

# **International Education Forum**

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## International Education Forum

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# Cultivation Practice of Innovative and Entrepreneurial Talents in Universities in the Background of Industry-Education Integration

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**Abstract:** In the era of accelerated development of new productive forces and continuous upgrading of industrial structure, industry-education integration has become a core path to promote higher education reform and address the disconnection between the cultivation of innovative and entrepreneurial talents in universities and industrial demands. Based on the policy orientation and connotative significance of the times of industry-education integration, this paper systematically sorts out the theoretical basis and practical dilemmas of cultivating innovative and entrepreneurial talents in universities under the background of industry-education integration, explores the practical cultivation path of “school-enterprise collaboration, industry-education symbiosis, and the unity of knowledge and action”, verifies the effectiveness of the practice through specific cases, and puts forward targeted optimization strategies. The purpose is to provide practical references for universities to improve the quality of cultivating innovative and entrepreneurial talents, align with industrial development needs, serve the national innovation-driven development strategy, and promote the in-depth integration of industry and education and the coordinated development of innovative and entrepreneurial talent cultivation.

**Keywords:** Industry-education integration; Universities; Cultivation practice of innovative and entrepreneurial talents

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## 1. Introduction

As the core carrier of innovation-driven development, the quality of cultivating innovative and entrepreneurial talents is directly related to the effectiveness of industrial upgrading, the enhancement of national innovation capacity, and the sustainable development of the economy and society. A series of policy documents, such as the Implementation Plan for National Vocational Education Reform and the Opinions on Deepening the Reform of the Modern Vocational Education System, clearly state that it is necessary to deepen the integration of industry and education, promote the effective connection of the education chain, industrial

chain, and innovation chain, and cultivate a large number of high-quality, innovative, and entrepreneurial talents. Universities shoulder the important mission of delivering compound talents with an innovative spirit and entrepreneurial ability to society. However, for a long time, there have been common problems in the cultivation of innovative and entrepreneurial talents in Chinese universities, such as “emphasizing theory over practice” and “prioritizing classroom teaching over industrial engagement.” There are also difficulties, including the disconnection between talent cultivation programs and industrial development needs, insufficient practical teaching resources, superficial school-enterprise cooperation, and the weak practical ability of the teaching staff. As a talent cultivation model characterized by “in-depth integration of industry and education and collaborative talent cultivation”, the core of industry-education integration lies in breaking down the barriers between universities and enterprises, realizing the co-construction and sharing of educational and industrial resources, complementing each other’s advantages, and enabling students to enhance their innovative and entrepreneurial abilities in real industrial scenarios.

## **2. Deepen industry-education integration and establish a school-enterprise collaborative education mechanism**

### **2.1. Establish an in-depth school-enterprise collaborative mechanism**

Universities should proactively align with industrial needs, establish long-term and stable cooperative relationships with leading enterprises and small and medium-sized enterprises in the industry, sign school-enterprise cooperation agreements, and formulate specific implementation details for cooperation, so as to promote the development of school-enterprise cooperation from a superficial level to an in-depth one <sup>[1]</sup>. At the same time, a school-enterprise collaborative education leading group should be established, jointly led by relevant persons in charge of universities and enterprises, to coordinate and promote cooperation in talent cultivation, practical teaching, scientific research and innovation, entrepreneurial incubation, and other fields. Regular cooperation meetings should be held to solve problems encountered in the cooperation process, forming a collaborative education pattern of “joint construction, joint management, and shared benefits” between schools and enterprises.

### **2.2. Promote enterprises’ in-depth participation in the entire process of talent cultivation**

Enterprise representatives can be invited to participate in core links such as the formulation of talent cultivation plans, curriculum setting, teaching implementation, practical guidance, and evaluation and assessment, allowing enterprises to put forward talent cultivation requirements and suggestions based on their own job needs, so as to ensure that the talent cultivation plans are accurately aligned with enterprise demands <sup>[2]</sup>. Enterprises should assign technical backbones and entrepreneurial mentors to participate in university classroom teaching, practical guidance, project review, and other work, integrating actual enterprise projects, industrial standards, and technical specifications into the teaching process, so that students can understand the actual operation mode of enterprises and the development trend of the industry.

### **2.3. Establish a benefit-sharing mechanism for industry-education symbiosis**

A cooperation mechanism facilitating benefit and risk sharing between schools and enterprises should be established, aiming to achieve win-win results through various means such as jointly building practical training bases, collaborating on scientific research projects, and co-incubating entrepreneurial projects <sup>[3]</sup>.

Universities provide talent support services for enterprises to help them solve technical difficulties, while enterprises provide practical resources, financial support, and faculty supplements for universities to assist them in improving the quality of innovative and entrepreneurial talent training. Meanwhile, the government should introduce relevant policies to provide subsidies and other support for enterprises participating in industry-education integration, thereby stimulating their intrinsic motivation to engage in such collaboration.

### **3. Optimize talent cultivation programs and promote curriculum system reform**

#### **3.1. Establish innovation and entrepreneurship-oriented talent cultivation objectives**

Universities should integrate industrial development needs with their own educational characteristics, establish a three-in-one talent cultivation objective of “innovation awareness, entrepreneurial ability, and practical literacy” for innovative and entrepreneurial talents, and integrate innovative and entrepreneurial education into the entire process of professional talent cultivation, so as to cultivate versatile talents with outstanding innovative and entrepreneurial abilities<sup>[4]</sup>.

