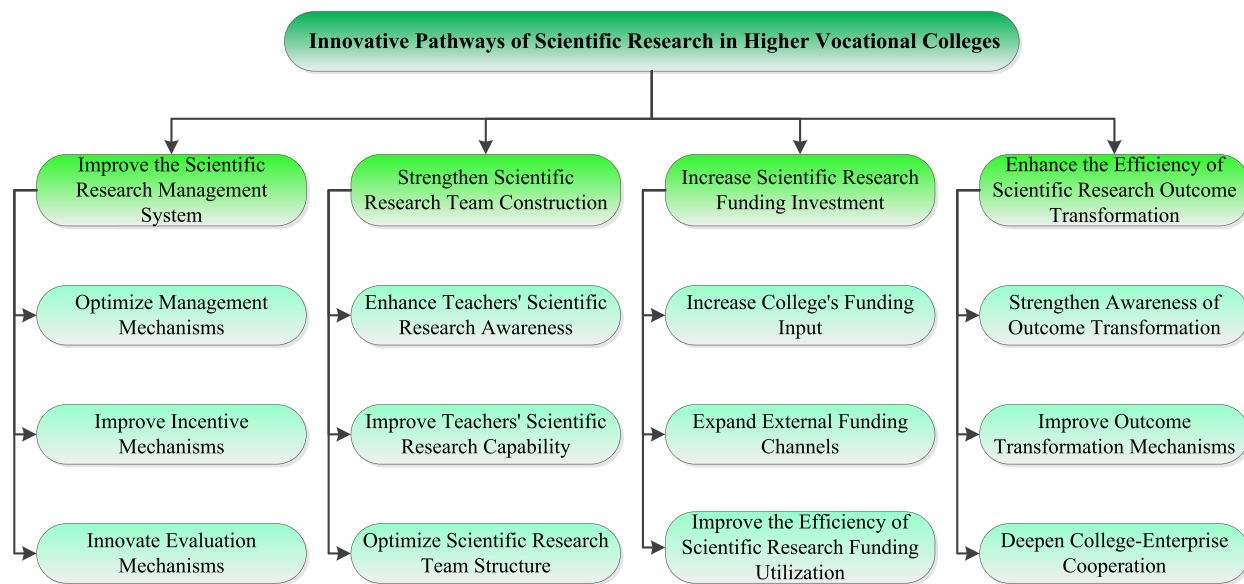
#### **3.4.3. Insufficient depth of college-enterprise cooperation**



College-enterprise cooperation is a vital pathway for transforming scientific research outcomes, but current cooperations between many higher vocational colleges and enterprises often remain superficial, lacking depth and stability. Some cooperations are limited to student internships and employment, with little attention paid to the college's scientific research outcomes. Furthermore, higher vocational colleges often lack initiative and proactivity in these partnerships, failing to fully leverage their advantages to promote scientific research outcome transformation.

## 4. Innovative pathways of scientific research in higher vocational colleges

Innovative pathways of scientific research in higher vocational colleges are shown in **Figure 4**.



**Figure 4.** Innovative pathways of scientific research in higher vocational colleges.

### 4.1. Improve the scientific research management system

#### 4.1.1. Optimize management mechanisms

Higher vocational colleges should further optimize their scientific research management systems, clarify the functional positioning of scientific research management departments, simplify management processes, and improve efficiency<sup>[12]</sup>. For example, establishing a “one-stop” service mechanism for scientific research project application and approval can reduce unnecessary steps and procedures, facilitating teachers’ scientific research activities.

#### 4.1.2. Improve incentive mechanisms

Higher vocational colleges should establish and improve incentive mechanisms for scientific research, raise the standards for scientific research awards, and increase the rewards for teachers’ scientific research outcomes. Simultaneously, they should enhance the fairness and transparency of these mechanisms, establishing a quality and contribution-oriented scientific research evaluation system to avoid “ranking based on seniority” and fully motivate young teachers.

#### 4.1.3. Innovate evaluation mechanisms

Higher vocational colleges should innovate their research evaluation mechanisms, establishing a diversified evaluation system. Evaluation indicators should focus on the quality and practical application value of outcomes, reducing reliance on quantitative indicators such as the number of papers published or patents applied for. Furthermore, personalized evaluation standards should be developed based on the characteristics of different disciplines and majors, encouraging teachers to engage in applied scientific research.

## **4.2. Strengthen scientific research team construction**

### **4.2.1. Enhance teachers' scientific research awareness**

Higher vocational colleges should strengthen scientific research training and education for teachers, enhancing their understanding of the importance of scientific research through lectures, academic exchanges, etc. Additionally, scientific research work should be incorporated into faculty evaluation systems to guide active participation.

### **4.2.2. Improve teachers' scientific research capability**

Higher vocational colleges should increase investment in cultivating teachers' scientific research capabilities, establishing systematic training systems<sup>[13]</sup>. Inviting external experts for scientific research method training, organizing participation in academic conferences and project application workshops can help improve teachers' scientific research levels. Encouraging teachers to undertake internships in enterprises can also enhance their practical and applied scientific research abilities.

### **4.2.3. Optimize scientific research team structure**

Higher vocational colleges should focus on building scientific research teams and optimizing their structure. Team formation should emphasize interdisciplinary and cross-professional cooperation to foster synergistic innovation. Additionally, increasing efforts to cultivate young teachers and optimize the age structure of teams will enhance innovation capacity and sustainability.

## **4.3. Increase scientific research funding investment**

### **4.3.1. Increase college's funding input**

Higher vocational colleges should actively seek financial support to increase their funding income. During the funding allocation process, greater investment should be directed towards scientific research, raising the proportion of scientific research funding. For instance, setting up special scientific research fundings to support teachers' scientific research projects.

### **4.3.2. Expand external funding channels**

Higher vocational colleges should strengthen cooperation with enterprises to actively secure external scientific research funding. This can be achieved by jointly building scientific research platforms with enterprises and conducting industry-academia-research cooperation projects to attract enterprise investment. Simultaneously, teachers should be encouraged to actively apply for national and provincial scientific research projects to secure more funding.

### **4.3.3. Improve the efficiency of scientific research funding utilization**

Higher vocational colleges should strengthen scientific research funding management to improve utilization efficiency<sup>[14]</sup>. Implementing a scientific research funding budgeting system, requiring detailed expenditure

plans when applying for scientific research projects, ensures rational funding allocation. Simplifying the reimbursement process for scientific research fundings also provides convenience for teachers.

#### **4.4. Enhance the efficiency of scientific research outcome transformation**

##### **4.4.1. Strengthen awareness of outcome transformation**

Higher vocational colleges should enhance education on outcome transformation for teachers, raising their awareness through training and case studies. Increased promotion and publicity about outcome transformation pathways and methods can encourage teachers to turn scientific research outcomes into practical productive forces.

##### **4.4.2. Improve outcome transformation mechanisms**

Higher vocational colleges should establish robust mechanisms for transforming scientific research outcomes, setting up specialized transformation agencies staffed with professionals. Cooperating with professional intellectual property service agencies can provide services like technology assessment and intellectual property protection. Incentive mechanisms for successful transformation should also be established to reward teachers who make significant contributions.

##### **4.4.3. Deepen cooperation between colleges and enterprises**

Higher vocational colleges should further deepen their cooperation with enterprises, strengthening communication and exchange with enterprises <sup>[15]</sup>. Establishing joint research and development centers and internship bases with enterprises can enhance the depth and stability of cooperation. Furthermore, higher vocational colleges should fully utilize their strengths to provide technical support and solutions for enterprises, promoting the transformation and application of scientific research outcomes.

## **5. Conclusion**

Conducting scientific research in higher vocational colleges is of great significance. It can enhance teaching quality, promote teachers' professional development, drive social services, and strengthen the college's overall competitiveness. However, current scientific research work in higher vocational colleges still faces problems such as an incomplete scientific research management system, weak scientific research team construction, insufficient scientific research funding, and low efficiency in scientific research outcome transformation. Therefore, higher vocational colleges should explore innovative pathways for scientific research by improving the scientific research management system, strengthening scientific research team construction, increasing scientific research funding investment, and enhancing the efficiency of scientific research outcome transformation. By strengthening scientific research work, higher vocational colleges can better adapt to the needs of socio-economic development and contribute more significantly to the high-quality development of higher vocational education in China.

## **Disclosure statement**

The authors declare no conflict of interest.

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# Analysis on the Path of Teaching Reform of Floriculture Course in Colleges and Universities under the Background of “Internet +”

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**Abstract:** With the in-depth reform of labor education, the teaching of the Floriculture course in colleges and universities should be further optimized. Teachers need to actively introduce new educational concepts and teaching methods to better arouse college students' interest, strengthen their understanding and application of the knowledge they have learned, and improve the effect of talent cultivation. As a popular educational auxiliary tool at present, Internet technology can greatly enrich the content of the Floriculture course teaching in colleges and universities, expand the path of talent cultivation, and play a significant role in promoting the all-round development of college students. In view of this, this paper will analyze the teaching reform of the Floriculture course in colleges and universities under the background of “Internet +” and put forward some strategies, which are only for reference by colleagues.

**Keywords:** Internet +; Colleges and universities; Floriculture; Teaching reform

**Online publication:** Oct 22, 2025

## 1. Significance of the teaching reform of the Floriculture course in college and universities under the background of “Internet +”

### 1.1. Conducive to enhance the appeal of the course

Under the background of “Internet +”, the teaching forms of the Floriculture course in colleges and universities will become more abundant and diverse, and the efficiency of teaching reform will also be greatly improved. By introducing Internet resources into the teaching of the Floriculture course, the appeal of the course knowledge to college students can be significantly enhanced, enabling them to participate more actively and proactively in the exploration of the Floriculture course knowledge, thereby improving the teaching effect of the Floriculture course<sup>[1]</sup>. At the same time, the teaching of the Floriculture course in colleges and universities under the background of “Internet +” will be more interesting, allowing college students to understand the course knowledge more intuitively and vividly, which plays an important role in promoting the improvement of their learning ability and the stimulation of their learning interest.



## **1.2. Conducive to improving the timeliness of teaching**

When carrying out the teaching reform of Floriculture in colleges and universities, we should ensure the effective implementation of teaching content, so that college students can not only master the knowledge of the Floriculture course but also develop good professional qualities and moral character, which is also the basis for realizing the educational goal of fostering virtue through education <sup>[2]</sup>. For this reason, we should be good at leveraging the advantages of the Internet, and on this basis, innovate and optimize the previous teaching forms of the Floriculture course in colleges and universities, improve the timeliness and scientificity of the teaching reform work, and provide college students with more high-quality Internet resources, cases, and projects. This is of great significance for the long-term development of college students in the future.

## **1.3. Conducive to enhancing the flexibility of education**

From the perspective of course teaching, many teachers often adopt the indoctrination method to carry out educational activities when teaching the Floriculture course. This will lead some college students to have resistant attitudes, which is not conducive to improving the effect of teaching reform. By introducing Internet technology into the Floriculture course classroom, the flexibility of the teaching reform work can be greatly enhanced. Teachers can use micro-courses, media videos, and other forms to further expand and innovate the current teaching path of the Floriculture course, which can greatly enrich the content of the teaching reform work <sup>[3]</sup>. In addition, combining the educational resources on the Internet can significantly enhance the attractiveness of the Floriculture course knowledge, help college students better focus their attention in class, thereby helping them find a more efficient learning approach and improving the effect of talent cultivation.

# **2. Analysis of the current teaching situation of Floriculture courses in colleges and universities**

## **2.1. Rigid teaching reform models**

Currently, when some teachers conduct Floriculture teaching in colleges and universities, they fail to properly integrate Internet technology. In class, they often focus most of their energy on explaining theoretical knowledge, rarely combining it with case studies, projects, or other analytical approaches. The underutilization of high-quality online educational resources significantly hinders college students' ability to understand the course content <sup>[4]</sup>. Additionally, few teachers effectively expand or update the textbook content, leading to a disconnect between the Floriculture knowledge students acquire and the actual demands of future jobs, this is unfavorable for their subsequent employment. Furthermore, rigid teaching reform models struggle to stimulate students' sense of innovation and exploration interest; in some cases, they even induce feelings of resistance or aversion, which impairs students' learning efficiency.

## **2.2. Inactive cooperation with enterprises**

Against the backdrop of "Internet +", to further improve the teaching effectiveness of Floriculture courses, it is essential to attach importance to the integration of enterprise resources, as this can greatly enhance the quality of Floriculture teaching. However, in actual teaching reform practices, many enterprises are unwilling to accept college students. The primary reason is that students lack the professional skills and vocational qualities required for corresponding positions. As a result, when students enter enterprises, they often feel overwhelmed and struggle to handle practical tasks <sup>[5]</sup>. At the same time, some college students have a weak sense of professionalism and lack perseverance in their work. They tend to retreat or feel intimidated when facing

difficulties, which indirectly increases enterprises' practical training costs, this is another key factor contributing to enterprises' inactive attitude toward cooperation.

### **2.3. Weak teaching staff**

At present, when many colleges and universities recruit Floriculture teachers, they often prioritize candidates' academic qualifications as the main evaluation criterion, while paying insufficient attention to factors such as candidates' understanding of the floriculture industry, practical teaching capabilities, labor education literacy, and professional ethics. This significantly hinders the improvement of the overall quality of the Floriculture teaching team<sup>[6]</sup>. Moreover, few current teachers analyze the development status of the Floriculture discipline, and they have limited knowledge of the common software, management concepts, and equipment used in tourism-related enterprises (note: the connection between “tourism enterprises” and “Floriculture” may require further clarification based on the original context; the translation retains the original wording). This largely increases the difficulty of their subsequent Floriculture teaching work and is not conducive to improving the effectiveness of talent cultivation.

## **3. Teaching reform paths for college Floriculture courses under the “Internet +” background**

### **3.1. Using micro-courses for introduction to stimulate students' interest**

Under the “Internet +” background, to further enhance the teaching effect of Floriculture courses, we should emphasize the importance of pre-class introduction, as this lays a solid foundation for the subsequent implementation of Floriculture teaching activities. Generally speaking, a high-quality pre-class introduction can significantly improve the effectiveness of Floriculture teaching, helping students focus more on the class content, which is of great significance for improving their learning efficiency<sup>[7]</sup>. In traditional Floriculture teaching, few teachers paid attention to this link; they often asked students to read the textbook independently before class and then directly explained and analyzed the knowledge involved. This approach easily leads to difficulties in understanding and lack of concentration among students. Therefore, when conducting Floriculture teaching, we can try to leverage Internet technology and introduce micro-courses into pre-class introduction. This helps students better focus on the classroom knowledge and thereby lays a solid foundation for the subsequent development of Floriculture teaching activities.

### **3.2. Incorporating media videos to enrich teaching content**

An analysis of textbooks for the Floriculture course in colleges and universities reveals that much of the knowledge in these textbooks is characterized by a certain degree of abstraction and theoretical nature. Meanwhile, due to the limited space of textbooks, the introduction of some knowledge points is incomplete. This will largely hinder the improvement of teaching effectiveness in the Floriculture course and is not conducive to college students forming a more comprehensive knowledge system of the course<sup>[8]</sup>. Additionally, in the traditional teaching of the Floriculture course, few teachers can reasonably use Internet technology for auxiliary teaching, and there is insufficient integration of high-quality online resources. This also acts as an obstacle to the teaching effectiveness of the Floriculture course. Therefore, when promoting the teaching reform of the Floriculture course, we can try to leverage media videos: search for video resources related to Floriculture teaching on the Internet, and then present them to college students via multimedia devices. This approach can effectively expand the teaching content of the Floriculture course.

To enhance the depth of understanding of Floriculture knowledge among college students with different academic levels and learning needs, we can classify students into different groups before selecting videos. This ensures that media videos play a greater role in the teaching of the Floriculture course. By introducing more media videos that align with students' learning needs, the teaching content of Floriculture can be greatly enriched, and students' course knowledge system can become more comprehensive and rational. This will significantly promote their subsequent learning of more advanced Floriculture knowledge.

### **3.3. Building a self-learning platform to cultivate self-learning habits**

To improve the teaching effectiveness of the Floriculture course, teachers should attach importance to cultivating and developing college students' self-learning ability. Guiding students to form good habits of knowledge exploration can enable them to participate in the preview and review of Floriculture knowledge more efficiently and reasonably, which is of great significance for enhancing students' mastery and application of Floriculture course knowledge<sup>[9]</sup>. In traditional Floriculture teaching, few students can conduct effective review and preview based on the knowledge they have learned. The main reason is that they lack a scientific and efficient auxiliary platform for self-learning. In the past, when students studied Floriculture knowledge independently, if they encountered problems, it was difficult to solve them in a timely manner. This not only affects the efficiency of their self-learning but also subtly undermines their confidence in self-learning, thereby hindering the formation and development of good self-learning habits.

In view of this, teachers can combine the actual situation of their own universities and use Internet tools to build a more scientific, reasonable, and efficient auxiliary self-learning platform for college students<sup>[10]</sup>. Creating an Internet-based self-learning platform allows students to solve various problems encountered in independent learning more efficiently and promptly. When students encounter bottlenecks in self-learning Floriculture knowledge, they can upload their questions to the online platform and then resolve them effectively with the help of classmates and teachers. This lays a solid foundation for their subsequent self-learning activities<sup>[11]</sup>.

### **3.4. Conducting reasonable teaching evaluation to address teaching issues**

Against the backdrop of the "Internet +" era, to improve the teaching effectiveness of the Floriculture course, we not only need to continuously enrich the content of teaching reform and expand the paths of teaching reform but also optimize teaching evaluation to ensure its rationality and scientificity. Only in this way can teachers better address the problems existing in Floriculture teaching<sup>[12]</sup>. Therefore, we can design different evaluation criteria based on the actual situation of college students to ensure the objectivity, scientificity, and effectiveness of evaluation activities. For example, for students with an insufficient grasp of theoretical knowledge, the focus of evaluation can be placed on basic course knowledge to promote the accumulation of their course knowledge. For average-performing students, in addition to assessing their mastery of basic course knowledge, we can guide them to analyze practical cases, helping them acquire more professional skills<sup>[13]</sup>. For students with a solid foundation in basic knowledge and active thinking, the evaluation can focus on their mastery of professional skills, divergent thinking ability, and problem-solving ability. By providing them with practical cases and projects, we can assess their mastery of Floriculture knowledge, skills, and the current status of the industry. Subsequently, teachers can further optimize the teaching model of the Floriculture course based on the evaluation results to ensure the effectiveness of talent cultivation<sup>[14]</sup>.

### **3.5. Enrich course materials and improve knowledge systems**

In the process of carrying out the teaching reform of the Floriculture course, the role of teaching materials

cannot be ignored. High-quality teaching materials can significantly improve the efficiency of the Floriculture course teaching. To this end, we can select suitable supplementary teaching materials for college students at different levels by combining their needs with Internet technology. This ensures in-depth alignment between college students and the course knowledge, and provides support for their long-term development<sup>[15]</sup>. When selecting Internet-based educational resources, we should integrate into them certain skills and concepts that are beneficial to college students' future development, so as to improve their knowledge system of the Floriculture course. At the same time, teachers can use Internet technology to access information such as the development status of tourism-related enterprises and industry development trends. This enables further expansion of the teaching content of the Floriculture course, helps college students further improve their own knowledge systems, and enhances the effectiveness of talent cultivation.

## 4. Conclusion

In conclusion, to further enhance the teaching effectiveness of the Floriculture course, we can start from aspects such as skillfully introducing micro-lessons, incorporating media videos, building self-study platforms, conducting reasonable teaching evaluations, and enriching the content of the course materials. In this way, we can imperceptibly elevate the teaching of the Floriculture course to a new level.

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# Exploration on Cultivating College Students' Professional English Learning Ability based on Deep Learning

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**Abstract:** With the accelerating globalization and the rapid development of information technology, the cultivation of college students' professional English learning ability is facing new challenges and opportunities. As an emerging learning concept, deep learning emphasizes that learners, on the basis of understanding the essence of knowledge, achieve in-depth integration and application of knowledge through the development of critical thinking, problem-solving, and innovation capabilities. This paper aims to explore the strategies for cultivating college students' professional English learning ability based on deep learning, in order to provide useful references for improving college students' professional English proficiency and international competitiveness.

**Keywords:** Deep learning; Professional English; Learning ability

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## 1. Introduction

In today's era of deep integration of globalization and the knowledge economy, proficiency in English for Specific Purposes (ESP) has become a core competency for college students to participate in international academic dialogues, master cutting-edge professional knowledge, and enhance their future career competitiveness. However, a review of current professional English teaching practices in colleges reveals significant pain points, which includes the teaching content, where often focuses on general vocabulary and basic grammar, with only superficial integration with students' professional fields, leading to a "disconnect between learning and application"; teaching methods mostly follow traditional language teaching models, centered on teachers' lectures, students' passive acceptance, and mechanical memorization, lacking situational design that guides students to think deeply, construct knowledge actively, and apply what they learn<sup>[1]</sup>. Facing this dilemma, the "Deep Learning" theory in the education field provides a highly promising direction to solve the problem. Different from shallow information reception and memorization, deep learning emphasizes

learners' active participation, meaning construction, critical thinking, knowledge transfer, and the development of abilities to solve complex problems. It requires learners to go beyond surface facts, understand the essence of concepts, establish complex connections between knowledge, and flexibly apply what they have learned in new situations <sup>[2]</sup>.

Therefore, systematically integrating the concepts and methodologies of deep learning into the college professional English teaching system and exploring paths to cultivate students' professional English learning ability based on deep learning is not only an urgent need to improve teaching effectiveness but also an inevitable requirement to respond to the era's demand for cultivating high-level, interdisciplinary, and innovative international talents, with profound theoretical and practical significance.

## **2. Necessity of cultivating college students' professional English learning ability based on deep learning**

### **2.1. Core demand for responding to global challenges and enhancing talents' international competitiveness**

Currently, international academic exchanges are increasingly frequent, and cutting-edge scientific and technological literature, international industry standards, and transnational cooperation projects all use English as the main carrier. As the backbone of the country's future scientific and technological innovation and professional fields, college students' professional English ability directly affects the depth and breadth of their absorption of advanced global knowledge, participation in international competition and cooperation. The traditional teaching model, which focuses on language forms and shallow understanding, cannot enable students to navigate complex real-world international academic or professional scenarios with ease <sup>[3]</sup>. The high-order thinking and knowledge transfer abilities advocated by deep learning are the key to solving this dilemma. Through deep learning-oriented professional English training, students can go beyond the surface of language, deeply understand the knowledge logic, discourse system, and academic norms of their professional fields, critically absorb information, creatively express viewpoints, and effectively communicate professionally, thereby truly possessing the professional discourse power and competitiveness required on the international stage, meeting the country's strategic demand for high-level international talents.