#### **3.2. Optimize the curriculum system and promote the alignment of curriculum content with industrial needs**

A three-in-one curriculum system consisting of “professional core courses+innovation and entrepreneurship core courses+practical courses” needs to be established, with an increased proportion of practical courses to ensure that the proportion of practical courses is not less than 30%. Professional core courses should update their content in conjunction with cutting-edge industrial technologies and enterprise job requirements, incorporating industrial standards and actual enterprise cases<sup>[5]</sup>; innovation and entrepreneurship core courses should cover innovative thinking training, entrepreneurial management, marketing, financing planning, intellectual property protection, and other fields to cultivate students’ innovative and entrepreneurial skills; practical courses should focus on combining with actual enterprise projects, offering courses such as project practice, entrepreneurial simulation, and internships, allowing students to improve their skills through practice.

#### **3.3. Innovate teaching models to enhance teaching effectiveness**

It is necessary to promote new teaching models such as project-based teaching, flipped classrooms, and blended teaching. Taking actual enterprise projects as carriers, guide students to actively participate in the entire project process and cultivate their innovative thinking. At the same time, invite enterprise technical backbones and successful entrepreneurs to enter the classroom to share actual enterprise cases and entrepreneurial experiences, enhancing the relevance and practicality of teaching. Online teaching platforms can also be utilized to integrate high-quality teaching resources, provide personalized learning services for students, expand teaching space, and improve teaching efficiency<sup>[6]</sup>.

### **4. Strengthen the construction of practical platforms and enrich practical teaching resources**

#### **4.1. Jointly build school-enterprise collaborative practical teaching bases**

Universities should collaborate with enterprises to jointly establish platforms such as training centers,



practical teaching bases, and entrepreneurial incubators, sharing enterprise resources, including equipment, technology, and venues, to provide students with authentic practical scenarios and positions. Based on industrial development needs and professional characteristics, targeted practical bases should be established, such as intelligent manufacturing practice bases, e-commerce entrepreneurial bases, and cultural and creative industry incubation bases, to ensure that practical teaching is consistent with industrial development. Meanwhile, the operation and management of practical bases should be strengthened, with professional managers and instructors appointed, and a comprehensive practical teaching management system established to ensure the orderly conduct of practical teaching.

## **4.2. Build an innovation and entrepreneurship incubation platform**

Educators should rely on school-enterprise cooperation resources to build platforms such as college students' innovation and entrepreneurship incubators and maker spaces, providing one-stop services for students' entrepreneurial projects, including venue support, equipment guarantee, technical guidance, financial support, and market connection. Educators should also invite enterprise mentors and investment experts to provide guidance for students' entrepreneurial projects, helping them improve their business plans, solve problems encountered in the entrepreneurial process, and promote the transformation and implementation of entrepreneurial projects. By holding innovation and entrepreneurship competitions, entrepreneurial salons, project roadshows, and other activities, educators can stimulate students' entrepreneurial enthusiasm, tap their innovative potential, and provide a platform for students to showcase and exchange ideas.

## **4.3. Enrich the content and forms of practical teaching**

A variety of practical teaching activities can be carried out, including internships, project practices, entrepreneurial simulations, and social practices, allowing students to accumulate experience and enhance their skills in different practical scenarios. Organize students to participate in actual enterprise project research and development, technical breakthroughs, and other activities, enabling students to understand the production process and technical standards of enterprises and enhance their ability to solve practical problems. Entrepreneurial simulation activities can also be carried out to simulate the entire process of enterprise registration, operation, and management, allowing students to accumulate entrepreneurial experience and enhance their entrepreneurial abilities. Organize students to carry out social practice activities, go deep into enterprises and communities to understand market demands, and explore entrepreneurial opportunities.

# **5. Strengthen the construction of a “dual-qualified” teaching staff and enhance educational capabilities**

## **5.1. Improve the practical ability, innovation, and entrepreneurship teaching ability of university teachers**

Firstly, universities should formulate teacher training plans, organizing teachers to take secondments in enterprises, participate in enterprise project research and development, attend industrial training, and other activities, so as to understand industrial development trends and enterprise actual needs, accumulate practical experience, and enhance practical teaching abilities. Secondly, teachers are encouraged to participate in innovation and entrepreneurship projects and scientific research and innovation activities to improve their

own innovation ability and entrepreneurial literacy, and integrate practical experience and innovation achievements into the teaching process. Furthermore, a mechanism for evaluating teachers' innovation and entrepreneurship teaching abilities should be established, incorporating the effectiveness of practical teaching and the results of guiding students in innovation and entrepreneurship projects into the scope of teacher assessment, so as to stimulate teachers' enthusiasm for improving their own abilities.

## **5.2. Strengthen the enterprise teaching faculty**

On the one hand, it is necessary to establish a corporate mentor pool, inviting enterprise technical backbones, entrepreneurial mentors, industry experts, and others to serve as part-time teachers in universities, participating in classroom teaching, practical guidance, project review, and other work to supplement the faculty strength of universities. On the other hand, it is also necessary to formulate an incentive mechanism for corporate mentors, providing them with corresponding labor remuneration, professional title recognition, and other preferential policies to stimulate their enthusiasm for participating in teaching and form a stable corporate teaching team. In addition, a two-way communication mechanism between university teachers and corporate mentors should be established to promote complementary advantages and mutual improvement.