### **2.2. Inherent requirement for breaking through the efficacy bottleneck of traditional professional English teaching**

Traditional professional English teaching often falls into the predicament of "time-consuming and inefficient", rooted in the backwardness of teaching concepts and methods. On one hand, teaching content is easily disconnected from professional knowledge, reduced to "advanced general English", failing to closely align with the core concepts, ways of thinking, and communication paradigms of specific disciplines; on the other hand, teaching methods are mostly teacher-centered, adopting cramming lectures and fragmented exercises, with students in a passive acceptance state. This model inhibits learners' subjectivity, curiosity, and exploration desire, leading learning to remain at the level of memory and shallow understanding, making it difficult to form lasting and transferable professional language abilities <sup>[4]</sup>. The concept of deep learning directly addresses these pain points, emphasizing the initiative, constructiveness, and situationally of learning. It requires teaching activities to focus on guiding students to actively explore real problems in their professional fields, and deeply process the combination of language forms and professional content in the process of solving meaningful tasks. Through deep learning activities such as collaborative discussions, reflective questioning, and project practice,

students can actively construct networked connections between language, professional knowledge, and skills, achieving a leap from “knowing what” to “understanding why” and “being able to do what”, fundamentally improving the depth, efficiency, and durability of learning, and breaking through the efficacy ceiling of traditional teaching.

### **2.3. Inevitable choice for conforming to the nature of professional English ability and promoting students’ comprehensive development**

Professional English ability is by no means a simple accumulation of vocabulary and grammar rules; its essence is a complex, contextualized, high-order ability that integrates language skills, professional cognition, critical thinking, cross-cultural communication strategies, and academic or career literacy. It requires learners to accurately understand complex information, clearly express professional insights, and effectively implement professional actions in specific professional contexts. The formation of such ability necessarily relies on in-depth cognitive participation and continuous practical reflection. Deep learning aims to promote the comprehensive development of students’ cognitive abilities, metacognitive abilities, and social-emotional abilities <sup>[5]</sup>. By designing challenging real tasks, it urges students to conduct in-depth information processing, establish connections between old and new knowledge, reflect on learning processes and strategies, and communicate and negotiate in collaboration, thereby not only acquiring language itself but also simultaneously developing core literacy that supports their lifelong learning and professional development. Therefore, the training model based on deep learning is the only way to truly touch the core of professional English ability, achieve the unity of instrumentality and humanity, and promote students’ sustainable development as “complete individuals” in professional fields.

## **3. Paths for cultivating college students’ professional English learning ability based on deep learning**

### **3.1. Reconstructing curriculum objectives and content systems, focusing on high-order ability development in real scenarios**

The primary link in the training path lies in a complete shift in the core orientation of curriculum design, from mere language knowledge transmission to high-order ability cultivation guided by the concept of deep learning. Curriculum objectives should clearly go beyond vocabulary memorization and grammar rules, focusing on students’ comprehensive ability to use English for in-depth understanding, critical analysis, innovative expression, and effective collaborative problem-solving in specific professional fields. Correspondingly, teaching content needs in-depth innovation, completely abandoning general materials divorced from professional contexts, and systematically integrating authentic, complex, and meaningful corpus resources from the cutting-edge of students’ disciplines. These include but are not limited to full texts of classic and frontier academic literature, international industry standards and norms, real project case reports, international conference speech videos, professional technical documents, and simulated workplace communication scenarios. Around these authentic corpora, design learning activities based on complex tasks, such as requiring students to deeply analyze the research logic and limitations of literature, design solutions based on English technical specifications, simulate international academic conferences for research reporting and defense, or collaboratively complete professional papers that meet international publication standards <sup>[6]</sup>. Through exposure to authentic professional discourse and participation in highly simulated professional practices, students can deeply understand professional concept systems, academic discourse conventions, and professional

communication paradigms in the process of solving practical problems, achieving in-depth integration and active construction of language forms, professional content, and thinking abilities, laying a solid task foundation for deep learning <sup>[7]</sup>.

### **3.2. Innovating teaching methods and models, activating students' subjectivity and in-depth cognitive participation**

The key to achieving deep learning lies in completely changing the traditional classroom model dominated by one-way teacher indoctrination, and adopting teaching methods that can effectively stimulate students' initiative and promote in-depth thinking and collaborative exploration. A student-centered, problem-oriented, and task-driven teaching paradigm should be vigorously promoted. Specific strategies include: implementing inquiry-based learning, guiding students to independently collect, screen, and analyze English materials around core issues or controversial topics in their professional fields, form and demonstrate personal insights; promoting project-based learning, organizing students to work in groups to experience the entire process from project initiation, plan design, data research, outcome production to final English presentation or complete project report writing, deeply applying language in solving real or highly simulated professional projects; conducting in-depth case-based discussions, selecting English cases containing complex professional information and decision points, organizing students to conduct multi-angle analysis, role-playing, debates, and reflections to deepen understanding of professional concepts and language expression; utilizing technology to enable blended learning, with online platforms providing rich authentic corpora, interactive resources, and personalized learning paths to support independent exploration and basic training, while offline classrooms focus on in-depth discussions, collaborative problem-solving, high-order thinking training, and immediate feedback <sup>[8,9]</sup>. The core of these methods is to create challenging situations, prompting students to actively engage in in-depth information processing, establish knowledge connections, reflect and question, collaborate and negotiate, and achieve active knowledge construction and substantial ability improvement in "learning by doing", "learning by using", and "learning by thinking" <sup>[10]</sup>.

### **3.3. Reshaping teacher roles and learning environments, providing scaffolds and ecological support for deep learning**

Deep learning-oriented professional English training places new demands on teachers' roles; teachers need to transform from authoritative knowledge transmitters to designers, facilitators, guides, and collaborators of learning. Teachers' core responsibilities lie in carefully designing challenging and meaningful learning tasks, building clear learning scaffolds, and providing timely and accurate guidance and feedback during students' exploration. This requires teachers to not only have solid language skills but also possess certain subject content knowledge and a deep understanding of deep learning concepts, being able to keenly insight into students' learning difficulties and thinking processes, and guide students to think deeply, establish knowledge connections, reflect on learning strategies, and gradually move towards autonomy through questioning, inspiration, demonstration, and resource recommendation <sup>[11]</sup>. At the same time, creating a safe, open, collaborative, and supportive learning environment is crucial. Encourage students to ask questions boldly, dare to question, and be willing to share views; even in the face of imperfect language expression or cognitive errors, regard them as valuable resources in the learning process. Actively build learning communities, promote in-depth dialogue, viewpoint collision, mutual learning, and knowledge co-construction among students through well-designed group collaborative tasks and classroom interaction mechanisms. Teachers should actively use



information technology to build intelligent, interactive, and personalized learning spaces, providing convenient access to authentic corpora, platforms supporting collaborative creation, tools for immediate language or content feedback, and environments for recording and reflecting on the learning process, comprehensively supporting the occurrence and development of deep learning <sup>[12]</sup>.

### **3.4. Constructing a diversified process-oriented evaluation system, focusing on ability development and in-depth understanding**

Evaluation is a baton, the traditional evaluation method, which is mainly based on summative examinations and focuses on discrete testing of language knowledge points, runs counter to deep learning goals. It is necessary to establish a matching diversified, process-oriented, and developmental evaluation system, with the core being to focus on students' learning processes, depth of thinking, ability development, and application performance. The evaluation subjects should be diversified, integrating teacher evaluation, student self-evaluation, and peer evaluation to promote the development of students' metacognitive abilities. Evaluation methods should be diversified: performance-based evaluation occupies a core position, such as observing students' actual performance in project practice, case discussions, and simulated conferences, and evaluating their comprehensive ability to use professional English for understanding, analysis, expression, and collaboration; portfolio assessment systems collect process materials such as students' participation in inquiry activities, completed phased reports, reflection logs, and revised drafts, showing their learning trajectories, efforts, depth of thinking, and progress; rubric-based assessment clearly defines specific standards for various deep learning abilities, providing students with clear goal guidance and transparent evaluation basis for evaluating the quality of project outcomes, research reports, oral presentations, and more <sup>[13]</sup>. Reflective evaluation encourages students to write learning reflections, examining their learning strategies, thinking processes, challenges encountered, and overcoming methods, promoting metacognitive development <sup>[14]</sup>. Evaluation content should focus on whether students can deeply understand the connotation and logic of professional materials, critically analyze and evaluate information, creatively use English to express complex professional ideas, and effectively communicate and solve problems in collaboration. This evaluation system, which emphasizes processes, abilities, and in-depth understanding, can not only more accurately measure learning effectiveness but also feed back into teaching, guiding teachers and students to continuously focus on the achievement of deep learning goals <sup>[15]</sup>.

## **4. Conclusion**

The active exploration, in-depth understanding, critical thinking, and transfer application emphasized by deep learning provide a fundamental basis for solving the persistent problem of "disconnect between learning and application" in traditional professional English teaching. Integrating deep learning principles into the entire process of curriculum design, teaching practice, and evaluation feedback can effectively promote the in-depth integration of students' language skills, professional cognition, and high-order thinking abilities, thereby cultivating interdisciplinary talents truly capable of international academic exchanges and professional competition.

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# Analysis on the Construction Path of EDA Laboratory for Computer Major in Colleges and Universities

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**Abstract:** Against the backdrop of the digital era, information technology is constantly evolving. Among various technologies, EDA (Electronic Design Automation) technology provides strong support for integrated circuit design and electronic system development, demonstrating significant value. Colleges and universities are key institutions for cultivating computer professionals. By building high-level EDA laboratories, they can effectively improve the effectiveness of teaching and train talents that meet industry demands. From the perspective of computer majors in colleges and universities, this paper discusses the construction objectives of EDA laboratories and proposes specific practical strategies. The purpose is to provide feasible references for the construction of EDA laboratories, effectively enhance the quality of professional talent cultivation, and offer insights for the subsequent teaching reform of computer majors.

**Keywords:** Colleges and universities; Computer major; EDA laboratory

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## 1. Introduction

With the continuous development of information technology, the computer industry has become an important part of the social economy. As the cornerstone of the information industry, the design and manufacturing level of integrated circuits is related to a country's scientific and technological competitiveness. Among them, EDA technology is the core tool for integrated circuit design, which contributes to the efficient and accurate design of integrated circuits. However, considering the current status of computer professional talent cultivation in colleges and universities, the traditional teaching model overemphasizes the teaching of theoretical knowledge, while practical teaching is relatively weak, resulting in students lacking sufficient practical opportunities. In response to this, colleges and universities need to attach importance to the construction of EDA laboratories, strengthen the connection between talent cultivation and industry needs, enhance students' employability and provide support for the sustainable development of the integrated circuit industry.

## **2. Construction goals of EDA laboratories for computer majors in colleges and universities**

### **2.1. Cultivating students' practical abilities**

In the teaching process of computer majors, practical ability is one of the indispensable core competencies for students. EDA technology covers complex circuit design, simulation verification, and other contents. If students only learn theoretical knowledge, it will be very difficult for them to truly master the knowledge<sup>[1]</sup>. In response to this, the goal of constructing EDA laboratories for computer majors in colleges and universities is to create a real practical environment for students, enabling them to engage in classroom activities, deepen their understanding of theoretical knowledge, and effectively apply such knowledge to practical operations<sup>[2]</sup>. Colleges and universities can carry out targeted projects through EDA laboratories, such as digital circuit design and simulation circuit modeling. Through practical operations, students can proficiently use EDA tool software and effectively complete the process from circuit design to functional verification. These practical operations allow students to master the proficient use of EDA tools, grasp the processes and skills of circuit design, and improve their ability to analyze and solve problems. For example, in the design process of a digital circuit experiment, students can flexibly use software according to design requirements, conduct high-quality circuit modeling with professional languages, and then use EDA tools for simulation verification to check whether the circuit meets the expected functions<sup>[3]</sup>. If problems arise during the process, students can troubleshoot errors independently, adjust the design plan appropriately, and promote the success of the experiment. The implementation of practical training helps to improve students' hands-on and practical skills, enabling them to quickly adapt to the needs of job positions after graduation.

### **2.2. Enhancing students' innovative abilities**

With the rapid development of science and technology, innovation has become the core driving force for the development of industries. EDA technology is a cutting-edge technology in the field of integrated circuit design, and its development is changing with each passing day, which puts forward high requirements for the innovative ability of practitioners. The construction of EDA laboratories for computer majors in colleges and universities helps to create a favorable growth environment, cultivate students' innovative thinking abilities, and effectively enhance their innovative literacy. Laboratories can set up open and exploratory experimental projects to encourage students to select topics independently and complete experiments on their own. For instance, students can be encouraged to use EDA technology for innovative electronic system design, such as smart home security system<sup>[4]</sup>. In the design process of specific projects, students can give full play to their imagination and creativity, combine the knowledge and skills they have learned, put forward effective innovative design schemes, and verify the feasibility of the schemes through experimental methods. At the same time, EDA laboratories can invite industry experts to give lectures on the development trends and cutting-edge applications of EDA technology, which can effectively broaden students' horizons and inspire their innovative inspiration. In addition, laboratories can organize students to participate in design competitions. Through such competitions, students can understand various complex problems and challenges. The mutual cooperation among team members not only helps to improve students' innovative abilities but also cultivates their team spirit and competitive awareness. The implementation of innovative practical activities helps to enhance students' innovative thinking and abilities, enabling them to adapt to the future development of the EDA field.

### **2.3. Meeting the talent needs of the industry**

With the continuous development of the integrated circuit (IC) industry, more stringent requirements have

been put forward for talents proficient in EDA technology. According to relevant industry reports, China will face a significant shortage of EDA talents in the future development process. However, there is a large gap between the application capabilities of EDA technology among computer major students trained by current colleges and universities and the actual needs of the industry, leading to difficulties in recruitment for many enterprises<sup>[5]</sup>. To adapt to the needs of market development, computer majors in colleges and universities must attach importance to the construction of EDA laboratories, effectively align with industry demands, and cultivate high-quality talents who meet the development needs of the industry. To achieve the goal of talent cultivation, the construction of laboratories can integrate the development trends of the industry and the skill requirements for talents from enterprises. Specifically, in terms of setting practical training content, emphasis should be placed on incorporating practical engineering cases from enterprises, helping students understand the workflow and technical standards of enterprises. For example, colleges and universities can conduct exchanges with IC design enterprises, transform the enterprises' actual design projects into corresponding experimental topics, allowing students to familiarize themselves with corporate design specifications and quality requirements during the experiment process. At the same time, laboratories can invite corporate engineers to participate in teaching and guidance, helping students master practical work experience and skills<sup>[6]</sup>. In addition, laboratories should also focus on cultivating students' professional literacy and comprehensive skills, such as teamwork and communication abilities.

The development of these capabilities can meet the talent needs of enterprises and help students adapt to the corporate work environment more quickly. Through in-depth cooperation between colleges and universities and enterprises, laboratories can adjust experimental plans in a timely manner, align with industry and talent demands, improve talent cultivation programs, enable students to meet the development needs of the industry, and provide strong talent support for the development of the IC industry.

### **3. Strategies for the construction of EDA laboratories in computer majors of colleges and universities**

#### **3.1. Construction of experimental platforms**

In the teaching and scientific research activities of EDA laboratories, the construction of experimental platforms plays a fundamental role, and its construction effect is directly related to the quality of teaching and scientific research. The construction of practical training platforms for EDA laboratories in computer majors should emphasize advancement and practicality to meet the professional characteristics and curriculum requirements of different schools<sup>[7]</sup>. Colleges and universities can promote the construction of inter-university experimental platforms to strengthen connections between different institutions, and enhance the alignment between curriculum teaching content and experimental requirements. By leveraging the compatibility and expandability of inter-university experimental platforms, these platforms can adapt to the teaching needs of different schools. In the process of building such communication bridges, relevant technical standards and specifications must be followed to ensure the seamless connection of experimental equipment and software across different schools. The establishment of standardized network interfaces and data transmission protocols enables students to share experimental resources and data<sup>[8]</sup>.

To address differences in professional settings and curriculum arrangements among different schools, it is necessary to strengthen platform construction and conduct in-depth investigations into the actual situation of each school. For colleges and universities that focus on IC design, high-performance EDA simulation software and IC design tools can be configured on the platform to improve the efficiency of knowledge



learning. Meanwhile, the construction of the platform should also take into account the hierarchical differences among students, providing corresponding experimental environments and resources based on students' grade levels. Furthermore, in the construction of experimental platforms, importance must be attached to safety and stability <sup>[9]</sup>. Experiments usually involve high-precision instruments and complex software systems; safety incidents can easily disrupt the normal operation of experiments, and may even lead to equipment damage or casualties. Therefore, during the platform construction process, it is essential to improve safety management systems, formulate emergency plans, and conduct regular inspection and maintenance of equipment to ensure the stable operation of the experimental platform.

### **3.2. Inter-school cooperation and resource sharing**

Given the uneven distribution of educational resources, inter-school cooperation and resource sharing can be carried out to effectively enhance the construction effect of Eda laboratories. Specifically, through inter-school cooperation, different universities can give full play to their respective advantages, achieve resource complementarity, and effectively improve the teaching and research capabilities of EDA laboratories <sup>[10]</sup>. Inter-school cooperation can take various forms, such as university-enterprise cooperation alliances and joint teaching. The establishment of university-enterprise cooperation alliances requires universities to form a synergy in the construction of EDA laboratories, formulate corresponding experimental construction standards and talent cultivation plans, and continuously conduct academic exchanges.

Among these forms, the implementation of joint teaching is conducive to deepening inter-school cooperation. Universities can recognize each other's credits, allowing students to study Eda-related courses and experimental projects at different universities, thereby deepening their understanding of computer professional knowledge. Meanwhile, teachers from different universities can share teaching experiences and methods, improve subsequent professional teaching practices, and effectively enhance teaching quality <sup>[11]</sup>. Shared experimental resources are the core content of inter-school cooperation. A shared platform can be built to make effective use of EDA experimental equipment, software systems, and other resources from various universities. For example, a unified experimental resource management platform can be established to encourage universities to upload information about their own experimental equipment and project details, facilitating teachers and students from all universities to use these resources according to their needs. The implementation of such resource sharing can improve the utilization efficiency of experimental resources, reduce the construction costs of laboratories in each university, and strengthen cooperative exchanges between universities.

### **3.3. A blended teaching model combining online and offline approaches**

With the development of information technology, online teaching has become an important part of the education field. Combining online teaching with offline teaching to build a blended teaching model can give full play to the advantages of both teaching models and improve the teaching effect of EDA laboratories <sup>[12]</sup>. Online teaching can provide students with rich learning resources and flexible learning methods. Universities can build online learning platforms and upload Eda-related learning materials such as teaching videos, courseware, and experimental instruction books. Students can conduct independent learning according to their own time and progress <sup>[13]</sup>.

At the same time, online platforms can also be equipped with functions such as online Q&A and discussion forums, allowing students to consult teachers and peers in a timely manner when encountering problems during the learning process. Offline teaching, on the other hand, focuses on students' practical operations and face-to-face communication. In the laboratory, teachers can provide on-site guidance to students, correct their



operational errors in a timely manner, and answer their questions. Meanwhile, students can conduct group experiments in the laboratory, complete experimental projects through team collaboration, and cultivate team spirit and communication skills. The blended teaching model combining online and offline approaches can achieve complementary advantages: online teaching provides students with a space for independent learning and rich learning resources, while offline teaching offers students opportunities for practical operations and interactive communication.

### **3.4. Scientific teaching evaluation system**

A scientific teaching evaluation system is a crucial means to ensure the teaching quality of the EDA Laboratory. Traditional teaching evaluation often focuses on students' experimental reports and final exam scores, which makes it difficult to fully reflect students' practical abilities, innovative capabilities, and comprehensive literacy<sup>[14]</sup>. Therefore, constructing a scientific and reasonable teaching evaluation system is of great significance to the construction of the EDA laboratory. The teaching evaluation system should emphasize the combination of process-oriented evaluation and summative evaluation, including the process-oriented evaluation mainly focuses on students' performance during the experiment, such as experimental attitude, operational skills, teamwork ability, and problem-solving ability. Teachers can conduct process-oriented evaluation of students through classroom observation, experimental records, and group evaluation. For example, while students are conducting experiments, teachers can observe whether students' operations are standardized, whether they can actively participate in team discussions, and whether they can proactively solve problems encountered in the experiment, and give corresponding evaluations based on these performances<sup>[15]</sup>. In addition, the teaching evaluation system should also introduce diversified evaluation subjects.

Apart from teacher evaluation, it can also include student self-evaluation, student mutual evaluation, enterprise evaluation, and so on. Student self-evaluation enables students to reflect on and summarize their own learning process and achievements, thereby improving their self-awareness. Student mutual evaluation promotes mutual learning and communication among students, and helps cultivate their evaluation ability. Enterprise evaluation, on the other hand, can assess students' abilities and qualities from an industry perspective, making the evaluation results more objective and fairer. Enterprise evaluation can assess students' abilities and qualities from an industry perspective, making the evaluation results more objective and fairer.

## **4. Conclusion**

To sum up, the construction of EDA laboratories for computer majors in colleges and universities is systematic. It helps cultivate high-quality talents and accelerate the development of the integrated circuit industry. Specifically, high-level EDA laboratories can be built through measures such as the construction of experimental platforms, inter-university cooperation, and online-offline blended teaching. In the specific process of laboratory construction, colleges and universities, enterprises, and all sectors of society can, through joint efforts, align with industry needs, improve talent cultivation programs, create a favorable construction environment, and provide reference for the optimization of subsequent teaching activities.

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# A Study of Discourse Markers in Foreign Language Classrooms from the Perspective of Conversation Analysis

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**Abstract:** Based on conversation analysis theory, this study explored how teachers and students used discourse markers in foreign language classrooms and how these markers affect classroom interaction. The results showed that teachers use different discourse markers in different teaching stages such as lead-in, presentation, practice and summary to make their teaching more organized and clearer. However, students used these markers less often, and their expressions are often less coherent. Based on these findings, the study suggests teaching strategies for teachers and learning strategies for students to improve how they use discourse markers. This can help make foreign language teaching more effective and interactive.

**Keywords:** Conversation analysis; Discourse markers; Foreign language teaching; Teaching strategies; Teacher-student interaction

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## 1. Introduction

In today's globalized world, with fast growing information technology, the goal of foreign language teaching is no longer just about teaching vocabulary and grammar. It now aims to help learners communicate effectively using the language. Discourse markers play a key role in building logical connections in language. Conversation analysis offers a new way to study how language is used in the classroom. This study focuses on how teachers and students use discourse markers in foreign language classes. It looks at how these markers are used in different teaching stages and contexts. The study also offers suggestions to make teaching more effective and interactive.

## 2. Overview of conversation analysis

In the 1960s, American sociologists Harvey Sacks, Emanuel Schegloff and Gail Jefferson created conversation analysis. The goal of this theory is not to describe the structure of language or to explain meaning, but to

discover the methods people use in social interaction and the social order behind these methods <sup>[1]</sup>. It looks at turn-taking, sequence organization and adjacency pairs. It stresses that communication is orderly and connected and shows how speakers tend to respond. It also studies how turns are given and taken. Recently, more and more researchers have used conversation analysis to study discourse markers and communicative acts in classroom interaction in order to find problems and improve teaching <sup>[2]</sup>.

### **3. Theoretical background of discourse markers**

In linguistics, discourse markers have been given different names over the years, such as pragmatic particles, discourse particles, discourse connectives, and pragmatic markers <sup>[3]</sup>. This paper uses the most common term “discourse markers”. Discourse markers are words or phrases that connect sentences or paragraphs. They show logical or semantic relationships. In spoken language, they can start a topic, change a topic, show a response, or even work as fillers to help the speaker keep their turn <sup>[4]</sup>. They help speakers organize their thoughts and guide listeners to understand the structure of the conversation. He Ziran and Ran Yongping, stated that discourse markers do not carry semantic meaning but provide procedural meaning <sup>[5]</sup>. They guide listeners and help them understand the talk. These markers are part of discourse form and also part of discourse organization. They affect how discourse is built and understood and show dynamic pragmatic features <sup>[6]</sup>.

## **4. Research methods**

### **4.1. Participants**

The study focuses on teachers and students in the English department of a university. It looks at how teachers use discourse markers in both online and offline classes and when and how often they use them in stages such as lead-in, presentation, practice and summary. It also looks at how much students know about discourse markers and how they use them in class.

### **4.2. Data collection**

To understand the use of discourse markers, the study used several methods. First, it recorded and transcribed classroom talk to observe how often teachers and students used discourse markers in different stages and contexts. Second, it gave questionnaires to students in the English department to learn about their knowledge and attitudes toward discourse markers.

### **4.3. Analysis methods**

The study used both qualitative and quantitative methods. Qualitative analysis was based on conversation analysis theory. It used sequence analysis, adjacency pair analysis and turn-taking analysis to study classroom discourse markers and their effects on interaction. Quantitative analysis used the transcriptions to count the frequency, types and distribution of discourse markers in class. Together with the questionnaire results, the study then gave suggestions for improving teaching through discourse markers.

## **5. Findings**

### **5.1. How teachers use discourse markers**

In the study, the teacher used discourse markers 23 times in class. 65.2% appeared during the presentation stage

as shown in **Figure 1**. This shows that when explaining difficult ideas, the teacher used markers to make the content clearer and more connected, but the use was uneven. In the lead-in stage, the teacher often used “well”, “okay” and “so” to get students’ attention and to show the learning goals. During presentation, the teacher used “for example,” “like” and “however” to make the content clearer and more logical. In the summary stage, the teacher used “to sum up” and “therefore” to review the main points. Using different markers in different stages helped build a clear knowledge line and helped students understand and absorb the content. The teacher’s use of discourse markers clearly improved teaching and increased student participation. In online classes, where face-to-face nonverbal cues are missing, the teacher relied more on discourse markers. These markers helped keep students’ attention and participation and made up for the lack of nonverbal communication. When students received clear instructions through the markers, they gave active feedback. This process followed the rules of turn-taking.

Classroom Information					
Teaching Mode			Online Class		
Teacher’s name			Ms Zhang		
Number of Students			34		
Class Duration			51 minutes		

Classroom Observation Form					
Teaching Phase	Context	Discourse Markers Types	User	Frequency (times)	Effect (Description)
Lead-in	Questioning, engaging attention	well, okay, so	Teacher	5	Guides students to focus and sets learning objectives
Presentation	Concept explanation, example analysis	for example, like, however	Teacher	15	Enhances clarity and coherence, improves student comprehension
Practice	Teacher-student Q&A, student responses	right?, you know	Students	8	Encourages active expression of ideas, promotes natural and fluent language use
Summary	Content review, assigning homework	to sum up, therefore	Teacher	3	Provides clear summarization, helps students consolidate key points

**Figure 1.** Classroom disclosure markers observation form.

## 5.2. How students use discourse markers

Students used discourse markers much less often than teachers, only 8 times in total, mostly during interactive parts of the lesson. They often used markers like “right?” and “you know” to confirm information or express their ideas. However, because they used these markers less often, their speech was sometimes less coherent. For example, when teachers asked questions using clear markers like “Do you agree with...?”, students often did not respond in a connected way. This broke the adjacency pair structure and could cause misunderstanding in class <sup>[7]</sup>. According to the survey, only 29.41% of students often use discourse markers in daily language learning. About 49.02% use them sometimes as shown in **Figure 2**, and 19.6% hardly ever use them. However, 92.16% of students said it is necessary to learn about discourse markers in class, and 84.31% said they are willing to learn more.

These results show that although students know discourse markers exist, they do not yet use them often or on purpose. Possible reasons include lack of knowledge about how and when to use them, lack of practice chances, or more attention to vocabulary and grammar than to markers. Another reason may be that teachers treat discourse markers as natural patterns and do not stress their importance, so students do not fully understand their function and value.



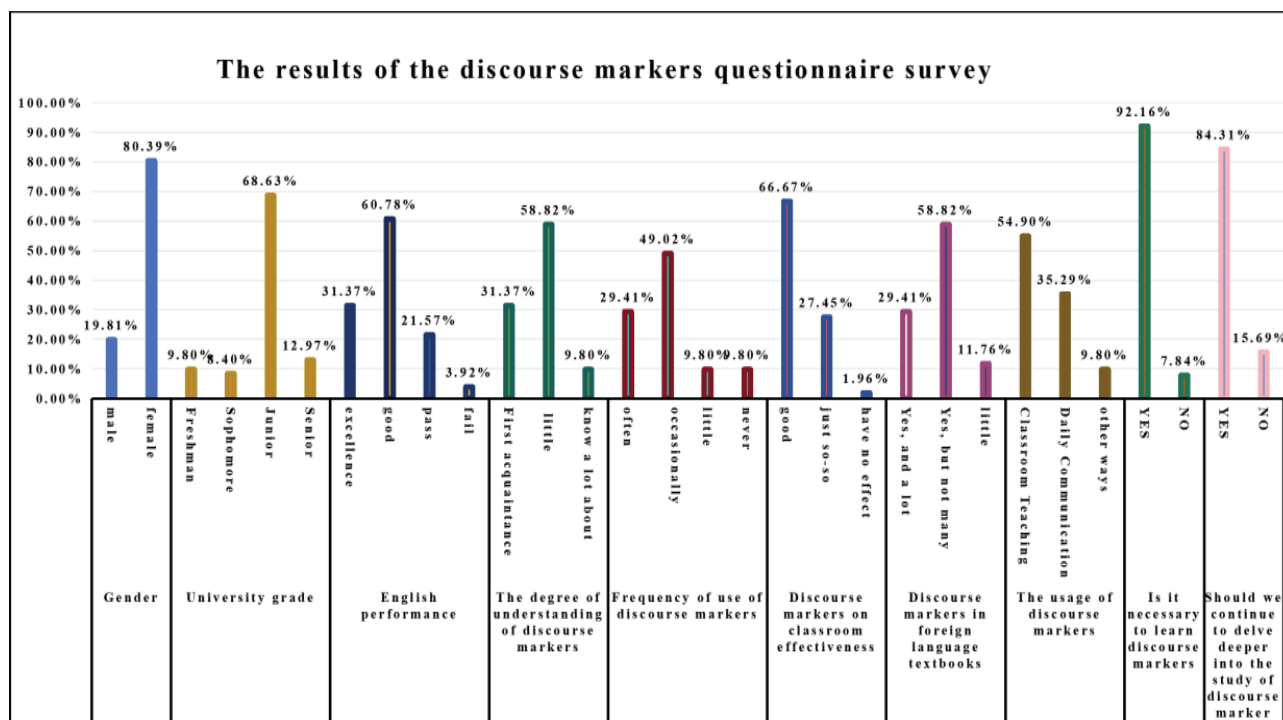


Figure 2. Survey results on discourse markers usage.

## 6. Teaching strategies for discourse markers

### 6.1. Strategies for teachers

Teachers can use regular feedback and self-assessment to look at how often they use discourse markers in different stages and to see which markers work well. For example, when watching class videos or reading teaching logs, teachers can focus on how often and how varied their markers are and whether student answers are clear and turns are taken properly. This helps teachers adjust their strategies in time. In class, teachers should guide students to notice discourse markers. They can set special sections to explain these markers, use open questions to give students turns, and combine language and non-language activities to help students build meaning through markers. Teachers can also create cross-cultural situations, such simulating an international business negotiation, to help students experience thinking patterns in different cultures and contexts and to improve their ability to use markers properly <sup>[8]</sup>.

Research divides language exercises into mechanical, meaningful and communicative practice <sup>[9]</sup>. Therefore, teachers should include all three types of practice for discourse markers. First, introduce basic concepts and let students memorize some markers. Next, analyze how markers are used in texts to deepen understanding. Finally, design interactive tasks in class to check if students can use markers correctly. These three steps can effectively improve students' mastery and use of discourse markers and develop their overall language ability.

### 6.2. Strategies for students

Students should look for chances to use discourse markers in their learning. For example, in group discussions or class presentations, they can try using markers like "for example" to give examples or "however" to show contrast. They should pay attention to the sequence of speech and how turns are taken in order to keep the talk

smooth. They can also watch English movie clips, read news reports and academic articles, and focus on how the three core ideas of conversation analysis are used in different contexts. Linking classroom learning with extra materials can strengthen their knowledge of discourse markers <sup>[10]</sup>.

Students need to take part actively in class interaction. They can share problems and confusion about using discourse markers during discussions and ask teachers for advice on how to use them better. Through constant interaction and feedback, students can gain more resources and suggestions, deepen their understanding and improve their ability to use discourse markers in real talk.

## 7. Conclusion

This study used conversation analysis to explore how teachers and students use discourse markers in foreign language classrooms. Teachers use these markers often, especially when explaining lessons, to make their teaching clearer. However, students use them less often, and their language is sometimes less coherent. To improve this, we suggest that teachers analyze their own teaching, create authentic practice situations, and design interactive exercises. Students should actively practice using discourse markers and take part in classroom communication. These strategies can help make foreign language teaching more effective.

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# Reconstructing Food Professional English Course Teaching to Meet Future Food Industry Needs: A Practice-Oriented Exploration from the Perspectives of Globalization and AI Empowerment

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**Abstract:** With the development of globalization, international communication in the food industry has become increasingly frequent. Mastering English skills related to the food profession can help students communicate effectively with international peers, enhance their adaptability in international enterprises, and boost their employment competitiveness, thereby expanding career development opportunities. The food professional English course is a mandatory subject set by universities to cultivate high-quality talents in the food field, enabling students to better understand the food cultures and consumption habits of different countries and regions. Furthermore, mastering relevant English skills allows students to access cutting-edge food science research techniques and the latest scientific achievements, promoting innovation in research levels. To enhance the cultivation of English skills and comprehensive qualities among food professionals, which will have a profound impact on their future learning, research, and career development, this article primarily analyzes the teaching reform pathways for food professional English courses under the new conditions of globalization and artificial intelligence. It was hoped that the viewpoints presented in this article can provide relevant guidance for the improvement and enhancement of food professional English courses.

**Keywords:** Globalization; Artificial intelligence; Food professional English courses; Teaching reform and practice

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## 1. Introduction

With the increase in global trade and communication, the food industry faces competition in the international

market, making professional English proficiency a necessary skill. Currently, the rapid development brought about by science and technology has led to swift advancements in food science and technology, which in turn requires timely updates to educational content to cultivate students' abilities to adapt to new technologies and methods. The continuous changes in food safety standards and regulations across countries require students in food-related majors to master relevant professional English knowledge in order to understand and comply with international standards. Consumers' growing demands for food quality, safety, and nutritional value urge food professionals to possess cross-cultural communication skills to meet the diverse needs of the food market. Therefore, in the context of higher education reform, which emphasizes quality education and practical skills training, food professional English courses should keep pace with the times and incorporate more practical applications<sup>[1]</sup>. In this social context, food professional English courses need more targeted and effective reform measures to better meet students' learning needs and the requirements of industry development<sup>[2]</sup>.

## **2. The teaching content of food professional English course**

The food professional English course is a compulsory program that integrates food science knowledge with the English language<sup>[3]</sup>. Its aim is to enable food science students to master relevant professional terminology and phrases, and to effectively apply English for both written and oral communication within the food industry. Moreover, the course requires students to proficiently read and translate English literature related to food science, facilitating independent learning of professional knowledge pertaining to the development of the food industry, thereby fostering a broader international perspective and professional competence. In addition to scientific paper writing, the course covers a diverse range of topics, including food chemistry, food nutrition, food microbiology and fermentation, food additives and enzymes, food processing and storage, food quality and safety, as well as new technologies in food production.

The section on scientific paper writing provides a detailed discussion on the characteristics of scientific papers, translation techniques, writing methods, and the reading and comprehension of scientific literature in food English. The course emphasizes relevant vocabulary and phrases, familiarizing students with common expressions used in food professional English<sup>[4]</sup>.

## **3. Problem existing in the teaching of food professional English course under current development situation**

### **3.1. The course content is not updated regularly**

Due to the rapid advancements in food science and technology, the curriculum for English courses in food studies has not kept pace with the latest research findings and industry developments, resulting in students acquiring knowledge that is not sufficiently cutting-edge. The field of food science and technology experiences swift updates in research outcomes, including novel food processing techniques, food safety standards, and nutritional studies. If the course content is not updated in a timely manner, students will be unable to access the latest scientific discoveries and technological applications. As market demands evolve, the food industry faces new challenges and opportunities. For example, there is an increasing consumer focus on health foods, and biotechnology and sustainability have become prominent industry topics. If the curriculum does not reflect these changes, students' knowledge may become outdated and fail to meet the actual needs of the industry.

The English course in food studies must not only teach professional terminology but also encompass content related to the latest research findings and industry dynamics. Without timely updates, students



may encounter difficulties in understanding and applying the latest research outcomes in practical settings. With the acceleration of globalization, international communication within the food industry has become increasingly frequent. Students need to be equipped with the latest information and research findings to effectively communicate with their international peers in a multicultural environment. A lagging curriculum will hinder students' ability to adapt to an internationalized work context. The rapid development of food science necessitates that students possess innovative thinking and problem-solving skills. If the course content does not include cutting-edge research and technologies, it may restrict students' capacity for innovation and adversely affect their performance in future careers. Therefore, the timely updating and adjustment of the curriculum is crucial to ensure that students acquire contemporary professional knowledge and skills.

### **3.2. Problem of insufficient teaching resources and mismatched professional backgrounds of teachers**

The issue of insufficient teaching resources is particularly prominent in the context of English instruction for food science <sup>[5]</sup>. This phenomenon directly impacts the professional backgrounds of teachers and the quality of instruction. Many English teachers specializing in food science may lack a solid background in food science, which hinders their ability to provide in-depth explanations of relevant professional knowledge during their courses.

This deficiency in knowledge prevents teachers from effectively integrating the latest research findings and industry developments in food science into their teaching, thereby affecting students' understanding and mastery of the subject matter. The professional background of teacher directly influences their teaching methods. Teachers without a background in food science may be unable to employ appropriate instructional strategies suited to this field, such as case-based learning or experimental teaching. As a result, their teaching methods may become monotonous, making it difficult to stimulate students' interest and engagement. Teachers often employ traditional teaching methods, such as lectures and rote memorization, which dominate the classroom <sup>[6]</sup>. This approach lacks interaction and practical application, resulting in low student interest and participation. This limitation in teaching approaches further diminishes students' participation and learning outcomes. The food industry is rapidly evolving, with new technologies, standards, and consumer demands constantly emerging. Teachers lacking a background in food science may have insufficient sensitivity to these industry dynamics, making it challenging for them to incorporate these changes into their course content in a timely manner. Consequently, students may miss out on exposure to the latest industry information during their learning process, leading to a knowledge base that becomes outdated and ill-equipped to adapt to the fast-changing market environment.

### **3.3. Insufficient integration of food professional English course with other disciplines**

The differences in students' English proficiency levels are significant, making it challenging for the course to meet the diverse needs of learners. The curriculum lacks authentic industry cases and internship opportunities, which hinders the ability of students to apply their knowledge in real-world contexts, thereby impacting their professional competency development. Additionally, the integration of the English course for food science with other disciplines, such as food science and nutrition, is often insufficient, preventing students from fully grasping the complexities of the food profession. The field of food science encompasses various domains, including food science, nutrition, food safety, and food processing. The knowledge across these different disciplines is interwoven, requiring students to possess interdisciplinary understanding in order to fully grasp the complexities of the food profession. If the English curriculum does not effectively integrate with these subjects,

students will struggle to connect their English learning with professional knowledge, resulting in an insufficient overall understanding of the food profession.

The assessment methods primarily rely on written examinations, lacking a comprehensive evaluation of students' practical application skills and overall competencies, which fails to accurately reflect their learning outcomes. To address these issues, effective reform measures are necessary to enhance the quality and effectiveness of the English curriculum for food majors.

### **3.4. The diverse demands under globalization and artificial intelligence on food professional English courses**

The process of globalization has rendered the markets and consumer demands within the food industry increasingly diverse. Students in food-related programs must acquire professional knowledge and language skills that are contextualized within various cultural frameworks to adapt to the evolving international market. However, existing English courses for food professionals often lack an in-depth exploration of different cultures and market demands, resulting in students being ill-equipped to effectively address the challenges posed by globalization in practical applications. Simultaneously, the rapid advancement of artificial intelligence technologies is profoundly transforming the food industry through innovations such as automated production, intelligent supply chains, and data analytics. Consequently, food professional English courses need to be updated to include relevant knowledge and applications pertaining to these emerging technologies. Nonetheless, current curricula frequently fail to keep pace with technological developments, leaving students without the essential skills and knowledge required for future employment.

In the context of globalization and artificial intelligence, interdisciplinary integration becomes particularly crucial. However, many English courses are inadequately integrated with other disciplines, hindering students' ability to comprehensively understand the complexities and diversities of the food profession. In summary, English courses for food professionals face numerous issues and challenges under the influences of globalization and artificial intelligence. To enhance the quality and effectiveness of these courses, significant reforms are necessary, focusing on interdisciplinary integration, curriculum updates, diversified assessment methods, and strengthened professional training for educators. This approach is essential for cultivating high-quality talent that meets the demands of the future market.

## **4. Educational innovation and professional development in food professional English course**

### **4.1. Adjustments in teaching philosophy**

In the context of globalization and artificial intelligence, higher education instructors face numerous challenges and opportunities <sup>[7-9]</sup>. The application of artificial intelligence technology in language learning, especially English teaching, is subverting the traditional learning mode <sup>[10]</sup>. To adapt to the new educational environment and meet student needs, educators must adjust their teaching philosophies and methodologies. Instructors should transition from being mere transmitters of knowledge to becoming facilitators and supporters of learning. The research found that artificial intelligence enhances learning experiences of students and affects the work engagement of higher education teachers <sup>[11]</sup>. A student-centered approach is essential, focusing on individual differences, interests, and needs while emphasizing active participation and personalized learning. This approach aims to stimulate students' motivation to learn English for the food profession and encourages the development of autonomous learning capabilities and critical thinking skills. Moreover, it is crucial to integrate

food professional knowledge with English language learning, assisting students in understanding professional terminology and industry contexts, thereby enhancing their practical application skills.

Globalization has introduced cultural diversity, necessitating the cultivation of students' cross-cultural communication abilities. Educators should incorporate the cultural contexts of the international food industry into the curriculum, helping students comprehend and respect diverse cultural backgrounds while broadening their global perspectives. Education should be viewed not as a finite phase but as a continuous process. Instructors should encourage students to develop a lifelong learning mindset, enabling them to adapt to the rapidly evolving food industry and its associated technologies.

#### **4.2. Reform of teaching methods**

The reform of teaching methods should integrate both online and offline instruction, combining online learning platforms with traditional classroom teaching. By utilizing multimedia resources and interactive tools, a flexible learning approach can be provided to meet the diverse learning needs of students, thereby enhancing the flexibility and convenience of the learning experience. Through a variety of teaching methods, students' key competencies can be cultivated. The use of real-world projects and case analyses is essential for improving students' practical skills and problem-solving abilities, thereby facilitating the integration of theory and practice.

Students should be encouraged to conduct research and engage in discussions related to practical cases concerning food safety and nutritional analysis, which will enhance their practical skills and language application abilities. Increasing classroom interaction through methods such as group discussions and role-playing will encourage active participation among students, thereby improving their oral expression skills and fostering teamwork. An open, inclusive, and innovative learning environment should be created to encourage students to express themselves freely and explore new ideas, ultimately cultivating high-quality talents who can adapt to the demands of future society.

#### **4.3. Emphasizing both ethics and skills development path for teachers**

In the context of economic globalization and the rise of artificial intelligence, it is essential to establish a development path for teachers that prioritizes ethical standards as the foremost criterion, integrating moral education with professional enhancement. This approach should address both moral qualities and professional skills, taking into account various factors such as teaching methods, curriculum design, teacher training, and international exchanges. This ensures that teachers can cultivate talents who possess not only professional skills but also a strong sense of social responsibility in a rapidly changing educational environment. Through continuous efforts and innovations, teachers will be better equipped to meet future educational demands, laying a solid foundation for the comprehensive development of students. Food professional English teachers must continually update their knowledge in food science, technology, and related fields to ensure they can teach the latest professional content. Additionally, enhancing their English proficiency, particularly in relevant technical terminology, will enable teachers to maintain the quality of their instruction and facilitate mutual exchanges with the international food industry. Furthermore, there should be an ongoing commitment to innovation in teaching methods and technologies.