## **5.3. Strengthen teacher training and exchange**

Regularly organize training for “dual-qualified” teachers, seminars on innovation and entrepreneurship teaching, school-enterprise teacher exchange activities, and other events, and invite domestic and foreign experts, outstanding teachers, and enterprise mentors to share teaching experience and practical insights, so as to enhance the overall level of the teaching staff. Encourage universities to collaborate with other universities and enterprises to jointly establish teacher training bases, share teacher training resources, and promote the coordinated development of teacher team building.

# **6. Improve the evaluation system and establish a sound incentive mechanism**

## **6.1. Establish a scientific and comprehensive innovation and entrepreneurship evaluation system**

Universities need to establish a diversified evaluation system that combines “process evaluation, summative evaluation, and practical achievement evaluation.” The evaluation content covers students' theoretical knowledge, innovation awareness, entrepreneurial ability, practical achievements, team collaboration ability, and other aspects, comprehensively reflecting students' innovative and entrepreneurial qualities. Process evaluation focuses on assessing students' learning and practical processes through classroom performance, practical reports, project progress, and other methods; summative evaluation focuses on evaluating students' innovation and entrepreneurship achievements through entrepreneurial projects, innovative works, internship performance, and other methods; practical achievement evaluation focuses on assessing the implementation and achievement transformation of students' innovation and entrepreneurship projects, ensuring the scientificity and objectivity of the evaluation.

## **6.2. Innovate evaluation methods and strengthen process evaluation**

A diversified evaluation method can be adopted, incorporating multiple evaluation subjects such as student self-evaluation, teacher evaluation, and enterprise evaluation, to ensure the comprehensiveness and fairness



of evaluation results. Information technology can also be utilized to establish student innovation and entrepreneurship files, recording students' learning processes, practical experiences, innovation achievements, and other information, so as to realize the informatization and intelligence of evaluation, promptly identify problems encountered by students in the process of innovation and entrepreneurship, and provide targeted guidance.

### **6.3. Improve the incentive mechanism to stimulate the enthusiasm of teachers and students**

Firstly, establish and improve a teacher incentive mechanism, providing incentives such as commendations, professional title promotion, and performance bonuses to teachers who participate in industry-education integration teaching, guide students in innovation and entrepreneurship projects, and carry out scientific research and innovation activities, so as to stimulate their enthusiasm for teaching and innovation. Secondly, establish a student incentive mechanism, providing financial support, honorary commendations, and credit recognition to outstanding students in innovation and entrepreneurship and excellent entrepreneurial projects, encouraging students to actively participate in innovation and entrepreneurship activities. At the same time, set up a special fund for innovation and entrepreneurship to provide start-up capital and subsequent development funding support for student entrepreneurial projects, promoting the transformation of entrepreneurial achievements.

## **7. Conclusion**

Industry-education integration is the core path to address the disconnection between the cultivation of innovative and entrepreneurial talents in universities and industrial needs, and it plays an important supporting role in talent cultivation in the background of new productive forces. The research in this paper shows that universities need to adhere to the concept of “school-enterprise collaboration, industry-education symbiosis, and the unity of knowledge and action”, and improve the quality of innovative and entrepreneurial talent cultivation by deepening industry-education integration and optimizing training programs. Currently, talent cultivation through industry-education integration still faces challenges such as insufficient integration depth and disconnection between courses and industries, which requires collaborative efforts from universities, enterprises, and the government. In the future, universities should proactively adapt to the needs of industrial upgrading, deepen industry-education integration, innovate training models, and contribute high-quality innovative and entrepreneurial talents to the country's innovation-driven development.

## **Disclosure statement**

The author declares no conflict of interest.

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# How Can Teacherhood Achieve Self-Determination? The Historical Background and A Recent Change in Light of the Five-Tier Grading System of the Nanyang Public School Normal College

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**Abstract:** The introduction of a teacher education system based on cultural subjectivity is among the best proposals that have been made under the new era for the development of high-quality education in China. The author is studying the Five-Tier Grading System as a specific training and testing program of the Nanyang Public School Normal College, which was the forerunner of the contemporary government-run normal education in China, and uses the historical institutionalism and textual analysis methodological approaches to deeply examine what it can be considered as an institution of a morally and academically advanced training system, a knowledge and practice incorporated system and a unified evaluation system and how it is rooted in the Confucian culture. The results indicate that the Five-Tier Grading System is not merely a knowledge evaluation system but a complete education system that involves moral growth, acquisition of knowledge, practical skills, and social accountability, hence a holistic approach in building a teacher personality. The present work critically builds upon the historical knowledge to tackle the current challenges and tries to create a model of training objectives of normal students, which will be called Three-Dimension and Five-Phase, to assist in resolving the current challenge in normal education, including a lack of cultural subjectivity and training goal uniformity. The framework is stated clearly in terms of progressive developmental indicators founded upon three critical dimensions of the physical body of a teacher, knowledge of a teacher, and the manners of the teacher to form the ideological basis to create localized discourse systems of teacher education and find out the progress of teacher education with Chinese characteristics creatively integrating the spirit of the traditional education with the current needs of the education.

**Keywords:** Nanyang Public School Normal College; Five-tier grading system; Cultural relativism; Personality of teachers; Training objectives

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## 1. Introduction

The quality of teachers is what drives the global educational competition. Having expanded over time and acquired a structure, the Chinese teacher education system is moving towards quantity and quality<sup>[1]</sup>. Although policy documents, including China Education Modernization 2035 and the New Era Basic Education Strong Teacher Plan, have raised the standards and assessments, the concept of an ideal teacher can be broken down into quantifiable competencies<sup>[2]</sup>. The conventional teacher image (the one that transmits information, eliminates doubts, and shapes individuals) is being pushed to the background, and there is a cultural identity crisis: can a teacher education system independent of culture be established in China with the development of globalization?

Existing models are based on the OECD competency model, but they pay attention to knowledge, skills, and effects. However, despite their practicality, they do not consider what the Chinese teacher needs to be. This culture is under threat as reducing ethics and sentiment to metrics might lead to the loss of culture. According to Ye Lan, the traditional pedagogy in China has to be grounded in the cultural heritage of the country and remind people of the old traditions of the land<sup>[3]</sup>.

That, in turn, makes the Nanyang Public School Normal College (1897) very important<sup>[4]</sup>. The founder is Sheng Xuanhuai, and it has become the first organized normal school in China. The Five-tier Grading System would be a synthesis of Confucianism and formal education in which the conceptual principles of teaching were transformed into methodical and progressive instruction on how to cultivate a well-balanced character. Its resurrection will restore the teachings of teacher education founded on culture.

Very few sources are available: they are either macro histories or references to them in university stories, or they merely brush up on the notion of Sheng. Research in the domain of the philosophy of education of this system is minimal. The present paper will examine the Five-Tier Grading System as one of the ways to explore the traditional knowledge, cultural subjectivism, and establish a culturally responsive and modern training model.

## 2. Institutional restoration and philosophical interpretation of the Five-Tier Grading System

The Five-Tier Grading System is a well-organized program for grooming full-grown teachers and is officially outlined in the Charter of the Nanyang Public School Normal College.

The First Tier (introductory) needs to have been built on the solid pillars of education, potential, integrity, taste, big dreams, and calmness. This screening process tests the aptitude, character, and beliefs of the candidates in the same manner that the ancient Chinese proverb says it places more emphasis on character than ability.

Secondary Level (adaptation) focuses on hard work, student tolerance, adherence to rules, communication, and civic responsibility. This kind of evaluation may be applied to the assessment of initial professional ethics and conduct.

The Third Tier (competence) concentrates on the teaching skills: guidance, observance, organization, class management, and flexibility. It can be treated as a change between learning and professional practice.

The absence of pettiness, jealousy, arrogance, greediness, pretense, and irritability is required on the Fourth Tier (maturity). Real teacher conduct requires inner refinement.

The Fifth Tier excellence is noble character, acquired talent, large learning, correct behavior, and gentle

silence. Its goal is to find the ideal teacher-virtue, knowledge, and character, which should be in a state of balance.

Overall, there are three main qualities in the system. Firstly, slow improvement, i.e., the steady increase in skill levels up to the state of perfection. Secondly, holistic improvement, i.e., every step includes the skills of aptitude, attitude, ability, and cultivation, but does not provide the fragmented training. Lastly, virtuousness: the ultimate stage is the embodiment of the model teacher as per the conventional Chinese beliefs. As shown in **Table 1**, the five-level grading system clearly defines different developmental stages for teacher students.

**Table 1.** The five-level grading system for teacher education students

| Level   | Original Standard                                                                                                                                                           | Explanation                                                                                                                                                                                                              | Core Focus                         |
|---------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------|
| Level 1 | Has a foundation in learning, solid character, genuine and sincere, ambitious, kind and calm                                                                                | Entry Stage: Completion of studies of methods, has a potential; is real and sincere by nature; ambitious; the temper is quiet and serene                                                                                 | Entry Qualifications & Temperament |
| Level 2 | Diligent and hardworking person, writes regularly, is trying to formalize the writing, is able to talk on a large level, prioritizes the well-being of people over the self | Adaptation Stage: Industrious and stubborn; they pay attention to their students; follow the rules; communicate well; can tell whether a problem is common or specific                                                   | Professional Attitude & Norms      |
| Level 3 | Good at guiding and encouraging, observant, organized, capable of handling situations and adapting                                                                          | Competency Stage: The expert at providing advice, sharp observations, and intentional behavior; he/she is a competent professional who has a capacity to react to the requirements of the classroom in a flexible manner | Teaching Ability & Methods         |
| Level 4 | Unassuming, avoids competition, not arrogant, modest, polite, calm                                                                                                          | The stage of maturity: There are no feelings of superiority, competition, arrogance but honesty and sincerity, absence of pretensions or aggressions.                                                                    | Personal Cultivation               |
| Level 5 | Broad knowledge, precise conduct, calm and humble                                                                                                                           | The Mastery Stage has the following characteristics: strong personality and high-quality talent, good knowledge base, appropriate behavior, ambitious but modest, quiet and composed personality                         | Exemplary Teacher Model            |



### **3. Core logic and cultural roots of the Five-Tier Grading System**

#### **3.1. Core logic: A spiraling philosophy of teacher cultivation**

The fundamental philosophy of education behind the Five-Tier Grading system is the notion of interconnected, progressive thinking <sup>[5]</sup>. At the initial steps of the training course, you will develop your own inner character, then your external teaching abilities, and finally come back to more profound personal development and spirituality to reach the space of the unity of the internal and external, virtue and talent. It is a procedure that accords with the tenets of the professional development of teachers that goes beyond technical ability and embraces the overall development of personality.