By utilizing a variety of online teaching platforms and artificial intelligence-assisted tools, teachers can expand their educational resources and improve teaching effectiveness. Courses that integrate food science with English language instruction should be developed to meet market demands and foster students' comprehensive abilities. This shift from the traditional "learning for application" to "application for learning" encourages

students' motivation by stimulating their engagement in language use to accomplish job-related tasks. This transition promotes a change from knowledge acquisition to skill enhancement, thereby comprehensively improving the research, innovative capabilities, and information literacy of food professional English teachers. Higher education institutions should allocate teaching resources effectively, providing necessary technical support and financial backing to facilitate the training and development of food professional English teachers

#### **4.4. Reform of digital practice course in food professional English course**

The digital practice of education towards intelligent education is crucial for the reform of food professional English courses, enhancing students' proficiency in professional English and their practical application abilities, as well as cultivating versatile talents that can adapt to the future development of the industry. To advance the digital practice course reform in food professional English, it is essential to clearly define course objectives. These objectives should align with the characteristics of the food profession and set English proficiency goals that match industry needs, such as fostering students' mastery of technical terminology and the ability to write industry reports. In the teaching process, educators need to integrate digital tools with food professional English to enhance students' practical application skills and professional competencies. This includes developing online course platforms and language learning software that utilize digital teaching resources, providing video explanations, case analyses, and compiling or introducing electronic textbooks.

Incorporating multimedia elements such as audio, video, and animations can further enrich the students' learning experience. To improve the academic performance of students and cultivated their learning motivation and self-regulation, confidence, and higher-order thinking skills through the flipped language classroom <sup>[12]</sup>. Regular teacher training should be organized to improve educators' capabilities and competencies in digital teaching.

### **5. Conclusion**

With the changes in international situations, educational policies and the iterative upgrades of artificial intelligence, there is always a market for those proficient in English and familiar with Western culture. In the face of a new wave of technological revolution driven by artificial intelligence, the empowerment of education by AI has become an inevitable trend, shaping a new paradigm for educational reform and development. The English course for food professionals, as a core course for students in food-related majors, needs to adapt to the current situation of economic globalization and the frequent exchanges and cooperation in the international food industry, aligning with the development and demands of the AI era to enhance students' learning and development in the digital age. Teachers must teach students how to think and create, rather than just focusing on knowledge transmission and acquisition.

The key is for teachers to guide students in using various AI technologies in a reasonable and scientific manner to cultivate logical and critical thinking. Therefore, in the practice of AI-empowered education, it is essential to keep abreast of the development trends of AI and deepen the application of AI in research, teaching, learning, management, and evaluation, fully leveraging the empowering effects of AI to reimagine and create a new pattern for the future development of education.

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# The Role Dilemmas and Resolution Paths of Vocational Education from the Perspective of the Integration of Education, Technology, and Talent

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**Abstract:** The integration of education, technology, and talent is a strategic institutional arrangement for China to build a high-quality education system and achieve innovation-driven development in the new era. As the main platform for cultivating technical and skilled talents, vocational education faces dilemmas such as ambiguous role positioning, conflicting role expectations, and insufficient role capabilities when it comes to the coupling of the three functions of “education-technology-talent”. Based on the analytical framework of role theory and structural functionalism, this paper proposes three paths: clarifying role positioning through the integration of vocational and general education, reconstructing role expectations through the integration of science and education, and enhancing role capabilities through the integration of industry and education. These paths provide theoretical references and practical guidance for optimizing the function of vocational education in the collaborative innovation system.

**Keywords:** Vocational education; Integration of education, technology and talent; Integration of vocational and general education; Collaborative innovation

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## 1. Introduction

Against the backdrop of the Fourth Industrial Revolution and the restructuring of the global industrial chain, education, technology, and talent have become core elements in the process of national modernization. The 20<sup>th</sup> National Congress of the Communist Party of China (CPC) for the first time made an integrated deployment of the three, emphasizing the strategic orientation of “prioritizing the development of education, achieving self-reliance and self-strengthening in science and technology, and driving development with talent leadership”<sup>[1]</sup>. The Third Plenary Session of the 20<sup>th</sup> CPC Central Committee made important arrangements for building an institutional mechanism to support comprehensive innovation and advancing the integrated reform of the institutional mechanisms for education, technology, and talent in a coordinated manner<sup>[2]</sup>. As a key link connecting education and industry, the role positioning and practical paths of vocational education urgently

need systematic reconstruction<sup>[3]</sup>.

From a theoretical perspective, the dual lenses of role theory and structural functionalism provide an analytical framework for analyzing the functional positioning of vocational education in the collaborative system. According to Merton's role set theory, social subjects need to assume multiple institutional roles simultaneously in a specific field; these roles not only have functional complementarity but may also generate structural tensions<sup>[4]</sup>. Parsons' structural functionalist view of education, with its unique theoretical framework, outlines the multi-dimensional role of education in the social system. As a subsystem, vocational education not only needs to meet the traditional role expectation of being a "transmitter of technical skills" but also undertakes the new mission of being an "integrator of innovative elements". The expansion and reconstruction of this role set will inevitably lead to institutional dilemmas such as role ambiguity and role overload, which urgently require institutional innovation to achieve a paradigm shift from a "participant of elements" to a "constructor of the system". Combined with cutting-edge policy trends and industrial transformation trends, this paper systematically deconstructs the role dilemmas of vocational education and proposes resolution paths.

## **2. Reconstruction of the mission of vocational education under the integration of education, science and technology and talent**

The report of the 20<sup>th</sup> National Congress of the Communist Party of China clearly sets the strategic goal of building a powerful educational country by 2035, positions education, science and technology, and talent as the core support for comprehensively building a modern socialist country, and emphasizes the need to coordinately promote the strategies of rejuvenating the country through science and education, strengthening the country through talent, and innovation-driven development<sup>[5]</sup>. General Secretary Xi Jinping further pointed out during the fifth collective study session of the Political Bureau of the Central Committee that the construction of a powerful educational country, a powerful science and technology country, and a powerful talent country has inherent synergy, and systematic integration is required to unleash the efficiency of high-quality development<sup>[6]</sup>. As a key component of the modern educational system, vocational education is in a critical period of transformation and upgrading, and its strategic positioning and mission of the times have been endowed with new connotations.

### **2.1. Structural optimization: Integration of vocational and general education to build a diverse educational ecology**

Against the backdrop of the coordinated development of education, science and technology and talent, promoting the integration of vocational and general education and reforming the educational structural system have become core issues in achieving high-quality educational development<sup>[7]</sup>. The integration of vocational and general education eliminates the traditional barriers between vocational and general education through mechanisms such as modular curriculum integration, credit bank systems, and coordinated resource allocation, constructing a flexible and diverse educational supply model. This measure can not only broaden the channels for students' personalized development but also significantly enhance the social recognition of vocational education.

The systematic optimization of the educational structural system is a crucial part of the educational modernization process. It is necessary to achieve deep coupling of the two types of education through dynamic adjustment of training objectives, structured connection of curriculum systems, and integrated design of evaluation criteria. Such a reform path can cultivate innovative talents with both theoretical literacy and

technical application capabilities, effectively meet the new demands for human capital posed by technological revolutions and industrial transformations, and thus provide intellectual support for the sustainable development of the economy and society.

The in-depth promotion of the integration of vocational and general education and the continuous improvement of the educational structural system will lay an institutional foundation for the integrated development of education, science and technology, and talent, ultimately forming a more inclusive and adaptable modern educational ecology.

## **2.2. Ability upgrading: Digital literacy empowering the cultivation of compound talents**

Driven by both technological revolution and industrial transformation, the traditional training model for skilled talents can hardly meet dynamic market demands. Modern vocational education urgently needs to transform from single-skill teaching to interdisciplinary ability construction, focusing on cultivating compound talents with innovative thinking, digital literacy, and interdisciplinary capabilities<sup>[8]</sup>.

This transformation requires the deep integration of cutting-edge technologies such as artificial intelligence and big data into professional curriculum systems, enabling learners to effectively address the challenges of intelligent production scenarios. Research shows that talents with cross-disciplinary knowledge integration capabilities can not only optimize problem-solving efficiency but also provide continuous impetus for industrial upgrading through technological innovation. Such talents have become key nodes linking educational and industrial systems, and the quality of their cultivation is directly related to the enhancement of national competitiveness.

## **2.3. Model innovation: Integration of science and education to drive the improvement of teaching efficiency**

Against the background of the current innovation-driven development strategy, vocational education, as a crucial link between education and industry, its development quality directly affects the overall efficiency of the national innovation system. As a new round of technological revolution and industrial transformation accelerates, vocational education must break through traditional school-running paradigms and construct a new talent training system deeply intertwined with technological innovation<sup>[9]</sup>. International comparative research shows that there is a significant gap in the efficiency of scientific and technological achievement transformation between China and developed countries, which highlights a key shortcoming of vocational education in the innovation value chain<sup>[10]</sup>. Implementing the “industry-university-research-application” collaborative education mechanism to transform cutting-edge scientific and technological achievements into high-quality teaching resources can effectively improve talent cultivation quality. Specifically, it is necessary to focus on promoting reforms in three aspects: synchronizing curriculum content with industrial technology development, organically integrating teaching scenarios with real production environments, and precisely aligning evaluation criteria with industry talent demands.

The implementation of this deep integration concept can not only cultivate high-quality technical and skilled talents who can adapt to new technological changes but also provide continuous impetus for regional innovative development. In the future, through institutional innovation and policy guidance, the pivotal role of vocational education in the innovation ecosystem should be further strengthened.

### **3. Analysis of the three-dimensional role dilemma in vocational education**

#### **3.1. Ambiguous positioning: Overlapping of functional boundaries and cognitive biases**

According to role theory, role positioning refers to the process where an individual, within specific social relationships and contexts, clarifies their identity, status, responsibilities, and behavioral patterns based on social norms and self-perception. This enables positive interaction with other roles and alignment with social expectations<sup>[11]</sup>. Vocational education faces a structural contradiction between “high positioning” and “low allocation”. The 2024 China Vocational Education Development Report shows that 73% of vocational colleges exhibit the phenomenon of “academic drift”, leading to severe homogeneity in talent cultivation. For example, among 10 higher vocational colleges in a certain province, 8 of them have an overlap rate of over 65% between their Internet of Things (IoT) professional courses and those offered by undergraduate universities, failing to highlight the characteristics of technical and vocational skills training.

At present, vocational education is confronted with a dual development bottleneck. First, there exists a systemic bias in social perception, which simply classifies vocational education as a subsidiary of general education, leading to long-term imbalances in resource allocation and policy support. Data shows that the proportion of research funds in vocational colleges accounts for less than 15% of the total investment in higher education, which severely restricts the development of their scientific and technological innovation capabilities<sup>[12]</sup>. Second, in the process of promoting the integration of vocational and general education, vocational education has not yet formed a differentiated development path, and its talent training goals tend to converge with those of ordinary universities, weakening its distinctive advantages in technical and vocational skills innovation.

#### **3.2. Expectation conflict: Tension between educational laws and industrial demands**

Role expectation refers to society’s anticipation of the behaviors and performance of a specific role<sup>[13]</sup>. Vocational education is confronted with conflicting role expectations from different stakeholders. A survey conducted by the Ministry of Education reveals that 82% of enterprises expect graduates to be “ready for work upon employment”, while 76% of teachers adhere to the concept of progressive cultivation. This contradiction is particularly prominent in rapidly evolving industries such as semiconductors. A chip manufacturing enterprise reported that new employees require an average adaptation period of 6 months, far longer than the 1-month period expected by the enterprise.

At present, the development of vocational education is trapped in a structural contradiction between educational value and industrial demands. The education system emphasizes following the laws of talent cultivation and focuses on developing students’ sustainable development capabilities. However, the industrial sector demands the immediacy of talent supply and pursues the rapid transformation of technical skills. This dualistic opposition in value demands leads to role conflicts in the positioning of vocational education’s talent cultivation goals.

#### **3.3. Capacity lag: Coexistence of faculty shortcomings and resource scarcity**

Role competence refers to the knowledge, skills, and qualities required for an individual to perform their role responsibilities<sup>[4]</sup>. The teaching staff in vocational education presents a “three-low” phenomenon: the proportion of teachers with corporate experience is less than 35%, the number of teachers presiding over scientific research projects at or above the provincial level is fewer than 15% and only 28% of teachers master cutting-edge technologies. The average update cycle of practical training equipment reaches 5.7 years, which makes it difficult to match the iteration speed of industrial technologies. Currently, vocational education is confronted



with systemic challenges in terms of innovative development capabilities.

Firstly, it manifests as structural deficiencies in the teaching staff. Teachers generally lack industrial practical experience and technological innovation capabilities, with obvious shortcomings in teaching competence especially in emerging fields such as artificial intelligence. Secondly, it is reflected in the inadequacy of practical teaching conditions, the replacement of practical training facilities lags behind technological development, making it hard to construct real production scenarios. A deeper-level constraint lies in the weakness of the industry-education integration mechanism and the imperfection of the university-enterprise collaborative innovation platform construction, which leads to the delay in technology transformation and teaching update.

## **4. Three breakthrough paths for collaborative innovation in vocational education**

Education, science and technology, and talents form a triple coupling system for innovation-driven development, jointly serving the construction of the national innovation system<sup>[14]</sup>. Under this strategic framework, vocational education must achieve transformation and upgrading in three dimensions: clarifying the positioning of “type-based education”, aligning with the needs of industrial development, and enhancing the ability to support innovation. By systematically optimizing the structure of educational supply and strengthening the function of technical and skilled talent accumulation, it will provide talent support for the construction of a modern industrial system.

### **4.1. Positioning anchoring: Institutional innovation for the integration of vocational and general education**

The Vocational Education Law has clearly stipulated that vocational education is a type of education with equal importance to general education, yet its social recognition still faces challenges. Currently, it is urgent to advance reforms at three levels: First, establish an institutional system for the integration of vocational and general education, and realize the organic connection of educational resources through mechanisms such as credit recognition and curriculum interoperability; Second, elevate the disciplinary status of vocational education, and it is suggested that vocational and technical education be upgraded to a first-level discipline to strengthen its academic discourse power; Third, improve talent training standards, with a focus on cultivating compound talents who possess both technological innovation capabilities and professional literacy.

Empirical studies show that the technical and skilled talents trained by vocational colleges every year contribute 7.2% to GDP, but the development of their disciplines lags significantly behind the needs of industrial development. In the future, efforts should be made to comprehensively enhance the social recognition of vocational education through the reconstruction of disciplinary systems and the innovation of training models.

### **4.2. Expectation adjustment: Paradigm revolution for the integration of science, technology and education**

The essence of “integration of science, technology and education” in vocational education is the in-depth coupling of scientific research and education & teaching, aiming to build a collaborative mechanism for science and technology, education, and talent training. Its implementation paths should focus on the following dimensions.

(1) Construct a three-stage competency training model of “basic scientific research literacy specialized  
**4.2.1. Adaptive cultivation of human resources**”. Design a composite evaluation system of “technical



skills + scientific research literacy”, and establish a gradient training mechanism covering secondary vocational education, higher vocational education, and vocational undergraduate education.

- (2) Cultivate a team of “double-qualified and tri-competent” teachers, and improve the teachers’ ability to transform scientific research achievements through the two-way flow of talents between schools and enterprises. Introduce mentors from scientific research institutions and enterprise engineers to form “double-qualified” teams, and increase the participation rate in scientific research projects to more than 60%.

#### **4.2.2. Technological transformation of the education system**

- (1) Establish the school-running orientation of “technology leadership” and deeply integrate innovation elements into the entire process of professional construction.
- (2) Implement a “research-teaching integration” curriculum system, and cultivate students’ technological innovation capabilities through real scientific research projects.

### **4.3. Capacity enhancement: Ecological reconstruction for the integration of industry and education**

As an important carrier for the accumulation of technical skills, the mechanism of industry-education integration in vocational education directly affects the quality of talent training<sup>[7]</sup>. Based on the background of the integration of education, science and technology, and talents, the following reform paths are proposed as below.

#### **4.3.1. Construction of integration conditions**

- (1) Deepen the “two-way flow mechanism for double-qualified talents” and form a teacher development model featuring mutual employment of personnel between schools and enterprises and technology sharing.
- (2) Establish a “four-in-one” practical training system, integrating resources from the government, industry associations, enterprises, and schools to build a virtual-real integrated practical teaching platform.

#### **4.3.2. Mechanism optimization and innovation**

- (1) Jointly establish joint-stock industrial colleges, and form an ecological circle of “joint talent cultivation-joint technology R&D-interests”. Promote the joint-stock school-running model, and deepen industry-education cooperation through risk sharing and benefit sharing.
- (2) Build industrial technology innovation alliances, and establish service platforms for technology transfer and achievement transformation.

## **5. Conclusions and prospects**

To achieve the goal of building a leading education-powered country, vocational education needs to redefine its role positioning through collaborative innovation. It should eliminate role ambiguity via institutional design, balance diverse expectations by integrating science and education, and enhance core capabilities based on the integration of industry and education. Ultimately, it will realize the transformation from “passive adaptation” to “proactive leadership”.

Vocational education must respond to the needs of new-quality productive forces with a “one-body-two-wings” model, with the “body” being the collaboration of education, science-technology and talents, and the “two wings” being digital and green transformation. Future research can focus on the reform of AI-driven talent

cultivation paradigms while remaining vigilant against the risks of technological alienation.

## Disclosure statement

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# Research on the Training Mode of Digital Finance Talents in Vocational Colleges under the Background of Digital Economy

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**Abstract:** Digital economy has become a new driving force for China's economic growth, continuously boosting economic development and rapidly integrating into various fields of China's economy and society. The advent of the digital economy era has reshaped the development pattern of the financial industry. The rapid development of financial technology has promoted the transformation of financial formats and put forward higher requirements for financial talent training in the new era. Digital finance is not only a key part of the transformation and upgrading of China's financial industry but also an integral component of China's modern financial ecosystem. Against the backdrop of the digital economy, cultivating digital finance talents in vocational colleges is of great significance to China's economic development. This paper analyzes the predicaments faced in digital finance talent training, explores in depth the reform of digital finance talent training modes, and proposes policy suggestions for the digital finance talent training system based on the development characteristics of digital finance.

**Keywords:** Digital economy; Digital finance; Talent training; Mode

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## 1. Introduction

Digital economy is an economic revolution driven by continuous innovation in digital technologies<sup>[1]</sup>. It refers to an economic system where digital technologies are widely applied in various sectors and links, bringing fundamental changes to the overall economic environment and economic activities. As a new driver of global economic growth, digital economy is also hailed as "the key to unlocking the fourth industrial revolution, which is crucial to national rejuvenation"<sup>[2]</sup>.

According to data from the Digital China Development Report (2024), China has built the world's largest and technologically advanced network infrastructure<sup>[3]</sup>. In 2024, the construction of Digital China took solid

new steps, showing a steady and high-quality development trend. The Digital China Development Index has maintained a steady growth of over 10% in the past three years. Digital technology innovation has reached a new level: among the 45,000 newly published generative artificial intelligence patents worldwide, China accounts for 61.5%. In 2024, data output reached 41.06 zettabytes (ZB), a year-on-year increase of 25%, with high-quality datasets improving in both quantity and quality. Digital infrastructure has achieved a new leap forward: the total computing power has reached 280 EFLOPS, 4.251 million 5G base stations have been built, the number of IoT terminal users has reached 2.656 billion, and the newly added computing power in the eight hub node regions accounts for over 60% of the country's total new computing power. The added value of the core industries of the digital economy accounts for approximately 10% of China's GDP.

The core function of vocational education is to serve industrial development and provide a talent echelon for the country's industrial transformation in advance. The digital transformation of vocational education, on one hand, serves vocational education itself; on the other hand, it serves society. Only when vocational education achieves digital transformation and innovation can it cultivate talents with digital thinking and capabilities that meet social needs.

Digital economy has become a new driving force for China's economic growth, continuously promoting economic growth and rapidly integrating into various fields of China's economy and society. The development of digital economy has exerted a significant impact on the education industry, especially vocational education, which is closely related to economic and social development. The digital economy, with digital technologies and data elements at its core, has penetrated into all aspects of vocational education development, which is conducive to promoting the high-quality development of vocational education. It is of great significance for vocational education to adapt to digital changes<sup>[4]</sup>. The arrival of the digital economy era has subverted the development pattern of the financial industry. The rapid development of financial technology has promoted the transformation of financial formats and put forward higher requirements for financial talent training in the new era.

## **2. Significance of cultivating digital finance talents in vocational colleges under the background of digital economy**

### **2.1. Digital finance talents are the key to the development of fintech**

The digital economy is the main economic form following the agricultural economy and industrial economy. The digital transformation is profoundly changing the modes of production, life, and governance, and exerting a profound impact on the world's economy, politics, and science and technology<sup>[5]</sup>. To promote the digital transformation of the financial industry and drive high-quality financial development, digital finance talents have become the core competitiveness of such transformation.

Up to now, the development of fintech and digital finance “echo each other from afar” and resonate with mutual superposition. Fintech empowers the digital transformation of the financial industry through cutting-edge technologies, mainly reflected in giving play to the role of scenario-based finance and emphasizing user experience; while digital finance drives the digital transformation of the financial industry relying on digital technologies, with digital process reengineering more embodying the internal driving force. Both need to abide by the logic of financial development and hold the bottom line of financial risks.

### **2.2. Cultivating digital finance talents helps high-quality economic development**

The cultivation and training of digital finance talents not only require “classified policies” but also multiple breakthroughs based on different job categories; they also need “integrated development” to strengthen the

cultivation of compound talents through more systematic, diversified, and innovative ways <sup>[6]</sup>.

The gap in digital finance talents is mainly reflected in the structural shortage of talents. With the expansion of banking business boundaries, the advancement of digital transformation, and the new opportunities brought by the new internet finance, banks have a continuous and long-term demand for digital finance talents. Such demand is embodied in compound talents who understand both technology and business, as well as talents with an open mind, innovative vision, and a willingness to keep learning <sup>[7]</sup>.