Moreover, this system is an embodiment of the amalgamation of knowledge and practice, knowledge and virtue. The process of gaining knowledge and teaching experience is tightly linked because it allows pupils to develop teaching abilities and simultaneously comprehend and assimilate what is referred to as the style of teaching. It is this integration that eliminates the gap between theory and practice that is rooted in the ancient Chinese philosophy of the oneness of knowledge and action.

To sum up, it also offers a developmental assessment model that is founded upon certain criteria and stages of development. All levels have their respective objective assessment criteria, and a student cannot be promoted beyond one until he/she has passed stringent tests. There are also directions of growth presented in the form of explicit directions, as well as persistent motivation in the form of feedback on how to break down long-term goals into achievable short-term goals, which is the essence of the contemporary developmental assessment.

#### **3.2. Cultural roots: Institutional transformation of Confucian educational thought**

The Five-Tier Grading System originates in Confucian educational practices that give it a strong cultural foundation <sup>[6-7]</sup>. It is founded on hierarchical concepts and the concept of progression, representing the practical implementation of Confucian principles of self-cultivation, family harmony, governance of state, and world peace, and spiritual growth into the area of common education. The requirements of honesty, sincerity, humility of the mind and the quietness of the spirit indicate the desire to achieve self-cultivation and correction of the heart; the prohibitions on arrogance and irascibility refer to self-restraint; the aspirations to promote the well-being of everyone and upright behavior and generosity speak of having a feeling of social responsiveness; and objectives to be broad-minded in learning and deep-minded in insight, high-minded in personality and subtle-minded in ability are consistent with the purpose of studying objects to gain knowledge and appreciating virtue during the process of learning.

To sum up, the Five-Tier Grading System is a modern version of the Confucian concept of the virtuous scholar in the light of the recent escalation of teacher professional growth. Its focus on the integration of teacher education within the traditional cultural practice can give valuable lessons in the current mainstream education.

### **4. Dialogue between past and present: historical limitations and contemporary implications**

#### **4.1. Historical limitations: Constraints of its era**

The Five-Tier Grading System also had its drawbacks, as well as any other historic institution. Firstly, there was an elite mentality. The initial enrollment at the Nanyang Public School Normal College was only



30 students, and even the lowest tier was a rigorous filter that demanded much natural talent and early education. Only a small fraction of the students who made it to the fifth layer were lucky enough to be in possession of the red certificate. Such elitism might be explained by the following Qing purpose of planting national talent instead of popular normal education, which is one of the main contradictions between the current expectations of large-scale and high-quality but fair normal education. Implementation of the Five-Tier Grading System, which dreams of personality cultivation into the framework of a mass normal education system, is a problem that has not yet been solved.

The next issue is that the ethical evaluation was unclear. It was necessary to evaluate the inner virtues and personality states of students at the fourth and fifth stages, respectively, which were aimed at eliminating negative attributes and paying attention to the characteristics and temperaments. They depended on teacher recommendations and regular observations but lacked clear and replicable measurements. Such ambiguity might have been tolerable during the end of the Qing era when the student population was still small, and the connection between students and teachers was quite intimate, but such ambiguity is a significant issue in the modern-day massive educational system, in which there can be tens of thousands of students. The main question in the heritage of the Five-Tier Grading System is the assessment of moral perfection.

Moreover, knowledge structures have been prone to bias since time immemorial. Third-tier teaching skills, including guidance and flexibility, included a knowledge foundation that was more supportive of Chinese education when compared to Western education. The charter also did not mention any evaluation criteria regarding Western courses, and it provided a loophole within the development of a translation academy of Western books at the same time. Conversely, the volumes of specialized, pedagogic, and technical knowledge are growing exponentially, and modern standard students are compelled to learn them. The financial resources do not allow this; moreover, the educator's desire is not to follow the path of an educational system based on classics. But educators need to retain attention to the unity of knowledge and practice of the Five-Tier Grading System and make sure that learners get enough knowledge but are not alienated due to these amounts, or forget the first reason why they need to be taught.

## **4.2. Contemporary implications: Timeless wisdom**

One of the most important meanings of the Five-Tier Grading System would be its application to the reform of regular education in the modern era, regardless of the history of the system. To begin with, the final aim of normal education is the formation of an ideal teacher character, which is the long-term formation of moral values, academic knowledge, and pedagogical knowledge, practical wisdom, and patriotism. The Five-Tier Grading System is like a reminder that there are no cognitive, emotional, or skills aspects of the normal students that should be cut off — it is a general perspective that is badly required in the modern normal education system.