Digital finance talents need to have three characteristics: professionalism, innovation, and integration. The first is professionalism. Digital finance is based on finance, and its core and foundation lie in the comprehensiveness and depth of understanding of the nature of digital finance. The second is innovation. With the vigorous development of the digital economy, the external business environment of the banking industry has undergone profound changes. It is necessary to comprehensively promote digital transformation from a strategic perspective, innovate concepts, processes, and business models to better serve customers. The third is integration. In the process of digital transformation of banks, it is necessary to promote the integration of customer service systems, including better integration of online and offline services, better integration of corporate finance and retail finance, and better integration of financial and non-financial businesses. Therefore, digital finance talents must have a cross-border vision, take customers as the center, and better promote integrated development <sup>[8]</sup>.

From the perspective of internet technology companies, there are three structural differences in the cultivation of digital finance talents compared with traditional financial institutions. Firstly, in terms of talent cognition, internet technology enterprises have a relatively unified and comprehensive understanding of digital talent cultivation. They have accumulated echelon-style digital talents in various aspects of technology research and development and business lines, and continuously carry out talent training and output. Secondly, in terms of talent structure, internet technology enterprises invest heavily in technology research and development and product innovation. Thirdly, in terms of capacity release, the decision-making systems and organizational structures of internet technology enterprises are very flat. Many business innovations and product developments are initiated independently from the bottom up, which can better release employees' innovative motivation and ability. The essence of digital finance is the transformation of financial technology, and digital finance must rely on efficient financial technology for operation <sup>[8]</sup>. Digital finance uses modern information technology to provide an efficient business model for the development of the financial industry, thereby improving the service capacity of the financial industry and ultimately promoting the development of the real economy <sup>[9]</sup>.

### **3. Difficulties in cultivating digital finance talents in vocational colleges**

Against the backdrop of cloud computing, the Internet of Things, mobile Internet, big data, and artificial intelligence, talents specializing in big data processing and research and development play an important role in the development of digital finance. In the era of digital finance, financial vocational education in vocational colleges must adapt to the market and improve their own talent training system <sup>[10]</sup>. The development of the financial industry will gradually shift from traditional to modern, from front-end services to back-end development, from large-scale finance to industrial finance, and from decentralization to information integration.

In this process, talent demand also presents the characteristics of diversification and multi-level. To meet the needs of the development of various financial businesses, the structure of financial talents can be divided



into three categories: high-end, middle-level, and grass-roots<sup>[11]</sup>. The goal of financial vocational education is to cultivate grass-roots professionals. Grass-roots financial talents mainly refer to application-oriented talents who are active in the front line of various financial institutions, master basic knowledge of finance and related majors, have good language and written expression skills, strong practical ability, and can be competent for specific financial service positions. Emerging financial institutions represented by financial service centers, Internet finance, and blockchain financial enterprises, as well as emerging financial formats such as financial technology, will have greater development space. The development of these emerging financial formats requires a large number of grass-roots financial service personnel with customer development capabilities, familiarity with financial product types, and basic operational skills to carry out expansion and maintenance work.

How to cultivate financial major students into digital finance talents needed in the era of digital economy? Traditional training methods are difficult to meet the requirements of the new era. Therefore, colleges and universities are required to actively reform teaching contents and plan teaching directions to face the impact brought by the digital economy.

First, the digital finance talent training system has not yet been formed. At present, most of the financial technology courses offered by colleges and universities are simply a superposition of finance and computer disciplines, without in-depth integration. The design of digital finance courses should reflect the internal logic of digital technology reshaping financial development.

Second, there is not only a shortage of digital finance talents in quantity but also an imbalance in talent structure. Nowadays, most financial technology talents are deployed in the marketing and risk control fields of retail banks. In fact, there is a talent shortage in many financial scenarios at present, such as digital operation and supply chain finance.

Third, the ability to solve practical problems relying solely on financial technology is insufficient. Some financial technology engineers trained by institutions or universities have little experience in solving practical problems because they lack financial experience.

Fourth, digital finance talents lack a policy guarantee mechanism. The government can introduce reward policies for financial technology talents and give rewards to those who have obtained qualification certificates.

#### **4. Reform of the training model for digital finance talents in vocational colleges**

The teaching model of vocational education is a relatively broad concept, mainly referring to talent training objectives, teaching models, curriculum models, teacher training, and school-running forms, involving the micro-level of higher vocational education. Some scholars have distinguished the higher vocational and technical education models in developed countries and analyzed each model<sup>[12]</sup>.

Foreign countries have conducted extensive research on vocational and technical education talent training models. For example, the “cooperative education” in the United States; Germany’s “dual system” (originating from the “apprenticeship system,” which involves both school education and enterprise practice, emphasizing the educational philosophy of “learning by doing”); the United Kingdom’s “sandwich” model (a school-running model of working while learning, also known as “work-study alternation”); and Japan’s “integration of industry and education” (emphasizing the role of enterprise production practice in cultivating students and incorporating research on technical issues in actual production into the school’s scientific research work). In addition, there is the former Soviet Union’s “basic enterprise model” (i.e., establishing practical learning bases for professional theoretical research and creating real production sites for students’ practical learning). The International Labor

Organization, through the analysis and comparison of these models, proposed the “MES” school-running model, which takes the public as the main body, highlights characteristics, and emphasizes practicality<sup>[12]</sup>.

#### **4.1. Talent training models of traditional vocational education**

“School-enterprise cooperation and work-study integration” are the essential requirements of higher vocational education. Vocational education institutions at home and abroad have actively explored and practiced talent training and school-enterprise cooperation in running schools, forming unique talent training models and achieving remarkable results. Representative research on talent training models includes the “order-based” talent training model, the “work-study alternation” talent training model, and the “employment-oriented” talent training model<sup>[13]</sup>.

##### **4.1.1. “Order-based” talent training model**

The “order-based” talent training model is one of the most popular models in current higher vocational education talent training. Through active exploration and practice by various vocational colleges, it has formed a unique model. The so-called “order” means that when students enroll, the school and enterprises sign an entrustment agreement, and they jointly conduct interviews, assessments, and screenings of students, combined with their entrance scores for selection.

##### **4.1.2. “Work-study alternation” training model**

Simply put, the “work-study alternation” model means that students alternate between study and work, and their training process is carried out in stages, with alternating study and work in enterprises. In this case, students have two identities: one as a student at school and the other as an employee in an enterprise. The training process adopts segmented teaching. In the first academic year, students mainly study cultural courses and professional theoretical courses at school to cultivate their basic moral cultivation and cultural quality, and master basic theoretical knowledge. In the following second and third semesters, the school will seek cooperation with companies suitable for students’ professional internships, arrange students to work in positions suitable for their majors, or take turns working, so that they can learn practical knowledge in a real working environment. Then they return to school to continue their studies of theoretical knowledge, and then go to work again, alternating between the two. This truly applies theory to practice and then tests theory through practice, thus realizing a “theory-practice-theory” talent training model, which is a cyclic model of learning and working.

##### **4.1.3. “Employment-oriented” talent training model**

Finding a good job is the ultimate goal of students attending school. In recent years, the difficulty of college students’ employment has attracted great attention from the country and society. Surveys show that the employment situation of vocational college graduates is extremely severe, and they face great employment pressure. This is because there is a certain gap between the professional settings of vocational colleges and the actual social demand for talent quality; moreover, college students generally have high employment expectations, but their own work ability and entrepreneurial ability are relatively low. In response to the above problems, the “employment-oriented talent training model” has become an inevitable choice for various vocational colleges. This model not only meets the market’s requirements for talent quality but also can improve the quality of graduates. To meet the market’s requirements for talent quality, schools will try their best to help students find good jobs after graduation.

## 4.2. “Integration of theory and practice” model for cultivating digital finance talents in vocational colleges

### 4.2.1. Repositioning of talent demand in the context of digital economy

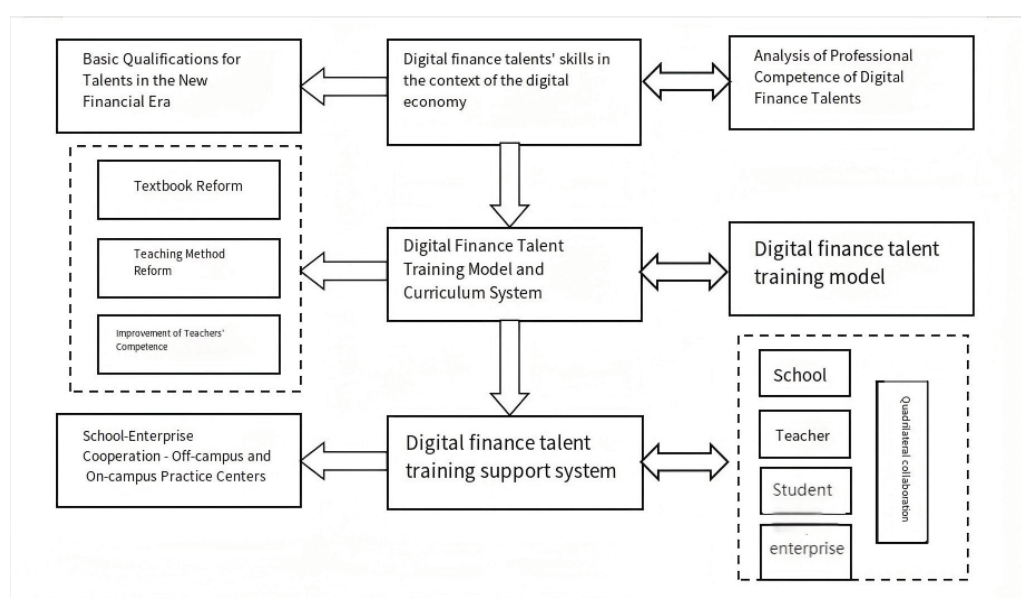
The traditional vocational education model is formulated based on the development status of traditional industries. In the process of China’s manufacturing industry moving towards high-end manufacturing, a number of new concepts have emerged continuously, such as “German Industry 4.0”, “Internet Plus”, “Made in China 2025”, “big data”, “cloud computing”, “artificial intelligence”, “Internet of Things”, and “industrial Internet”. The future will be dominated by big data, artificial intelligence, and digital economy.

Therefore, it is necessary to reform the existing vocational education model to adapt to the development of the digital era. As the main positions for outputting technical and skilled talents, higher vocational colleges should strengthen their key school-running capabilities, improve the ability to cultivate digital talents, build an industry-education integration community, enhance the adaptability of digital talent cultivation, construct a scientific education evaluation system, and consolidate the achievements of digital talent cultivation, so as to cultivate more high-quality digital talents who can adapt to China’s technological progress, industrial upgrading, and economic and social development <sup>[5]</sup>.

### 4.2.2. Reconstruction of training objectives and curriculum system for digital finance talents

The cultivation of digital finance talents is faced with the reconstruction of training objectives and curriculum system. Different from traditional higher education, the “school-enterprise cooperation, integration of work and study” talent training model is currently the most scientific talent training model for higher vocational education in China. Vocational education is competence-oriented and career-based; traditional higher education is knowledge-oriented and discipline-based <sup>[14]</sup>.

In the context of digital economy, how higher vocational education cultivates applied talents with new skills and technologies needed by the front line of society is a new challenge faced by higher vocational education in the new era. In this context, we list the training model and curriculum system for digital finance talents, as shown in **Figure 1**.



**Figure 1.** Financial talent training model and curriculum system.

The cultivation of digital finance talents in vocational colleges should comply with the market demand of the digital economy era, establish the training objectives and curriculum system for digital finance talents and carry out curriculum reconstruction and teaching material reform based on professional training objectives. In terms of teaching methods, we should actively reform, use information-based means for classroom teaching, construct a scientific and reasonable practical teaching model, establish a comprehensive financial laboratory, improve the level of on-campus practical training teaching, strengthen school-enterprise cooperation, and attach importance to the construction of off-campus internship bases.

#### **4.2.3. Consolidating the professional literacy of digital finance talents**

We should cultivate compound, innovative, high-quality, and high-skilled talents who can adapt to the development of the fintech ecosystem <sup>[15]</sup>. Such talents should have all-round development of morality, intelligence, physical fitness, and aesthetics, and possess good comprehensive qualities; master the basic principles of economics and finance, and be familiar with common financial transaction rules, trading practices, and policies and regulations; have the computer technology foundation of fintech and the basic knowledge of big data mathematical statistics and analysis; and possess basic business skills and marketing operation capabilities in fintech.

#### **4.2.4. Reforming the curriculum system**

Realize the shift from the teaching of traditional finance professional courses to the curriculum setup oriented towards fintech. Replace traditional courses and practical training in bank wealth management and insurance with fintech courses and practical training.

#### **4.2.5. Reconstructing course content**

Traditional courses are not synchronized with the development of the financial industry. Teachers should update their financial knowledge system in a timely manner, integrate theoretical teaching with scientific research, and enable students to master the latest disciplinary trends through research and introduction of cutting-edge financial knowledge. Colleges and universities should actively cooperate with financial institutions, invite practitioners in the financial industry to teach about innovative businesses and new management concepts of financial institutions; cooperate with financial research institutions, and invite well-known experts, scholars, and industry experts to teach cutting-edge knowledge and trends in finance.

### **5. Strategic suggestions for cultivating digital finance talents in vocational colleges**

#### **5.1. Cultivating digital finance talents with big data processing capabilities**

The traditional talent training model in vocational colleges has flaws, and priority should be given to cultivating digital finance talents with big data processing capabilities. Financial enterprises can use technologies such as big data and blockchain to conduct full-life-cycle performance evaluations of talents, optimizing talent management models and financial technology business models. At the same time, it is necessary to treat back-end technical support personnel and financial technology managers fairly and provide a transparent and equitable competition platform.

#### **5.2. Establishing a composite training mechanism for digital finance talents**

Vocational colleges should emphasize the composite ability of professional knowledge and encourage talents



to develop in-depth in the fields of finance and the Internet. Digital finance focuses on the financial system, and Internet technology is one of the reform approaches. Financial enterprises need to clarify the key points of training content for composite talents. Vocational colleges should implement the requirements of digital finance for composite talents, combine the background of Internet education, use Internet platforms to carry out digital finance talent training, optimize educational models, realize the integration of education and Internet resources, develop an online-offline dual talent training model, supplement and optimize talent training content, and achieve precise training.

### **5.3. Building a diversified practical simulation mechanism for digital finance talents**

In talent training, vocational colleges should provide practical opportunities in stages and carry out flexible practical simulation activities to enhance students' understanding of financial markets and businesses. The essence of digital finance is the transformation of financial technology, which relies on efficient financial technology operations. Information technologies such as big data, cloud computing, and artificial intelligence improve the efficiency and intelligence level of financial services. Vocational colleges should also pay attention to practical ability and the level of financial technology innovation when cultivating talents.

In terms of talent sources, focus on the digital transformation of existing talents and the digital training of incremental talents; in terms of industrial development, promote the digitalization of financial business personnel and financial supervision; in the integration of majors and businesses, focus on the integration of digital technology talents and business digital talents, strengthen the exchange of rotating positions between technology and business, and cross-disciplinary talent exchanges.

Under the development trend of digital finance, the traditional human resource structure of financial enterprises cannot achieve development goals, and there is an urgent need for digital financial talents. Vocational colleges should establish a composite financial talent training mechanism, build a diversified digital financial talent training mechanism, and improve the quality of talent training to meet the demand for talents in the era of digital finance.

## **6. Conclusion**

The vigorous development of the digital economy has profoundly reshaped the landscape of the financial industry, posing systematic reform requirements for the cultivation of digital financial talents in vocational colleges. As the core driving force for fintech development and an important support for high-quality economic development, the cultivation of digital financial talents must address dilemmas such as the unformed system, structural imbalance, insufficient practical ability, and lack of policy guarantees. Vocational colleges should base themselves on the “integration of theory and practice” model, take the market demand in the digital economy era as the orientation, reconstruct training objectives and curriculum systems, consolidate students' professional literacy, innovative ability and integrated vision.

By reforming curriculum content, strengthening school-enterprise cooperation and building practice platforms, they should strive to cultivate interdisciplinary talents with both in-depth financial expertise and digital technical capabilities. At the same time, it is necessary to focus on cultivating big data processing capabilities, establish a composite talent training mechanism and a diversified practical simulation system, and promote the in-depth integration of the education chain, talent chain, and industry chain. Only in this way can the problem of structural shortage of digital financial talents be effectively solved, providing a solid talent



guarantee for the digital transformation of China's financial industry and sustainable economic growth.

## Disclosure statement

The authors declare no conflict of interest.

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# Research on Pragmatic Relevance and Translation of Tea Culture Terminology from the Perspective of Digitalized Teaching

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**Abstract:** This paper focuses on the teaching of tea culture terminology translation against the backdrop of digital transformation in education. Based on the theory of pragmatic relevance, the research emphasizes shifting the focus of translation from static linguistic equivalence to more dynamic communicative effectiveness. This paper advocates the flexible application of various strategies. These include literal translation, free translation, transliteration with annotation, and adaptive translation based on the target audience's cognitive context. The paper innovatively proposes digitally-enabled teaching implementation paths, including constructing modular online courses, building intelligent terminology case databases, conducting cloud-based workshops on translation, and implementing industry-academia collaborative project practices. These aim to reshape the teaching process utilizing digital technology, effectively cultivating higher vocational students' cultural communication abilities and practical translation skills, thereby providing high-quality language service talent support for the internationalization of Chinese tea culture.

**Keywords:** Tea culture terminology; Pragmatic relevance; Translation strategies; Digitalized teaching; Business English

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## 1. Introduction

Tea culture terminology is a linguistic symbol that carries the millennial Chinese civilization, philosophical thought, aesthetic taste, and business practice<sup>[1]</sup>. With the continuous deepening of the internationalization and brand transformation of China's tea industry, Business English translation professionals not only need to master language conversion skills, but also should have the ability to interpret culture and convey values. Therefore, studying the translation of tea culture terminology has become crucial for promoting reforms in Business English translation education. From a terminological perspective, the system of tea culture terminology is vast and can be broadly categorized into three types.

- (1) Entity Terminology: Referring to objectively existing tea varieties, tea utensils, chemical components, for example Longjing, Puer Tea, Tea Polyphenols. Translations for these terms are relatively stable,

often employing “transliteration + meaning” or standardized translations.

- (2) Process and Sensory Terminology: Describing tea production processes, brewing techniques, and tasting experiences, for example, fixation, shaping, mellow and thick, throat feeling or aftertaste. These terms represent the difficulty in translation, as they are underpinned by unique Chinese experiences and aesthetics, often lacking exact equivalents in English.
- (3) Cultural and Conceptual Terminology: Embodying philosophical ideas and aesthetic values, for instance, the “chadao” as translated as teaism or as known as the way of tea, the unity of Zen meditation and tea practice in Chinese spiritual tradition, harmony, tranquility, enjoyment and truth, ichigo ichie, treasuring every encounter <sup>[2]</sup>. Translating these terms goes far beyond the linguistic level, entering the deep field of cultural decoding and re-encoding, serving as a touchstone for testing a translator’s cultural literacy and cross-cultural competence.

The in-depth analysis and precise translation of these three categories of terminology are key to reforming Business English translation teaching from a “language instrumental” model to a “culturally empowering” one. It demands that teaching moves beyond imparting techniques of “how to translate” to delving into the cognitive level of “why translate this way”, fostering students’ ability to make dynamic decisions based on context, audience, and communicative purpose. This is precisely the domain where pragmatic relevance theory can play a significant role.

## **2. The meaning of pragmatic relevance theory and its guiding significance in the reform of Business English translation**

Pragmatic relevance theory, developed by Sperber and Wilson, suggests that human communication is fundamentally an ostensive-inferential process <sup>[3]</sup>. The speaker provides information with most appropriate meaning through ostensive behavior, and the hearer infers meaning based on this information and their cognitive context. Communication success depends on whether the information produces sufficient contextual effects with minimal processing effort <sup>[4]</sup>. Viewing this theory through the lens of Business English translation reform reveals its significant role in guiding the reform of Business English translation.

### **2.1. Reconceptualizing translation: from “equivalence” to “effectiveness”**

It reshapes our understanding of the essence of translation: from “equivalence” to “effectiveness”. Traditional translation teaching pursues linguistic “equivalence”, whereas pragmatic relevance theory regards translation as a cross-linguistic, cross-cultural ostensive-inferential communicative act <sup>[5]</sup>. The translator’s core task is no longer to find word-for-word correspondences but to create most appropriate meaning within the target language cognitive context for the original reader/listener, ensuring the translation yields contextual effects similar to the original, thereby achieving successful communication. This represents a conceptual upgrade for higher vocational translation teaching, guiding students to focus on communicative “effectiveness” rather than mechanical “correctness”.

### **2.2. Clarifying the translator’s subjectivity and decision-making role**

It clarifies the translator’s role as an active participant and decision-maker. Relevance theory emphasizes that the translator is a “participant” in communication, not an “invisible” conduit. In business translation, the translator must fully consider the target reader’s cognitive environment (including cultural background, knowledge reserve, reading expectations) and the communicative situation (e.g., product manual, e-commerce product

page, high-end tasting session) <sup>[6]</sup>. For instance, the translation strategy for the term “huigan” would necessarily differ when promoting a new tea drink to young North American consumers versus providing a professional tea evaluation report to a British tea buyer. The former might require a free translation like “a sweet aftertaste that lingers”, while the latter could use a more professional “Hui Gan (returning sweetness).” This capacity for dynamic decision-making based on audience and purpose is a core competency for modern business translation professionals and a key focus of teaching reform.

### **2.3. Providing a robust theoretical framework for translation strategy selection**

Literal translation, free translation, transliteration, explanatory translation, and other strategies, are no longer arbitrarily chosen methods but rational decisions guided by relevance theory. The criterion for decision-making is whether it can bring target readers the best contextual effects with minimal processing effort, achieving effective cultural transmission. Use literal translation when it creates sufficient relevance for example “Green Tea; when literal translation causes relevance failure or comprehension barriers, for example “Red tea”, alternative strategies like free translation, transliteration with annotation, or explanatory translation must be employed. This provides students with a clear, explainable, and operational theoretical basis for their translation practice, avoiding pedagogical blindness and empiricism in teaching.