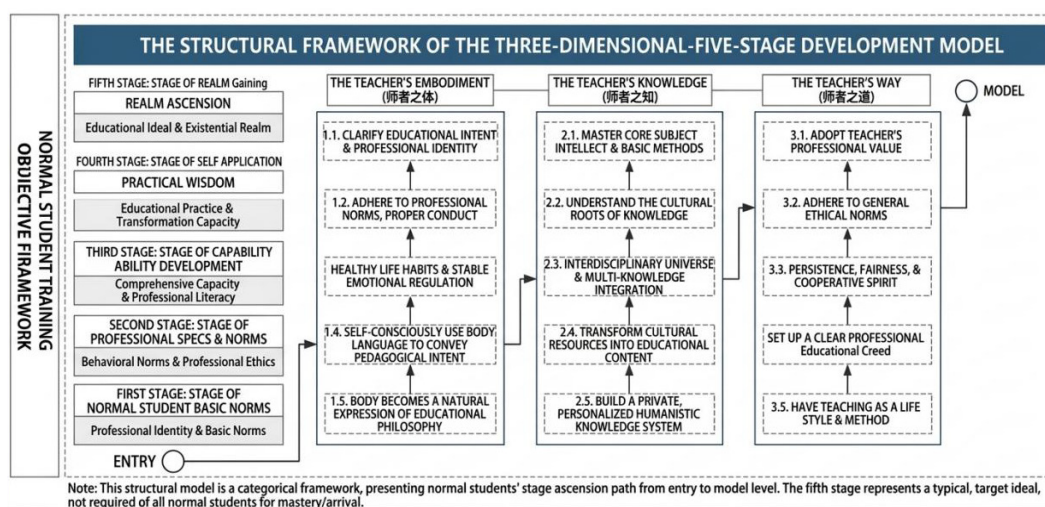
Moreover, culture and identity are the spiritual grounds of teachers' professional development. Teacher professional confidence and cultural heritage in China are based on the profound awareness and inheritance of the civilizational legacy and educational experience of China. The Five-Tier Grading System has turned the Confucian scholar's evolution of cultural consciousness into the stairs of the conventional education that can be used effectively as a template to solve the problem of the cultural aphasia crisis in contemporary conventional education.

In summary, teacher education needs to be aligned with the national development policies and social demands. The professional development of teachers ought to be linked to the future of the country,

creating teachers who can react to the situation. It was this systemic understanding of the core and practical application that came at the end of the Qing transformation of Chinese learning as the core and Western learning as the practical application, and it is an intentional response to the issues of its time.

## 5. Contemporary transformation: A new framework for cultivating “Chinese-style teacher personality”

The use of the Five-Tier Grading System is imaginative as well as era-specific<sup>[8]</sup>. The attention is directed to the teachers of the feudal age towards those who will produce the new generation of people called people educators, whose main objective is to bring in virtues and skills into the nation. It appears that with regard to this fact, the Three-dimensional and Five-stage model of normal students, which includes the body, knowledge, and style of teachers, as well as the developmental stages, which include entry, development, intermediate, advanced, and excellence, should be developed. As shown in **Figure 1**, the three-dimensional and five-level professional development framework elaborates on the development stages of Chinese teacher students in the new era.



**Figure 1.** Three-dimensional five-level professional development framework

The teacher's embodiment is a proper phrase to understand the total physical and mental growth of students and their best behavior. At this level, it correlates with the initial stage of learning readiness, integrity, ambitious goals, and character pacification, but instead of a threshold, it is a lifelong thread of physical and mental growth. Besides the physical health and respectability of teachers, emotional stability, will, and personal spirituality are also included in this sphere. It is determined that conventional education, which is known today, tends to be more oriented toward teaching competence than toward the physical and psychological preparedness of the students to teach. The level of integrity and tranquility of the first tier helps one to recall that it is necessary to be a whole and healthy person to become a teacher. The progressive measures are stated in the following order: setting the goals of teaching and professional identity; adhering to the professional standards and courteous interaction; acquiring healthy habits and emotional regulation abilities; using body language to express the educational message intentionally; and natural manifestation of

educational philosophy through behavior.

The use of the notion of the teacher's knowledge suggests the cultural literacy and transformative potential of the students. This aspect is similar to the third tier concerning guidance and flexibility, and the fifth tier concerning extensive learning, extending the body of knowledge beyond the classics to the traditional cultural and disciplinary boundaries, to the transformation of knowledge. It includes not only the disciplines but also the cultural context and the capacity to translate the knowledge into educational resources. One of the biggest problems confronting contemporary students is not the lack of information but the inability to convert it into anything: there are those who are proficient at great volumes of information without knowing where it came from or what it was meant to do, and how to apply it to fashion the minds of the students. The shift among the guidance abilities in the third tier to the broad learning in the fifth tier reflects the move between the process of knowledge acquisition and creative application. The progressive phases would be as follows: acquiring basic knowledge and approaches in the field; awareness of cultural roots of knowledge; inter-disciplinary viewpoints and synthesis; conversion of cultural sources into educational content; formation of an individual educational knowledge system. This method proceeds via acquisition, comprehension, integration, transformation, and creation. At the final step, students become the active creators of information instead of passive receivers because they sense and arrange teaching in their own way.

Commitments and professional identity are appreciated by students, which is the teacher's way. This characteristic could be manifested in the second-tier emphasis on industry, patience, and social good, the fourth-tier dismissal of negative traits and characteristics, and the fifth tier on character and tranquility, as an integral part of one overall spiritual growth system of professional ethics, personality development, and value identity. It reflects an intense feeling of dedication to education, addressing the underlying question of why someone should teach and the spiritual motivation behind lifelong professional development. Contemporary normal school education is inclined to eliminate the spirituality of the path of a teacher by making it into principles and teacher emotions into statistics, and this de-mythologizes the spiritual nature of the path of a teacher. The concept of the fourth-tier wisdom tells us that the path to spiritual development requires getting rid of the internal obstacles that can help uncover the true heart of the authentic teacher. The phases of advancement include the realization of the importance of the teaching profession, adherence to professional ethics, developing patience, fairness, and teamwork, developing sound educational values, and acceptance of education as a way of life. It starts with mindfulness, then moves on to norms, and then continues to the development of character, belief formation, and finally to the practice of education as a vocation. The final stage implies that education has stopped being laborious but has turned into a lifestyle, and the instruction of children has taken a natural form of the person's existence; it is the embodiment of the fifth-tier ideal within the framework of the contemporary era.

## 6. Conclusion

Three dimensions and five stages together create the so-called Three-Dimensional and Five-Stage model. The basic reasoning is: progressive moral excellence, and here the five stages are seen as upward motion between entry and exemplar; holistic personality integration, in which case the three dimensions are developed simultaneously at every stage; rigid entry criteria, which repeat the emphasis on competence and intent in the first tier; and aspirational exemplars, which serve as signs of the peak of the fifth tier of virtue, ability, and

tranquility. It is also worth pointing out that such an organization does not resemble the competence models, but rather serves as a conceptual framework to comprehend the process of growth, not any kind of assessment of performance. One cannot anticipate all students attaining the fifth grade, in view of the fact that there have never been more than a small number of outstanding teachers, even in the best of times. Rather, it directs both students and teachers to the idea of constant development, and competence models can be applied to ensure that competencies are minimized, and moral excellence models can be used to encourage aspirational models. Teacher education standards in China must be extraordinarily strict, with rigorous competency training and lofty principles of personality.

## Disclosure statement

The author declares no conflict of interest.

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# A Study on the Optimization of English Translation for Chinese Short Video Content from the Perspective of International Chinese Communication

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**Abstract:** From the perspective of international Chinese communication, this study investigates the optimization of English translation for Chinese short video content. Using a case study approach, six representative short video cases from TikTok and YouTube were selected, covering cultural, lifestyle, humor, and live-streaming content. Through sentence-by-sentence comparison and qualitative analysis, the study identifies five major categories of translation problems, such as improper handling of culture-specific elements, clumsy translation of colloquial and internet slang, loss of humor and double entendre, excessive subtitle length, and conflicts between verbal and visual information. In response, the study proposes corresponding optimization strategies, including retaining core cultural terms with concise explanations, pursuing pragmatic equivalence in colloquial translation, reconstructing humor functionally rather than literally, compressing subtitle length to suit short-video reading speed, and utilizing multimodal compensation strategies. The findings demonstrate that short videos, due to their fragmented, colloquial, and multimodal nature, impose new demands on traditional translation approaches. This study not only enriches research on audio-visual translation (AVT) within the context of short videos but also provides practical guidance for translators and content creators seeking to improve the international communication effectiveness of Chinese short video content.

**Keywords:** International Chinese communication; Short video translation; Audio-visual translation (AVT); English subtitles; Multimodality

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## 1. Introduction

Under the “Belt and Road Initiative” and the cultural strategy of “telling China’s stories well and spreading China’s voice effectively”, international Chinese communication has become a key pathway for enhancing

the nation's cultural soft power. The global expansion of short video platforms has opened new channels for the international communication of Chinese content. However, the quality of English translations for subtitles and captions in current short videos varies significantly, with frequent issues such as semantic discrepancies and cultural barriers severely limiting the effectiveness of overseas communication. At the same time, systematic research on optimizing short video translation in the field of international Chinese education is still in its infancy, lacking targeted strategic guidance. Thus, this study focuses on solving this problem: How can the English translation of subtitles and captions in short videos be optimized from the perspective of international Chinese language communication to enhance cultural acceptance among overseas audiences? This research, theoretically, expands the interdisciplinary field of international Chinese communication and translation research, enriching the applicability of audio-visual translation (AVT) theory within the context of short videos. Practically, it provides actionable optimization strategies for short video creators and translation professionals, thereby enhancing the effectiveness of Chinese content communication overseas.

## **2. Literature review**

### **2.1. International Chinese communication**

International Chinese communication refers to the Chinese language communication activities that use the Chinese language as a medium to promote Chinese language and culture to overseas audiences <sup>[1]</sup>. Li Yuming and Tang Peilan systematically summarized the development process of international language communication institutions, and paid great attention to the role of Confucius Institutes and other organizations in the international language communication landscape <sup>[2]</sup>. Zhao Qizheng underlined the importance of discursive power in cross-cultural communication and argued that multiple stakeholders must be involved in telling China's stories well <sup>[3]</sup>. In the new media environment, short videos have become the main carrier of international communication in the Chinese language <sup>[4-5]</sup>. Short videos have their own discourse features: fragmentation, colloquialism, multimodality, and high contextuality. Pan Qianwen pointed out that video information has become the most common way of communication <sup>[6]</sup>. From the perspective of multimodal synergy, short videos can combine multiple modalities, such as speech, vision, and sound, in a short time span to achieve the highest effectiveness of communication.