Therefore, introducing pragmatic relevance theory into business English translation teaching is not merely a simple theoretical addition but a profound paradigm revolution. It shifts the teaching focus from “text” to “communication”, from “teacher-led” to “student decision-making”, from “knowledge transmission” to “ability empowerment,” fully aligning with the goal of higher vocational education to cultivate high-quality, application-oriented skilled talents.

## **3. The specific application of pragmatic relevance theory in the Chinese-English translation of tea culture terminology**

Guided by pragmatic relevance theory, the practice of translating tea culture terminology from Chinese to English can be transformed into a series of well-founded strategic choices. The following section elaborates on its specific application with examples and how these can be converted into teaching content.

### **3.1. Literal translation**

When the literal meaning can produce the most appropriate meaning, for terms that either have established cognitive counterparts or represent conceptual gaps, literal translation is the most economical and efficient approach <sup>[7]</sup>. For example, “lǜcha” Green Tea. Since the association between green and tea color already exists in the Western cognitive context, literal translation can instantly activate the correct concept with minimal processing effort and strong relevance.

#### **3.1.1. Teaching implication**

Teachers should integrate digital tools and guide students in using online collaboration platforms such as WPS Office, Tencent Office to create, maintain, and update a digital terminology database. Besides, students can utilize the terminology module in Computer-Assisted Translation (CAT) tools for practical training. This helps systematically distinguish which terms fall into the category of directly transferable “universal terminology”. Furthermore, virtual simulation scenarios or corpus retrieval tools can be used to train students’ ability to quickly identify, automatically match, and effectively apply such terms, enhancing their translation efficiency

and accuracy empowered by technology.

### **3.2. Free translation**

When the literal meaning fails to establish sufficient relevance, that is, when the cultural connotations of a term far exceed its literal meaning and a literal translation would lead to confusion or misunderstanding, free translation should be employed to reconstruct the relevance<sup>[7]</sup>. For example, a literal translation “gongfucha” as “Kungfu Tea” may mislead Westerners into associating it with “martial arts”. However, its core connotation is “the art of tea preparation that involves spending time, emphasizing skills, and brewing carefully”. Therefore, free translations like “brewed with great skill and care” or “artisanal tea preparation” can better convey its essence. Although more processing effort is required, a more accurate contextual effect is achieved. For another example, “lenghouhun” refers to the milky coagulation that occurs when tea soup cools down, which is a sign of high-quality black tea. A literal translation like “cold after muddy” would be a complete failure. Free translations such as “creaming down (a sign of quality tea)” or “Tea cream formation” establish the correct relevance<sup>[8]</sup>.

#### **3.2.1. Teaching implication**

This is the focus and difficulty of teaching. Against the backdrop of digital education, teachers can fully utilize virtual simulation laboratories or online collaboration platforms (such as Miro and Padlet) to create cross-cultural communication situations and organize students to conduct online group discussions and case comparison analyses. Teachers should guide students to search for and analyze parallel corpora or using interactive translation teaching systems, therefore, they can intuitively compare the effects of literal and free translations and train their ability to accurately “deconstruct” the deep cultural connotations of terms. At the same time, students can be encouraged to use AI-assisted translation tools to initially generate translations, and then critically evaluate and optimize them around “relevance” and “contextual effect”, ultimately enhancing their digital practice ability to accurately “reconstruct” meaning in the target language context.

### **3.3. Transliteration and annotation**

For core concepts with extremely high cultural load and complete conceptual void in English, transliteration is the first step to preserve cultural identity, but it must be supplemented with annotation to establish relevance<sup>[9]</sup>. For example, “wulongcha” as “Oolong Tea”. The transliteration has been widely accepted. And teachers should thoroughly explain its etymology (the legend of “black dragon”) in teaching, thereby establishing a strong association between “Oolong” and “a type of semi-fermented tea” in students’ minds. For another example, “liubaocha” as translated to “Liubao Tea”. Adding a brief note after the transliteration: “Liubao (a famous dark tea from Liubao Town, Guangxi, China)” can convey the information that Liubao is a famous tea-producing area in Guangxi, China, helping to enhance international audiences’ awareness and interest in Guangxi Liubao tea<sup>[1]</sup>.

#### **3.3.1. Teaching implication**

Teachers should emphasize that transliteration is never the endpoint of translation but the starting point of cross-cultural transmission. In a digital teaching environment, students can be guided to use online collaboration platforms to jointly build a “Digital Knowledge Base for Characteristic Chinese Cultural Terms”, which includes not only the standard transliteration but also etymology, cultural background, recommended



explanatory phrases, and multimedia resources (e.g., images, short videos). At a practical level, students can be encouraged to use the terminology and translation memory features of CAT tools to automatically add brief, standardized parenthetical notes or footnotes for transliterated terms like “Tieguanyin” when translating product descriptions, ensuring consistency and explanatory professionalism<sup>[10]</sup>.

Additionally, the production of micro-lesson videos or AR/VR immersive cultural experience projects can be employed to vividly narrate the legends associated with “Oolong” and dragons, as well as the historical connections between “Tieguanyin” and Buddhism. Through this in-depth cognitive process, students can internalize the application scenarios and business value of the “transliteration plus annotation” strategy. This enables them to more skillfully create accurate and profound new associations for concepts unique to Chinese culture in future cross-cultural business communication.

### **3.4. Adaptive translation**

**Dynamic Adaptation for Business Communication:** This represents the highest-level application of Relevance Theory in business contexts. To achieve optimal promotional impact (contextual effects) in target markets, translators may strategically add, delete, restructure, or culturally adapt source information<sup>[11]</sup>. For example, the Chinese description “zhe kuan pu er cha chen xiang chun hou” is rendered as “This aged Puer Tea boasts a complex, earthy aroma and a smooth, mellow taste, highly valued by connoisseurs for its unique character developed over time”. The translation incorporates marketing-oriented phrases like “highly valued by connoisseurs” and reinterprets “chenxiang” which means aged fragrance, through Western wine-tasting terminology such as “earthy aroma” and “complex”, effectively evoking quality associations among target consumers and fulfilling commercial promotional objectives.

#### **3.4.1. Teaching implication**

Project-based learning such as designing an English website for a tea brand can be used to simulate real business scenarios. Students can be tasked with writing different translated copy for the same product based on different audiences and platforms, deeply experiencing the strategic and creative nature of “adaptive translation”.

## **4. Suggestions for teaching implementation: Reform and innovation empowered by digitalization**

In order to effectively transform the translation strategies of tea culture terminology guided by pragmatic relevance theory into teaching achievements and deeply integrate them into the wave of educational digitalization, this study proposes the following systematic suggestions for teaching implementation:

### **4.1. Digital modular teaching reconstruction**

The traditional linear teaching sequence should be broken, and a modular teaching system integrating “online theoretical foundation-virtual case exploration-digital training empowerment” should be established<sup>[12]</sup>. The theoretical module can rely on online course platforms (such as Chaoxing Platform) to release micro-lessons, lecture videos, and interactive quizzes to consolidate students’ foundation in pragmatic relevance theory. The case module can make use of virtual simulation laboratories or interactive translation teaching systems, embedding rich real materials such as tea export packaging, international e-commerce detail pages, and exhibition materials to create immersive problem-solving situations. The training module should focus on introducing computer-assisted translation (CAT) tools, corpus search platforms, and AI-assisted

translation systems to guide students in completing the whole process of terminology management, translation, proofreading, and quality assessment under the support of technology.

## **4.2. Intelligent teaching case database construction**

A digital teaching case database should be built integrating Chinese-English terminology, correct/incorrect examples, cultural background explanations, and multimedia materials <sup>[13]</sup>. Teachers and students should be encouraged to use network technology to collect and annotate authentic materials from tea cross-border e-commerce platforms, international brand websites, overseas social media, etc., and use databases or online collaboration platforms for intelligent classification, retrieval, and sharing. This case database should support multi-dimensional tagging, for example, by strategy: literal/free/transliteration/adaptive; by terminology type: tea type/process/sensory evaluation, and more which use to facilitate independent inquiry and comparative analysis by students, providing strong data support for translation decision-making.

## **4.3. Cloud-based translation workshop simulation**

The “cloud-based translation workshop” teaching model should be fully implemented <sup>[14]</sup>. Students use online meeting platforms and collaborative whiteboards to organize online group discussions, translation presentations, and peer reviews. Teachers can share screens in real-time to demonstrate how to use CAT tools for terminology unification and management, or guide students in critically optimizing and evaluating the relevance of AI-generated initial drafts. The core of the workshop is to use digital tools to make students’ thinking processes, collaboration workflows, and draft iterations visible, thereby deepening their understanding and application ability of pragmatic relevance principles.

## **4.4. Collaborative digital project practice between higher vocational colleges and enterprises**

Teachers should actively establish cooperative relationships with tea export companies, cross-border e-commerce firms, or localization service providers and introduce real localization projects (such as the creation of English product catalogs, website globalization, and translation of e-commerce detail pages) <sup>[15]</sup>. Through remote collaboration platforms and cloud-based project management tools, students form online project teams to assume roles such as project manager, translator, and reviser, applying learned strategies and technical tools to complete tasks within authentic business processes. Industry experts participate in online mid-term reviews and final defenses, providing real-world feedback. This approach not only enables students to accumulate practical experience but also deepens their understanding of collaborative models and the commercial value of translation work in the digital age.

## **5. Conclusion**

This paper explores the guiding value and application strategies of pragmatic relevance theory for the translation of tea culture terminology from the perspective of educational digitalization. The research indicates that this theory provides a solid theoretical foundation for terminology translation, while digital tools and platforms such as CAT, online corpora, cloud-based workshops do offer efficient pathways for translating theory into practice. The integration of modular courses, intelligent case libraries, and real-world project practice can not only significantly enhance teaching efficiency and students’ learning experiences but also cultivate their core competencies in cross-cultural communication and digital collaboration.

In the future, researchers could further explore the application of artificial intelligence technology in the precise assessment of term translation and personalized teaching feedback, continuously deepening the reform and innovation of business English translation teaching.

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# Dynamic Trajectory of Sharing Behavior in Rural 4–5 Children: A Situational Experiment

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**Abstract:** Sharing behavior is of great significance to the development of young children. This paper takes 170 middle class children as a sample to explore the influencing factors of sharing behavior in preschool children and its age development characteristics. This study shows that the score of willingness to share and the number of shares was inversely proportional to the value of the shared items; When there is an abundance of items to share, children share significantly more in the presence of the sharing partner than in the absence of the partner. Based on the findings, educational recommendations are made from three aspects: cultivating intrinsic motivation in children, enhancing the stability of children's behavior, and guiding children to form correct values.

**Keywords:** Preschool children; Sharing behavior; Age development characteristics; Influencing factors

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## 1. Introduction

As a typical altruistic act, sharing refers to the behavior of an individual who is willing to share something, a resource, or an emotional experience with others <sup>[1]</sup>. It is of great significance for children to build good interpersonal relationships and promote the development of social and emotional abilities and moral standards <sup>[2]</sup>. The age of 4–5, being a crucial period for the development of empathy, theory of mind and peer relationships, is regarded as a rapid period for the development of shared ideas and behaviors <sup>[3]</sup>. When the recipient has a resource need, the child shares more candy compared to when there is no resource need. Conventional behavior, like having a resource need, is more likely to encourage 5–6 year old children to share generously <sup>[4]</sup>. There is a significant positive association between the quality of a child's attachment and three prosocial behaviors (helping, sharing, and comforting) <sup>[5]</sup>. A mother's choice does not necessarily reduce sharing behavior and feelings. A positive mother-child relationship and reasonable reasons have a protective effect on a child's sharing motivation when the mother makes a choice <sup>[6]</sup>. Studies show that the development of sharing behavior in young children is age-specific, with 5 year old children showing more prominent sharing behavior than 3 year old children <sup>[7]</sup>. Older children reported mainly pride as positive emotions in actual sharing tasks, while



younger children reported more joy<sup>[8]</sup>. However, as the study progressed, supporting evidence for other different viewpoints gradually emerged. Further research has confirmed that the psycho-theoretical ability of children aged 3–6 predicts an increase in their sharing with friends over time. The interaction between age and recipient type suggests that older children are more likely to make prosocial allocations to friends and strangers<sup>[9]</sup>.

## **1.1. Research questions**

We will examine the following questions. Firstly, did the sharing behavior of young children changes before and after the study? Is it an increase or a decrease? Were there significant age differences between the two observations? Secondly, how do the elements influence children's sharing behavior under different conditional controls? How much variation do these factors account for together?

## **2. Research methods**

### **2.1. Research subjects**

In this study, 200 children aged 4–5 in the middle class were randomly selected from four rural kindergartens in Binzhou City, Shandong Province, with an average age of 56.37 months, and valid data of 170 children (85 boys and 85 girls) were retained.

### **2.2. Research materials**

This paper selects cartoon stickers as the research material. Before the formal implementation, three popular cartoon-themed stickers were prepared, including two sizes: large stickers (6 × 6 cm) and small stickers (3 × 3 cm).

### **2.3. Data processing and analysis**

Descriptive statistics, experimental effects analysis, difference tests, and multiple linear regression analyses were conducted using SPSS software.

## **3. Research results**

### **3.1. Overview: age differences and development trends**

This study recorded in detail the willingness score of children to share in each task (1 point for willingness to share and 0 point for unwillingness to share), the actual number of papers shared, and the proportion of children whose number of papers shared decreased and increased in the post-test.

For example, in task T1, 14.2% of the children shared fewer sheets with others in the posttest than they did in the pretest, and 6.6% shared more stickers with others in the posttest than they did in the pretest. According to the results of the significant difference test, before the experiment, there was a significant age difference in the number of children to share, and the sharing behavior of young children showed an overall downward trend.

### **3.2. The specific effects of each factor in experiment 1**

When the number of shared items was insufficient (1, T1 and T5), children's willingness to share scores were significantly lower than when the number was sufficient (4/5, T2–T3 and T6–T7) (pre-test  $p = 0.001$ ; post-test  $p = 0.000$ ). However, regardless of whether the number of shared items was sufficient or not, there was no significant difference in the willingness to share scores among the children when the sharing object was present

or not.

### 3.3. The specific effects of each factor in experiment 2

#### 3.3.1. Different types of shared species and their presentation methods

All possible combinations can be divided into two categories based on the type of shared items and the way they are displayed: two groups of tasks for “the same number and type of shared items but different ways of display” and four groups of tasks for “the same number of shared items but different types and ways of display”.

Whether the recipients are present or not. Based on whether the sharing object was present, all the tasks were recombined to form six groups of tasks with the same number, type, and presentation of sharing objects but different sharing objects. **Table 1** shows the results of the significant difference test.

**Table 1.** Test results for significant differences in the number of shares when the sharing object is present and absent

Sharing objects	Present (T1–3, T4 overall, T4 special, T4 ordinary) VS absent (T5–7, T8 overall, T8 special, T8 ordinary)					
Types and their ways of presenting	Presented separately, all are regular stickers			It appears in combination with other types of stickers		
Quantity (variety)	1 Regular	4 Regular	5 Ordinary	1 special + 4 regular	1 Special	4 Ordinary
Mission	T1 and T5	T2 and T6	T3 and T7	T4 populations and T8 populations	T4 special and T8 special	T4 normal and T8 normal
Pre-test <i>p</i> value	0.334	0.000	0.000	0.000	0.880	0.000
Post-test <i>p</i> value	0.913	0.001	0.017	0.000	0.759	0.000

When the number of shared items is sufficient (4/5 of the total), the sharer shares significantly more in the presence of the target than in the absence of the target; In cases where the number of shared items is scarce (only 1), the difference in the number of shared items between the presence and absence of the target is not significant.

In the pretest, factors such as the type of shared items and their presentation and quantity could account for 40.3% of the overall variation; In the posttest, 37.5% of the total variation was explained. Moreover, the type of shared species and its presentation (standardized Beta: pre-test 0.432, post-test 0.393) had a greater impact on the willingness to share score than the number of shared items (standardized Beta: pre-test 0.369, post-test 0.381).

## 4. Discussion and analysis

### 4.1. The act of sharing is inversely proportional to the value of the shared object

When the types and display methods of shared items are the same, shared items with lower rarity have higher value. When the number of shared items is insufficient, children’s sharing behavior is significantly reduced <sup>[10]</sup>. When the number of shared items is scarce and the variety is unique, their value increases <sup>[11]</sup>. In this case, young children score low on willingness to share, share relatively fewer times, and show a certain degree of selective strategy in order to keep as many special stickers as possible and share the ordinary ones. This phenomenon is consistent with the findings of Lai Jiaxin et al., where young children tend to share less when faced with items or resources that they love, are novel, once exclusive, or have made efforts to obtain, that is, of higher value <sup>[12]</sup>. Younger children are more likely to engage in self-centered and hypothesis testing behavior than to

share, compared to older children. Young children do not share resources to the same extent; children share the most hard-earned prizes and the least accidentally obtained food <sup>[13]</sup>. Another study, excluding food, yielded completely different results, finding that children shared more of the premium stickers they got by accident and less of the plasticine they got through hard work <sup>[14]</sup>. This is because food is more valuable to children than the way they obtain it.

#### **4.2. Sharing behavior is influenced by social norms**

When there is an abundance of items to share, the presence or absence of a sharing partner only has a significant impact on the number of times a child shares, but there is no significant difference in willingness to share. Specifically, the number of shared items received by the person present was significantly greater, and this difference gradually decreased as the child grew older. In fact, this highlights that children's behavior is constrained by social norms. The theory of social norms holds that prosocial behaviors, including sharing, stem from the observation and learning of social rules. Once mastered, a certain sense of restraint is established in the mind, and it is believed that a certain behavioral response should or must be carried out in a specific situation. For children aged 4–5, they have the characteristics of obeying authority, respecting and strictly adhering to the rules set by authority. Meeting others' requests to share is an important criterion for them to regulate their own behavior and become good kids. Even if they hesitate a little during the sharing process, they will still choose to share for reasons such as expecting to follow the rules, gain approval, or avoid blame.

#### **4.3. The amount of explanations for external factors is limited and decreasing year by year**

In terms of willingness to share scores, the explanatory power of three factors, including quantity, type and presentation of shared items, and presence or absence has accounted for about 40% in the pretest and slightly declined in the posttest; In terms of the number of shares, only when the number of shared items was insufficient, the two factors of the type and display of shared items and the presence of the shared person had nearly 50% explanatory power for the number of shares in the pretest and decreased in the posttest. Children aged 3 shared more stickers and showed more prosocial behavior under the psychoactive robot observation conditions than under the other two observation conditions <sup>[15]</sup>. However, when the number of shared items was sufficient, the explanatory power of both factors was less than 10% in both pre and posttests. This result suggests that, on the one hand, there are significant differences in the explanatory power of each factor under different factor controls and scoring methods. On the other hand, these factors are all external, and their overall explanatory power is relatively limited and gradually weakens as the child grows older. This provides reliable contrastive evidence of the importance of intrinsic factors in children's sharing behavior.

### **5. Conclusions and recommendations**

This article provides a new perspective and dimension of thought on the controversy over the age development characteristics and trends of sharing behavior among preschool children. As we delve into the specific impact of various factors on children's sharing behavior and the reasons behind it, we further confirm the importance of internal factors in sharing behavior by examining the overall degree of influence of external factors and their development trends. Future research should continue to deepen and seek stronger evidence to support it. Other questions about the development characteristics of children's sharing behavior still need to be explored and answered by researchers. In educational practice, teachers can use various methods such as situational

stories and picture book reading to guide children to understand the emotional states of others and thereby build empathy. Set up a variety of social interaction scenarios to enhance the stability of children's sharing behavior. Guide children to form correct values and try to reduce their dependence on material things and the mentality of exclusivity.

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# A Study on College English Teaching Practice from the Perspective of Applied Linguistics Theory

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**Abstract:** With the in-depth implementation of educational reform, college English should also keep pace with the times, focusing on reforms in theoretical and practical teaching to improve the effectiveness and efficiency of talent cultivation, enabling students to comprehensively apply their professional knowledge to related work after graduation. To promote the smooth implementation of reform, college English teachers need to conduct in-depth research on applied linguistics theory, understand its connection with college English, and improve the teaching quality of this subject by applying it to the entire process of English teaching. This paper focuses on exploring college English teaching practice from the perspective of applied linguistics theory, aiming to provide useful references for front-line teachers.

**Keywords:** Applied linguistics theory; Colleges and universities; English teaching

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## 1. Introduction

Currently, the reform of college English teaching is in full swing, with the goal of cultivating students' core English proficiency and intercultural communication skills to adapt to the new trends in educational development and meet the social demand for such talents. With the continuous deepening of higher education reform, teaching in various disciplines has strengthened the cultivation of practical talents, and the same applies to college English teaching. Although this teaching plays an important role in cultivating such talents, there are some urgent problems to be solved, such as outdated teaching methods and low learning enthusiasm of students<sup>[1]</sup>. As an independent discipline, applied linguistics has distinct practical characteristics. It studies linguistic knowledge and theories and applies them to language disciplines, which is conducive to solving practical problems. It can be said that it has created new opportunities for the reform of college English teaching. From this perspective, this paper aims to understand the nature of linguistics, explore its laws, and analyze the approaches to English teaching practice, hoping to provide new ideas for the teaching reform<sup>[2]</sup>.

## **2. The connection between applied linguistics and college English linguistics**

An analysis of applied linguistics reveals that it studies language use, and its application in college English teaching has positive significance. It provides theoretical support and methodological guidance for such teaching. For example, in terms of teaching objectives, this branch of linguistics focuses on cultivating students' language communication skills and intercultural communication competence. At the level of teaching content, teachers, when designing courses, need to take second language acquisition as a theoretical guide. While strengthening language input, they should also attach importance to cultivating students' cultural cognitive ability, such as conducting vocabulary teaching with the help of corpora. In terms of teaching evaluation, the evaluation system based on this linguistics helps colleges and universities build a new assessment mechanism to comprehensively evaluate students' language ability. By focusing on students' learning processes, it has changed the previous single examination-based assessment method<sup>[3]</sup>.

Meanwhile, making full use of neurolinguistics and applying it to information-based teaching is conducive to improving teaching quality. In short, integrating theory with practice can inject new vitality into such teaching, enabling it to adapt to the current talent training situation. It also emphasizes the induction, analysis, and summary of students' learning characteristics, creating favorable conditions for subsequent local innovation and reflecting the application and guiding value of this linguistics<sup>[4]</sup>.

## **3. Theoretical basis for college English teaching practice from the perspective of applied linguistics**

### **3.1. Social constructivist learning theory**

An analysis of social constructivist learning theory shows that the characteristics of language learning it advocates, such as sociality and situationally, having important guiding value for English teaching<sup>[5]</sup>. The theory holds that for learners to learn a language well; social interaction is indispensable. In addition, they should actively participate in the situations created by teachers, and language ability is closely related to the social environment.

First, the sociality of language learning means that learners acquire language knowledge and master language skills through interaction with others<sup>[6]</sup>. In teaching practice, college English teachers should actively organize various activities, encourage students to step out of their small world, and actively engage in social interaction with others. Through language communication and interaction with peers, students can acquire English knowledge and skills. Such interaction can not only improve students' language output ability but also indirectly cultivate their language input ability, which is of positive significance in stimulating students' learning enthusiasm and improving their learning effects<sup>[7]</sup>.

Second, another characteristic of language learning is situationally, which emphasizes that learners improve their language application ability through real situations. In teaching practice, college English teachers can simulate real situations to create communication scenarios for students and guide them to apply the knowledge they have learned in these scenarios. This practice helps improve students' learning efficiency, that is, deepening their impression of the learned language and enhancing their language application skills<sup>[8]</sup>.

Finally, a major theoretical basis for college English teaching practice from the perspective of applied linguistics is task-oriented teaching. This teaching method emphasizes the dominant position of learners, advocates their active learning, and cultivates students' comprehensive abilities, such as language learning ability and communication ability, through practical tasks. In addition, this teaching method places students at the core. By scientifically and reasonably designing tasks and endowing them with meaning, it can enable

students to exert their subjective initiative. When encountering problems, they will not shrink back but rise to the challenge, take the initiative to explore and solve problems, making their English learning more efficient. This learning method integrates active participation and initiative, which is conducive to changing students' passive learning attitude, improving their learning confidence, and cultivating their self-learning ability<sup>[9]</sup>.

### **3.2. Meaning-oriented teaching theory**

First, this theory holds that learning effects are closely related to learners' initiative and cooperativeness. Initiative can prompt learners to change their learning attitudes and participate actively, while students' cooperation not only enhances communication but also helps build knowledge systems. The significance of learning plays an important role in stimulating students' initiative and interest in exploration<sup>[10]</sup>.

In college English teaching, teachers should respect students' dominant position, allow them to give full play to their subjective initiative, provide them with learning tasks, and create a good learning atmosphere to promote students' language learning and improve their communication and interpersonal skills. On one hand, the theory emphasizes that learners should exert their initiative. When teaching is conducted with a focus on meaning, learners play a more active role. By actively participating in communicative activities, they build and improve their knowledge systems, which also helps stimulate and sustain their enthusiasm for learning. Meaningful learning can broaden students' horizons, enabling them to connect what they learn with real life, deepening their understanding and laying a solid foundation for the application of knowledge. On the other hand, the theory highlights learning cooperation. Through cooperation with peers, students analyze and solve problems together, and exchange and discuss viewpoints and experiences. Such cooperation also provides students with new ways of thinking and is an important way to cultivate their sense of cooperation and team spirit.

Second, give full play to the role of task significance to enhance students' learning motivation<sup>[11]</sup>. If the learning tasks assigned by teachers are combined with students' interests and learning needs, it will often change students' inherent cognition, make them realize the significance of learning. In the process of completing tasks, students will gain a sense of achievement, which stimulates their internal motivation for learning.

Finally, let emotion and cognition influence and promote each other. In teaching practice, the meaning-oriented teaching theory should be fully applied to enable emotion and cognition to interact and reinforce each other. Specifically, the impact of improved cognitive ability on students' learning is reflected in more comprehensive mastery and deeper understanding of learning content, which is an important way to cultivate their learning confidence and enhance their sense of learning achievement. When tasks are completed smoothly or problems are properly solved, students often burst out stronger willingness to learn and gain a full sense of achievement, which is an important way to improve the efficiency of both teaching and learning<sup>[12]</sup>.

## **4. Strategies for implementing college English teaching from the perspective of applied linguistics**

### **4.1. Reforming teaching methods to enhance students' comprehensive abilities**

#### **4.1.1. Reforming teaching and assessment methods**

College English teachers should reform traditional teaching methods. While respecting students' dominant role, they should adopt diverse teaching approaches such as case-based teaching and project-based learning to boost students' learning enthusiasm. In actual teaching, teachers should fully analyze students' characteristics, interests, and learning needs to optimize teaching strategies, ensuring that every student receives guidance. In terms of assessment, under the student-centered philosophy, emphasis should be placed on comprehensive

evaluation to promote students' all-round development. This assessment method helps avoid the drawbacks of traditional evaluation by comprehensively assessing students' qualities and abilities, thereby facilitating their overall development and personalized growth<sup>[13]</sup>. In this process, teachers can flexibly use multiple assessment methods, such as peer group evaluation and project assignments, to assess students' learning outcomes.

#### **4.1.2. Application and interaction of artificial intelligence technology**

From the perspective of applied linguistics, the application of artificial intelligence (AI) technology has reformed college English teaching strategies and provided design paradigms for them<sup>[14]</sup>. Based on constructivist theory, AI tools optimize existing teaching strategies through core mechanisms. Firstly, intelligent algorithms enable the strategy of stratified teaching to accurately match individual cognitive levels. Secondly, language processing technology optimizes task-based teaching methods by providing corpus support. For example, the COCA corpus can be used to generate language tasks, mainly situational ones. Thirdly, interactive systems enrich the dimensions of hypotheses, specifically the Output Hypothesis and provide multi-dimensional feedback on language production through VR scenarios. The AI-driven evaluation system can refine language learning strategies into several micro-indicators, which helps improve teaching strategies and provides a basis for their improvement. This technology facilitates the implementation of the "teaching based on learning" strategy and offers a practical model<sup>[15]</sup>.

In writing teaching, for instance, AI provides support for the progressive feedback strategy, giving it an operational framework. In the teaching of college English essays, the system implements a three-level feedback strategy. The first level focuses on language accuracy. At this stage, AI tools pay attention to key training contents in textbooks, such as concessive adverbials, analyze the use of their clauses, and provide distribution maps for common misuses of although or though. The next level of feedback focuses on discourse coherence. Relevant technologies analyze textbooks to assess the match between topic sentences and supporting sentences, marking deviant paragraphs. The advanced level of feedback focuses on academic norms, automatically checking citation formats to see if they meet textbook standards.

In terms of feedback methods, embedded guidance is adopted, if students use key textbook vocabulary such as cultural identity or globalization in their writing, the system responds by automatically popping up example sentences or collocations from the original textbook content. The application of AI systems also helps strengthen connections with teaching materials by mapping semantic links between students' compositions and textbook texts. Through systematic analysis, it can determine whether students' writing aligns with the unit theme, which helps improve teachers' guidance.

### **4.2. Conduct interdisciplinary cooperation and strengthen resource integration**

#### **4.2.1. Emphasize the practicality and relevance of learning content**

Teachers should integrate knowledge from other disciplines into English teaching to make the learning content more practical and relevant. For example, scientific discoveries, social hotspots, and more, can be introduced into English classes, combining English learning with disciplines such as history, culture, and ideological and political education. This integration helps improve students' understanding of English knowledge and broadens their horizons.

#### **4.2.2. Cultivate interdisciplinary thinking ability**

For activities or projects involving intersections between English and other disciplines, students need to use multidisciplinary knowledge and master corresponding methods. For instance, in English classes, teachers



can incorporate scientific experiments, which not only trains students to express themselves in English but also encourages them to analyze and elaborate on learning content using theories and methods from other disciplines.

#### **4.2.3. Broaden students' learning horizons**

By integrating English teaching in colleges and universities with other disciplines, it becomes easier for students to access learning resources, grasp relevant cases, and understand the connections between various disciplines. Take the landscape architecture major as an example, through interdisciplinary integration, students can learn English while being exposed to professional terms in landscape architecture, which helps enrich their expression methods. Additionally, they can understand the specific application of English in other fields through concrete cases, which not only enriches their learning content but also stimulates their interest in learning and exploration, contributing to their all-round development.

#### **4.3. Design courses based on actual needs to promote students' all-round development**

First, conduct a comprehensive analysis of students' professional development needs. Students majoring in different fields require significantly different knowledge and skills. Therefore, when designing courses, teachers should analyze students' career development paths, identify the English skills and literacy required for their target professions, and incorporate these into the curriculum and teaching objectives. For example, for agricultural majors, college English courses should focus on science and technology, guiding students to read English scientific and technological literature and cultivating their ability to do so. For economics and management majors, the English courses should lean toward business English to develop their business communication and negotiation skills.

Second, integrate social hotspots. College English teaching should not be isolated from reality but keep pace with the times. Hot topics should be introduced into the classroom, and students should be organized to discuss and communicate, so as to enhance their learning enthusiasm. For example, incorporating popular issues such as environmental protection and the college entrance examination can help students learn professional terms while improving their expressive and pragmatic abilities. Third, focus on cultivating students' cross-cultural communication ability and national literacy. Against the background of globalization, there is an increasing demand for talents with cross-cultural communication skills. Therefore, when designing courses, teachers should emphasize the integration of content related to cultural awareness. By introducing international business-related content, they can strengthen the cultivation of students' communication skills and literacy.

### **5. Conclusion**

In a word, against the backdrop of the new era, college English teaching practices should conform to the new situation of the industry, adapt to the needs of new technologies, and based on applied linguistics theories, conduct in-depth exploration on college English teaching practices to develop new teaching concepts, modes and methods. To this end, we should have a clear understanding of the current shortcomings, and adopt various strategies such as reforming teaching methods to improve students' comprehensive abilities, carrying out interdisciplinary cooperation and strengthening resource integration. These efforts will help promote the reform of English teaching, steadily develop students' professional qualities, and enhance their core competitiveness. While advancing the construction of an education powerhouse, they will also contribute to the implementation of the strategy of making the country strong through talents.



## Disclosure statement

The author declares no conflict of interest.

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# Enhancing International Communication Effectiveness: The Impact of ESAP on the Output of Academic Paper Abstracts

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**Abstract:** English for Specific Academic Purposes (ESAP) focuses on English language skills in specific disciplines or research fields, and has played an important role in international communication in recent years. This paper aims to explore the relationship between ESAP, the output of academic paper abstracts, and international communication effectiveness, so as to provide new ideas for enhancing international communication effectiveness. Through a questionnaire survey and combined with the structural equation model analysis method, the results show that the improvement of ESAP has a positive effect on the output of academic paper abstracts and international communication effectiveness; the output of academic paper abstracts can also positively enhance international communication effectiveness; meanwhile, the output of academic paper abstracts has a significant mediating effect.

**Keywords:** International communication effectiveness; Academic paper abstract; ESAP; Professional discourse competence; Postgraduate students

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## 1. Introduction

Enhancing the dissemination power and influence of Chinese civilization, and accelerating the development of a Chinese discourse and narrative system, are crucial tasks for strengthening China's international communication capacity building. The academic community in colleges and universities has widely argued that fostering college students' international communication competence holds positive significance, which aligns with the paradigm of education serving the high-quality development of the country<sup>[1]</sup>. The development of international communication capacity is inseparable from high-level professional foreign language proficiency. On one hand, it helps improve the effectiveness of international communication, enabling the effective dissemination of Chinese spirit, Chinese values, Chinese path, and Chinese strength, thereby contributing to shaping China's national image. On the other hand, it facilitates the international expression of Chinese wisdom<sup>[2]</sup>.

The objective of postgraduate English teaching is to meet the needs of cultivating postgraduates' ability

to produce and disseminate academic papers<sup>[3]</sup>. Among these abilities, academic writing and communication reflect postgraduates' research capabilities and academic standards. The ability to produce written outputs, as well as the ability to acquire materials, extract information, and conduct research innovation using foreign languages, plays a vital role in demonstrating professional competence, publishing in international journals, and enhancing academic discourse power. Currently, many colleges and universities offer ESAP (English for Specific Academic Purposes) courses for postgraduates, which highlight the interdisciplinary integration advantages of "major + foreign language +" and align with the goal of cultivating first-class interdisciplinary talents proposed in the "New Liberal Arts" initiative<sup>[4]</sup>. Specific-purpose languages primarily provide targeted linguistic support for learners and professionals to engage in specialized academic research, management, and other work using English. They explore the genre structure and communication principles across various disciplines to achieve effective professional communication<sup>[5-7]</sup>. However, at present, postgraduates' professional academic writing skills and international communication capabilities urgently need improvement, and insufficient attention is paid to teaching objectives such as literature reading and academic writing.

Research on the effectiveness of international communication covers multiple fields, including culture, sports, communication strategies, talent cultivation, and social media. Among these studies, research on the role of English for Specific Academic Purposes (ESAP) courses and academic abstracts in enhancing the effectiveness of international communication is relatively scarce. As a carrier of cultural communication, Chinese academic achievements are also an indispensable part of efficient international communication. Additionally, the research gap regarding the relationship between academic abstract production and ESAP, as well as their role in the effectiveness of international communication, deserves attention.

Previous study mentioned that students' English abstract writing skills are not proficient, with overuse of the simple present tense, excessively high frequency of active voice, and incomplete abstract structure<sup>[8]</sup>. A study pointed out that students have a vague understanding of the stylistic characteristics of abstracts; they use simple methods to achieve textual cohesion and coherence, resulting in lengthy texts and non-concise language; and they lack dynamic mastery of the new characteristics of disciplinary language<sup>[9]</sup>. Currently, the English abstracts of postgraduates' graduation theses in China mainly have problems such as spelling errors, non-standard use of tenses and voices, incomplete content structure, expression influenced by Chinese thinking patterns, and machine translation issues. It is difficult for students to flexibly apply genre knowledge in combination with communicative contexts<sup>[10,11]</sup>. This survey found that: the scattered content of teaching courses, weak connection between knowledge points, insufficient authenticity of the teaching environment, and lack of scenario design affect learners' self-efficacy and academic attitude; even if postgraduates have passed the College English Test Band 4 and Band 6, their academic English writing skills are still not ideal, as they struggle even with short English abstracts. All these reflect the inadequate integration of postgraduates' professional knowledge and academic language, as well as the lack of genre-based teaching practices.

ESAP courses provide targeted training in discipline-specific vocabulary and language conventions, helping learners understand the structural elements and stylistic nuances required to produce clear and concise abstracts, thereby contributing to overall academic success. ESAP serves as a bridge between learners' general English proficiency and the professional language skills needed to write academic papers. Secondly, as a concise summary of an academic paper, an abstract is a window for readers to understand the content of the paper. In terms of the effectiveness of international communication, abstracts should fully consider the structuring of content, the accuracy of language, the reasonable use of professional vocabulary, and sensitivity to cultural differences. However, few studies have focused on the impact of ESAP on the production of academic paper

abstracts, despite the close connection between the production of academic paper abstracts and the effectiveness of international communication. Therefore, this study aims to bridge the gap between learners' language skills and the specific terminology required to convey professional academic content, emphasize "language reconstruction" and "conceptual transformation", and strive to provide new ideas for the effective dissemination of academic achievements and the enhancement of China's international communication effectiveness, as well as to provide feedback for teaching.

## 2. Research design

The research hypothesizes that the quality indicators of academic abstracts (accuracy, conciseness, completeness, structure, and reader acceptance) and the six dimensions of international communication effectiveness (language clarity, cultural sensitivity, communication channels, international citation rate, interdisciplinary influence, and open access) have a significant impact on the overall effectiveness of academic abstracts and their international communication effectiveness.

A total of 251 postgraduate students majoring in non-English disciplines from universities were recruited for the survey, covering majors such as International Economics and Trade, International Business, Finance, Economics, Law, Business Administration, International Chinese Language Education, Journalism and Communication, and Accounting. The questionnaire was designed to include four parts, including personal information, measurement of academic English proficiency, evaluation of academic abstract quality, and evaluation of international communication effectiveness.

The sample data showed high diversity. Among the samples, males accounted for 54.6% (137 participants) and females accounted for 45.4% (114 participants); in terms of grade distribution, first-year postgraduates accounted for 28.3% (71 participants), second-year postgraduates accounted for 32.7% (82 participants), and third-year postgraduates accounted for 39.0% (98 participants). Regarding English proficiency, 31.5% of the students held a College English Test Band 4 (CET-4) certificate, 35.5% held a College English Test Band 6 (CET-6) certificate, and held higher-level English proficiency certificates for about 33.1%.

The construction of the research model is based on the evaluation of academic abstract quality and international communication effectiveness. The evaluation of academic abstract quality includes accuracy, conciseness, completeness, structure, and reader acceptance<sup>[12]</sup>. The evaluation of international communication effectiveness covers language clarity, cultural sensitivity, communication channels, international citation rate, interdisciplinary influence, and open access<sup>[13]</sup>. Using these data, a research hypothesis model was constructed to explain the impact of these dimensions on academic abstracts and their effectiveness in international communication.

## 3. Research analysis

### 3.1. Reliability and validity analysis

**Table 1** shows that the Kaiser-Meyer-Olkin (KMO) Measure of Sampling Adequacy reached 0.954, which is higher than the commonly accepted standard of 0.954 ( $> 0.7$ ). This indicates that the partial correlations among variables are low, so the data is suitable for factor analysis. In addition, the results of the Bartlett's Test of Sphericity show that the approximate chi-square value is 3475.804, with 171 degrees of freedom, and the significance level reaches the conventional significance level of 0.000 ( $< 0.05$ ). This means that there is a common factor structure among the data, and the null hypothesis that all variables are mutually independent

is rejected. The combination of these two indicators shows that the scale used in this study has high statistical applicability and is suitable for subsequent construct validity verification and other multivariate statistical analyses.

**Table 1.** Structural validity analysis: KMO and Bartlett's test

KMO Measure of Sampling Adequacy		.954
Bartlett's Test of Sphericity	Approx. Chi-Square	3475.804
	Degrees of Freedom (df)	171
	Significance	.000

**Table 2** presents the results of the reliability analysis, showing that all Cronbach's Alpha coefficients are higher than 0.9, the Cronbach's Alpha coefficient for ESAP (English for Specific Academic Purposes) is 0.941, for academic paper abstract output is 0.908, and for international communication effectiveness is 0.919. These results are far higher than the conventional acceptable standard of 0.8, indicating that the scales for each variable have high internal consistency, which ensures the reliability of the measurement tool. A high Cronbach's Alpha value indicates that the scores of each item have high statistical consistency, thus verifying the reliability of the questionnaire in measuring attitudes and opinions. Therefore, it can be considered that the scale used in this study is statistically robust, providing a reliable measurement basis for further factor analysis and structural equation modeling.

**Table 2.** Reliability analysis

Research Variables	Number of Items	Cronbach's Alpha
ESAP	8	0.941
Academic Paper Abstract Output	5	0.908
International Communication Effectiveness	6	0.919

### 3.2. Confirmatory factor analysis

**Table 3** presents in detail the results of the convergent validity test. The convergent validity test is a method used to assess whether two or more theoretically related measurement tools actually measure the same construct. The latent variables included in the study are ESAP (English for Specific Academic Purposes), academic paper abstract output, and international communication effectiveness. Under the ESAP variable, the factor loadings of observed indicators such as compositional knowledge application ability and listening comprehension ability range from 0.775–0.840, indicating a high level of measurement consistency. In addition, the composite reliability (CR) of ESAP is 0.941, and the average variance extracted (AVE) is 0.665, both exceeding the criteria for determining good convergent validity ( $CR > 0.7$ ,  $AVE > 0.5$ ). For the latent variable of academic paper abstract output, its observed indicators (e.g., accuracy and conciseness) also show robust factor loadings. With a CR value of 0.908 and an AVE value of 0.664, it similarly demonstrates strong convergent validity. The relevant observed indicators of international communication effectiveness include language clarity and cultural sensitivity. Their factor loadings range from 0.786–0.820, with a CR of 0.918 and an AVE of 0.651, this further confirms the convergent validity of the model. Overall, these results verify that the measurement indicators of the scale have good statistical consistency and reliability, laying a solid foundation for further analysis.



**Table 3.** Convergent validity test

Latent Variables	Observed Indicators	Factor Loading	CR	AVE
ESAP	Organizational competence	0.818	0.941	0.665
	Listening comprehension	0.840		
	Reading comprehension	0.812		
	Oral expression	0.814		
	Written expression	0.821		
	Pragmatic ability	0.827		
	Interpreting ability	0.815		
	Translation ability	0.775		
Academic Paper Abstract Output	Accuracy	0.765	0.908	0.664
	Conciseness	0.826		
	Completeness	0.846		
	Structure	0.807		
	Reader acceptance	0.827		
International Communication Effectiveness	Language clarity	0.809	0.918	0.651
	Cultural sensitivity	0.818		
	Communication channels	0.800		
	International citation rate	0.806		
	Interdisciplinary influence	0.786		
	Open access	0.820		

**Table 4** presents the results of the discriminant validity test. The test assesses whether each latent variable in the model can be effectively distinguished by comparing the relationship between the correlation coefficients among different latent variables and the square root of the Average Variance Extracted (AVE) of each corresponding dimension.

**Table 4.** Discriminant validity test table

Latent Variables	ESAP	Academic Paper Abstract Output	International Communication Effectiveness
ESAP	0.815		
Academic Paper Abstract Output	0.579	0.815	
International Communication Effectiveness	0.623	0.592	0.807

Note: The values on the diagonal represent the square root of the Average Variance Extracted (AVE) for the corresponding dimension

The square roots of AVE for the latent variables ESAP, Academic Paper Abstract Output, and International Communication Effectiveness are 0.815, 0.815, and 0.807 respectively. These values on the diagonal represent the communality of the internal constituent elements of each latent variable. By comparing these values with the inter-latent-variable correlation coefficients on the off-diagonal in the table (for example, 0.579 between

ESAP and Academic Paper Abstract Output, and 0.623 between ESAP and International Communication Effectiveness), it can be observed that all correlation coefficient values are significantly smaller than the square roots of AVE of the corresponding latent variables. This result indicates that there is good discriminability among the latent variables, thereby verifying that the discriminant validity of the scale is reliable.

**Table 5** presents the results of the measurement model fit indices, which provide a comprehensive assessment of the degree of fit between the model and the observed data.

**Table 5.** Measurement model: table of measurement model fit indices

Fit Indices	$\chi^2/df$	RMSEA	GFI	AGFI	NFI	TLI	CFI
Reference Criteria	< 3	< 0.08	> 0.9	> 0.9	> 0.9	> 0.9	> 0.9
Results	1.021	0.009	0.941	0.925	0.957	0.999	0.999

Specifically, the value of  $\chi^2/df$  is 1.021, which is lower than the reference standard of 3, indicating that the model has a good fit. The RMSEA (Root Mean Square Error of Approximation) is 0.009, below the threshold of 0.08, demonstrating that the model error is extremely small and the goodness of fit is very high. Regarding other fit indices, the GFI (Goodness of Fit Index) is 0.941 and the AGFI (Adjusted Goodness of Fit Index) is 0.925, both exceeding the 0.9 benchmark, which reflects that the overall goodness of fit of the model is favorable. The values of NFI (Normed Fit Index), TLI (Tucker-Lewis Index), and CFI (Comparative Fit Index) are 0.957, 0.999, and 0.999 respectively. All these indices are significantly higher than the reference value of 0.9, indicating that the model performs excellently in the sample data.

The model fitting indices presented in **Table 6** provide us with a method to measure the degree of match between the statistical model and the observed data, and these indices indicate that the proposed model exhibits an excellent fitting effect. Specifically,  $\chi^2/df = 1.021$  ( $< 3$ ), which suggests that the error between the model and the data is small, and the model has a good fitting degree.  $RMSEA = 0.009$  ( $< 0.08$ ), implying that the model residuals are extremely small and the fitting quality is very high. GFI and AGFI are 0.941 and 0.925 respectively, both exceeding the good fitting standard of 0.9, which indicates that the model as a whole has a good consistency with the data. The values of NFI, TLI, and CFI are 0.957, 0.999, and 0.999 respectively, all significantly higher than the 0.9 standard. These indices show that the predictive accuracy and explanatory power of the model remain at an extremely high level even after adjusting for model complexity.

**Table 6.** Structural equation model: model fit indices table

Fit Indices	$\chi^2/df$	RMSEA	GFI	AGFI	NFI	TLI	CFI
Reference Criteria	< 3	< 0.08	> 0.9	> 0.9	> 0.9	> 0.9	> 0.9
Results	1.021	0.009	0.941	0.925	0.957	0.999	0.999

**Table 7** presents the test results of the direct effect paths in the structural equation model. Hypothesis H1 examines the impact of ESAP (English for Academic Purposes) on the output of academic paper abstracts. The path coefficient ( $\beta$ ) is 0.579, with an estimated value of 0.543, a standard error (S.E.) of 0.066, and a critical ratio (C.R.) of 8.281. The  $p$ -value is marked with three stars (\*\*\*), indicating  $p < 0.001$ , which proves this path is statistically extremely significant. Hypothesis H2 investigates the effect of ESAP on international

communication effectiveness. Here,  $\beta = 0.422$ , the estimated value is 0.406, the standard error is 0.069, and the C.R. value is 5.903; the  $p$ -value is also extremely significant. Finally, Hypothesis H3 explores the influence of academic paper abstract output on international communication effectiveness. For this path,  $\beta = 0.348$ , the estimated value is 0.356, the standard error is 0.073, the C.R. value is 4.850, and the  $p$ -value is likewise extremely significant. These results all support the research hypotheses, demonstrating that ESAP not only directly promotes the improvement of academic paper abstract output but also indirectly enhances international communication effectiveness by improving the quality of paper abstracts.

**Table 7.** Path test results of the structural equation model

Hypothesis	Path	Estimate	$\beta$	S.E.	C.R.	p	Result
H1	ESAP $\rightarrow$ Academic Paper Abstract Output	0.543	0.579	0.066	8.281	***	Support
H2	ESAP $\rightarrow$ International Communication Effectiveness	0.406	0.422	0.069	5.903	***	Support
H3	Academic Paper Abstract Output $\rightarrow$ International Communication Effectiveness	0.356	0.348	0.073	4.850	***	Support

The results of the bootstrap test for mediating effects shown in **Table 8** pertain to Hypothesis 4 (H4), which examines whether the output of academic paper abstracts plays a mediating role between ESAP and international communication effectiveness. The results indicate that the effect value of the mediating path “ESAP  $\rightarrow$  Output of Academic Paper Abstracts  $\rightarrow$  International Communication Effectiveness” is 0.194, with a standard error of 0.051. The Bias-Corrected 95% confidence interval ranges from 0.103–0.314. Since this confidence interval does not include 0, it demonstrates that the output of academic paper abstracts exerts a significant mediating effect between ESAP and international communication effectiveness. This finding emphasizes the bridging role of academic paper abstract output in enhancing the impact of ESAP on international communication effectiveness, and reveals the mechanism through which ESAP indirectly improves international communication effectiveness by enhancing the quality of academic paper output.

**Table 8.** Bootstrap test table for mediating effects

Hypothesis	Mediating Path	Effect Value	Standard Error	Bias-Corrected 95% CI	
H4	ESAP $\rightarrow$ Academic Paper Abstract Output $\rightarrow$ International Communication Effectiveness	0.194	0.051	0.103	0.314

Combining the analysis results from **Table 7** and **Table 8**, **Figure 1** constructs a structural equation model diagram, which shows that ESAP (English for Academic Purposes) exerts a positive effect on the output of academic paper abstracts, and the output of academic paper abstracts also has a positive impact on the effectiveness of international communication. At the same time, the output of academic paper abstracts plays a mediating role in the relationship between ESAP and the effectiveness of international communication.

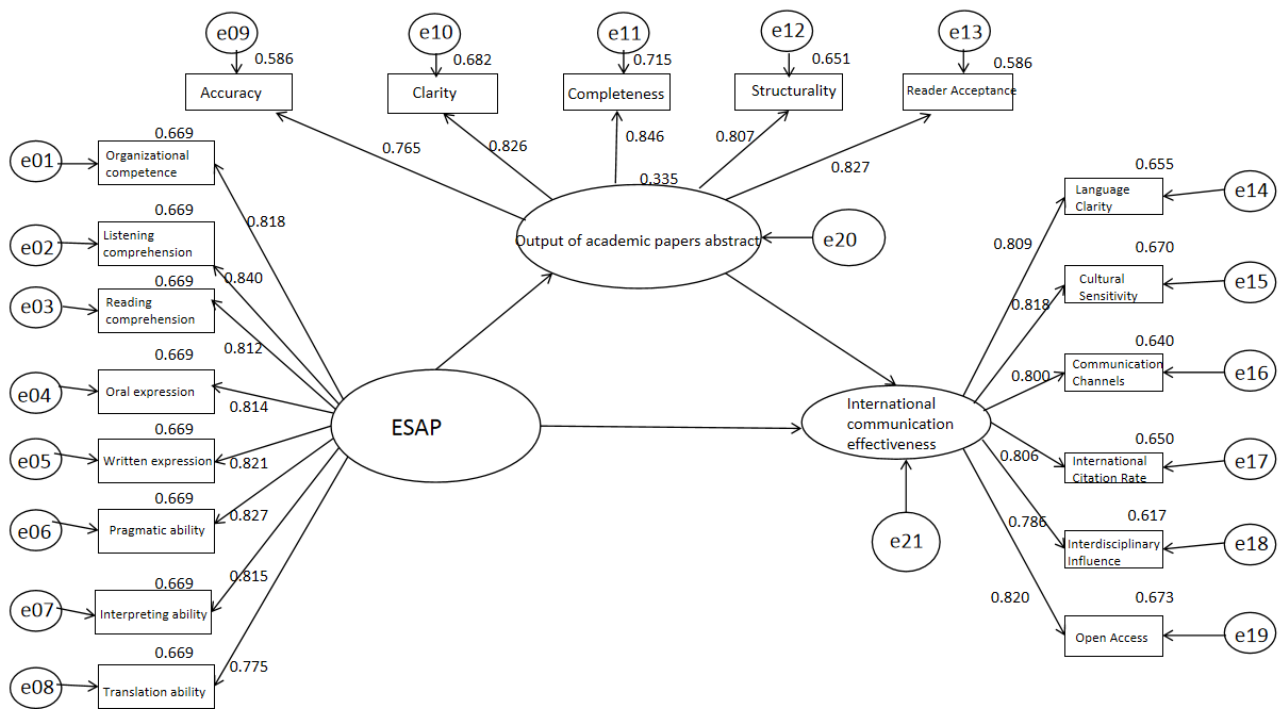


Figure 1. Structural equation model diagram.

## 4. Conclusions and implications

This study reveals that English for Academic Purposes (ESAP) training plays a positive role in enhancing the quality of academic paper abstracts and the effectiveness of international dissemination. Furthermore, the effective output of academic paper abstracts exerts a significant mediating effect on improving international dissemination effectiveness. The implications of the study are as follows.

Previous studies have mostly focused on the teaching effects of ESAP or discussed the optimization of academic paper abstracts in isolation. They lacked a quantitative analysis of how these two factors interact to enhance international dissemination effectiveness and overlooked the specific connections and interactions between academic English proficiency and the quality of academic paper abstracts<sup>[14]</sup>. This study addresses this gap and emphasizes the critical role of improving ESAP teaching quality in boosting the international dissemination of academic papers. Traditional communication theories rarely focus on the specific impact of language skills in specific academic fields on international communication. This study not only verifies the key role of language proficiency in ensuring effective communication within professional fields but also advances the application of communication theories in academic contexts.

In addition, the research results highlight the mediating role of academic paper abstracts and reveal the importance of improving abstract quality in optimizing academic communication. Based on the research findings, it is suggested that higher education institutions should attach importance to and strengthen the curriculum design of ESAP, particularly in teaching students how to write academic paper abstracts with international influence. This study not only expands the understanding of ESAP's role in the academic field but also promotes in-depth discussions on how to effectively disseminate academic knowledge through academic abstracts.

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# Research on the Construction Path and Practice of “Dual-Qualification and Dual-Competence” Teaching Teams in Higher Vocational Colleges—A Case Study of the Nursing Professional Teacher Team of Guangzhou Huanan Business College

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**Abstract:** Against the background of the in-depth reform of vocational education, the construction of “dual-qualification and dual-competence” teaching teams has become increasingly prominent as a core link to promote the in-depth development of industry-education integration and improve the quality of technical and skilled talent training. Due to its strong practical characteristics, the nursing major has higher requirements for teachers’ “dual-qualification and dual-competence” (systematic theoretical teaching ability and clinical practical operation ability). Taking the Innovation Team for Education and Teaching of Nursing Professional Group of Guangzhou Huanan Business College as the research object, this paper systematically analyzes the practical paths constructed by the team in the construction of “dual-qualification and dual-competence”, such as the “internal training and external introduction” teacher optimization mechanism, the “school-hospital collaboration” practical training platform, and the “quantitative + qualitative” evaluation system. It also deeply discusses the structural contradictions faced in the construction process and the breakthrough strategies. The purpose is to provide a referenceable and promotable practical model for the construction of teaching staff in higher vocational nursing majors and contribute to the high-quality development of vocational education.

**Keywords:** Higher vocational nursing; Dual-qualification and dual-competence; Teaching team; Industry-education integration

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## 1. Introduction

The National Vocational Education Reform Implementation Plan emphasizes the construction of a vocational education system supported by “dual-qualification” teachers, and proposes the construction of industry-

education integrated enterprises and high-level practical training bases to ensure the training of “dual-qualification” teachers<sup>[1]</sup>. The construction of “dual-qualification” teacher teams relies on industry-education integration as an important carrier and is also an institutional innovation in the reform of modern higher vocational education<sup>[2]</sup>. In 2019, the Ministry of Education issued the Construction Plan for Teachers’ Teaching Innovation Teams, initiating the construction of teachers’ innovation teams in vocational colleges<sup>[3]</sup>. “Dual-qualification” teachers play a crucial role in promoting cooperation between the education field and the industry. They can accurately grasp the needs of enterprises and integrate the latest industry technologies and knowledge into the teaching process<sup>[4]</sup>.

Nursing is a branch of the medical field with strong practicality, and the quality of nursing education affects the level of medical care. Nursing teachers are required to have solid theoretical knowledge and rich clinical experience. “Dual-qualification and dual-competence” is a criterion for evaluating the competitiveness of teaching teams. Since 2022, Guangzhou Huanan Business College has implemented the project “Innovation Team for Education and Teaching of Nursing Professional Group”, focusing on the cultivation of “dual-qualification and dual-competence” and exploring a characteristic development path. The team has achieved remarkable results in teacher optimization, teaching quality improvement, and social service capabilities, providing a reference for other colleges and universities.

## **2. Core paths for the construction of “dual-qualification & dual-competence” teaching teams**

### **2.1. Establishing a faculty optimization mechanism of “internal cultivation and external introduction”**

The fundamental project for building a “dual-qualification & dual-competence” team lies in improving the structural quality of the faculty. The cultivation of teachers should cover professional ethics, professional knowledge, teaching methods, and practical services<sup>[5]</sup>. Some scholars argue that teachers’ professional development involves three dimensions, knowledge, skills, and literacy<sup>[6]</sup>. The nursing team of Guangzhou South China Business and Trade Vocational College has adopted an internal-external integration approach, further enhance the quality through internal cultivation and improving effectiveness through external introduction, and to build a sustainable faculty development model.

In terms of enhancing internal capabilities, the team focuses on strengthening clinical practical skills and strictly implements the system of teachers engaging in practical training at enterprises. During summer vacations and other periods, teachers go to school-enterprise cooperation units to participate in frontline clinical tasks, and produce outcomes such as Reports on Teachers’ Practical Training at Enterprises to ensure the traceability of practice and the evaluability of results. Through practice, teachers can master the latest clinical standards, technologies, and processes, and transform cutting-edge information into teaching materials. By the mid-term inspection of the project, 5 teachers including Jiang Jinxia have passed the assessment and been rated as 2024 “dual-qualification” teachers in Guangdong provincial vocational education, which demonstrates the effectiveness of the internal cultivation mechanism.

When introducing external talents, the team focuses on recruiting industry experts with senior professional titles and high skills, aiming to make up for the shortcomings in the teaching of specialized nursing fields. It has successively recruited experts with rich clinical experience, such as Associate Professors Fang Chuyu and Mi Yufen. Their profound practical accumulation in the field of specialized nursing not only enriches the content of practical teaching, but also promotes the improvement of the team’s clinical practical ability through the

“mentorship” model, injecting vitality of industry frontiers into the team.

## **2.2. Innovating a practical training platform of “school-hospital collaboration”**

Practical platforms play a crucial role in connecting theoretical learning and practical operation, and are also key media for promoting the transformation of teachers’ “dual competences”. The mastery of technical skills is a process of gradual accumulation<sup>[7]</sup>. By establishing internship bases through school-enterprise cooperation, the team has built a talent cultivation model that integrates teaching, practical training, and scientific research, further promoting the in-depth integration of school education and clinical practice.

The team has reached cooperation intentions with 40 medical institutions including Guangzhou Xinsi Hospital to jointly build practical education bases. Cooperative units provide cross-department internship opportunities for faculty and staff, and arrange senior clinical nursing supervisors or attending physicians as instructors to teach and evaluate teachers’ clinical skills. In addition, schools, hospitals, and enterprises have jointly developed a loose-leaf Nursing Practical Training Guide, which has become an important tool for promoting the dual improvement of teachers’ professional and teaching capabilities. Breaking through the limitations of traditional textbooks, this guide integrates the latest nursing standards of cooperative hospitals with the teaching needs of the school. Some core contents are co-compiled by clinical head nurses and full-time lecturers to ensure that it not only meets practical application requirements but also conforms to the standards of the education system, providing a standardized teaching platform for the development of teachers’ “dual competences”.

## **2.3. Establishing a “quantitative + qualitative” competence evaluation system**

Establishing a reasonable and scientific evaluation system is particularly important for ensuring the quality of the “dual-qualification & dual-competence” education model. Evaluation criteria need to be both comprehensive and supported by scientific basis<sup>[8]</sup>. When constructing an evaluation system for teachers’ innovation teams, it is necessary to take into account both professional backgrounds and team characteristics<sup>[9]</sup>. This system aims to address the previous evaluation bias of emphasizing certificates over practical abilities, and builds a comprehensive assessment method around three dimensions to ensure fair and comprehensive evaluation. First, qualification certification, it confirms teachers’ basic qualifications for clinical practice based on rigid requirements such as nurse practitioner qualification certificates, years of clinical work experience, and training experience. Second, teaching transformation, through competitions such as curriculum presentations and clinical skills demonstrations, it measures teachers’ ability to transform clinical practice into teaching content, and tests their proficiency in integrating clinical cases and embedding industry standards into teaching. Third, social services, it refers to teachers’ achievements in participating in community nursing training, nurse practitioner qualification exam tutoring and more, to highlight the social significance of “dual-qualification & dual-competence”.

## **3. Construction achievements and phased outcomes**

### **3.1. Significant optimization of faculty structure**

After two years of efforts, the faculty structure of the team has achieved substantial improvement. The initial structure of “1 professor + 3 lecturers + 7 teaching assistants” has been optimized to “1 professor + 1 associate professor + 4 lecturers + 5 teaching assistants”. The proportion of “dual-qualified” teachers (teachers with both teaching and professional practical capabilities) has increased to 50%, among whom 3 teachers hold dual professional titles, meeting the dual standards of teaching ability and clinical skills. The overall quality of the

faculty has been significantly enhanced. Despite the increase in the proportion of “dual-qualified” teachers, the update of clinical practice is slow, and the mastery of new technical standards is insufficient, which has an impact on the timeliness of teaching<sup>[10]</sup>.

### **3.2. Continuous improvement of teaching quality**

With the support of the “dual-qualified and dual-competent” faculty team, courses such as Fundamental Nursing for the nursing major have been developed on the Learning Pass platform. By integrating clinical cases and virtual simulation resources, the course satisfaction rate has reached 92%. In skill competitions, teachers of the team have won 2 national-level awards. Among them, the achievements in the clinical nursing operation skill competition have provided technical support for the hybrid teaching mode of “online virtual simulation + offline practical operation”. This mode solves the problems of “high risk, high consumption, and difficulty in repetition” in traditional practical training, and enhances the practicality and innovation of teaching.

### **3.3. Enhancement of social service capabilities**

The “dual-qualified and dual-competent” faculty team has transformed their clinical experience into social service capabilities, realizing the integration of educational and social values. The team has carried out special tutoring for the National Nurse Qualification Examination, using clinical experience to analyze key and difficult points, which has enabled the first-time pass rate of nursing students in Grade 2021 to reach 71.4%. In addition, the team has organized 3 community health promotion activities and provided nursing skill training for nearby nursing homes, with a total service time exceeding 200 hours. These efforts have been widely praised by local residents, demonstrating the role of higher vocational nursing education in serving local medical and health undertakings.

## **4. Existing problems and breakthrough strategies**

### **4.1. Major bottlenecks**

#### **4.1.1. Insufficient depth of practice**

The corporate practice (hospital-based) of some teachers remains superficial. Due to the heavy workload of clinical work in hospitals and the poor matching between internship positions and actual needs, such practice often only focuses on the learning of basic nursing skills. It neglects the improvement of abilities in complex scenarios, such as emergency and critical care response and interdisciplinary collaboration. As a result, there is no significant improvement in their clinical operation capabilities.

#### **4.1.2. Inadequate ability of scientific research transformation**

When formulating development goals, most professional teacher teams in higher vocational colleges fail to effectively integrate the functions of teaching, scientific research, and social services, with a stronger emphasis on teaching<sup>[11]</sup>. Although our team is in charge of two school-level teaching reform projects, there is a shortage of scientific research achievements based on clinical practice. Most studies only stay at the level of discussing teaching methods, lacking the ability to identify specific problems in clinical nursing practice and transform them into research topics. Consequently, a positive cycle of “practice-research-teaching” has not been formed.

### **4.2. Improvement paths**

#### **4.2.1. Establishing a flexible talent introduction mechanism**

Strengthen school-enterprise cooperation by inviting experts from cooperative hospitals to serve as industrial



professors, who will participate in teaching through online lectures and offline guidance. Build a database of clinical physician mentors, assign clinical consultants to teachers, and improve teachers' ability to deal with complex medical scenarios through regular consultations and discussions. Special attention should be paid to young teachers in higher vocational colleges, providing them with policy, resource, and platform support to enhance their development capabilities<sup>[12]</sup>.

#### **4.2.2. Enhancing scientific research capabilities**

Conduct special training on scientific research projects transformed from clinical problems, invite experts to give lectures, and guide teachers to identify research topics from clinical practice to promote in-depth integration of scientific research and clinical practice. Adopt target management to scientifically allocate teaching and research tasks<sup>[13]</sup>. Establish a mechanism for transforming scientific research achievements into teaching resources, converting scientific research results into teaching cases, and using scientific research to drive the update of teaching content and the improvement of teaching quality.

### **5. Conclusion**

Building a “dual-qualification and dual-competence” teaching team for nursing majors in higher vocational colleges is a systematic and complex project, which must break through the superficial misunderstanding of valuing certificates over the cultivation of practical abilities. It is particularly important to establish a comprehensive system integrating practice, education, and evaluation based on the principle of in-depth cooperation between schools and enterprises. Only by proactively integrating into relevant industries can vocational colleges reshape and strengthen their confidence and concepts in talent cultivation<sup>[14]</sup>. The practice of the nursing professional teacher team of Guangzhou South China Business and Trade Vocational College has proved that only by allowing teachers to engage in in-depth work at the clinical frontline, transforming industry standards into specific teaching content, and using real clinical cases as important teaching resources, can high-level nursing talents meeting the needs of the big health industry be efficiently cultivated.

The development of education lies in improving the quality of teachers<sup>[15]</sup>. In the future, the team should strive to establish a stable long-term cooperation mechanism between the school and enterprises. By signing specific cooperation agreements, the responsibilities and rights of both parties in the process of school-enterprise joint training of teachers should be clarified, so as to effectively solve the “last mile” problem in practical teaching. In addition, it is necessary to explore the career development path for “dual-qualification” teachers, improve relevant incentive policies, stimulate teachers' internal motivation for self-improvement, and promote the dual improvement of their professional skills and practical abilities.

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