### **2.2. International communication of short videos**

Regarding the international communication of short videos, Zhang Luyuan analyzed the functional anchoring of such dissemination and proposed three dimensions of internationalization: content, platform, and culture <sup>[7]</sup>. Based on a qualitative comparative analysis of 34 "Chinese Stories" short videos on YouTube, Wang Chaoqun and Liao Mingzhu found that soft topics related to food culture attract audiences through precise content marketing, while multilingual subtitles and distinctive cultural symbols help build bridges for cross-cultural communication <sup>[8]</sup>. Regarding strategies for English subtitling, Pan Li and Huang Chuxin proposed the "principle of prioritizing informational value", arguing that translation strategies for short videos should be selected based on the type of information and its value elements <sup>[9]</sup>. Pan Li and Yang Yuxin explored principles for translating synchronized audio in documentary short videos <sup>[10]</sup>. Zhao Anxin et al. studied the translation of subtitles for overseas publicity short videos from the perspective of multi-modal discourse analysis <sup>[11]</sup>. In other words, systematic research specifically optimized for the English translation of short videos remains limited.



### 2.3. Audio-visual translation (AVT)

A lot has been produced by the field of AVT. In comparative studies on the translation of slang in AVT, free translation strategies have been proven more adaptable in social media short videos<sup>[12]</sup>. Krasnopeyeva applied a Bourdieuan sociological perspective to study the dynamic mechanisms of UGT on YouTube and observed that the translation of popular content has become an important avenue for user-translators to attain attention capital<sup>[13]</sup>. Díaz-Cintas developed his ideas on the influence of technological developments on subtitling practices in a systematic way<sup>[14]</sup>. Some studies in the field of multimodal discourse analysis have explored the synergistic mechanisms of multiple modalities in short videos<sup>[15]</sup>. Calhoun studied the dissemination rules of cross-platform multi-modal intertextuality through qualitative coding and comment analysis of TikTok short videos, providing theoretical perspectives for understanding the unique discourse characteristics of short videos<sup>[16]</sup>.

### 2.4. Research gaps

A systematic review of domestic and international literature reveals that, despite short videos emerging as a core form of communication in the era of globalization, research specifically focused on optimizing their translation into English is scarce; existing studies primarily concentrate on subtitles for traditional films and television series or long-form video content. Second, domestic translation studies predominantly focus on long-form videos or formal texts, with a relative lack of systematic analysis and strategy development regarding the discursive peculiarities of short videos, such as their fragmented nature, high contextuality, and multimodality. Finally, the field of international Chinese communication rarely approaches the subject from the micro-level perspective of “translation optimization.” These research gaps constitute the logical starting point of this study.

## 3. Methodology

### 3.1. Research design

This study employs a case study approach, conducting an in-depth examination of typical short video translation cases to analyze their translation issues and optimization strategies. The case study method is suitable for investigating complex phenomena in real-world contexts that are difficult to dissociate from their background. In translation studies, it is frequently used to explore translation strategies and evaluate their effectiveness in specific contexts, making it highly aligned with the problem statement of this study.

### 3.2. Samples

The short video samples are mainly from YouTube Shorts and TikTok, because the original Chinese content on these two major global short video platforms has high international exposure and demand for English subtitles. The number of cases is limited to 6 to achieve analytical depth. These cases are divided into three categories: cultural content (traditional festivals, cuisine, and handicrafts) and lifestyle content. Selection criteria include the presence of English subtitles (machine-translated or user-generated) and the presence of typical or representative translation issues (**Table 1**).

**Table 1.** The characteristics of the samples

| Case | Source                             | Title / Topic                                 | Duration    | Category           | Key Scenario                                                           |
|------|------------------------------------|-----------------------------------------------|-------------|--------------------|------------------------------------------------------------------------|
| 1    | TikTok (Li Xiaoming)               | Hakka Culture Tour                            | ~3 min      | Culture            | Hakka youth shows American friend local culture.                       |
| 2    | TikTok (@a_chinese_translator1001) | “Malfoy” Pun Explanation                      | ~45 sec     | Humor              | Explains Chinese pun “马年，有福。”                                          |
| 3    | YouTube (Dianxi Xiaoge)            | Yunnan Flower Banquet                         | ~3 min      | Food/<br>Culture   | Quiet host with machine-like subtitles.                                |
| 4    | TikTok (Ireland’s Strange Guy)     | Chinese Idiom Challenge                       | ~30 sec     | Culture/<br>Humor  | Foreign friend misinterprets idiom “一举高中” as “high school.”            |
| 5    | YouTube (Dianxi Xiaoge)            | Guangdong Cuisine—Crab                        | ~8 min      | Food/<br>Lifestyle | Yunnan dialect dialogue full of warmth and banter.                     |
| 6    | Multi-platform                     | Hyperthyroidism Guy’s Interpreter Controversy | Live stream | Controversy        | Interpreter mistranslates barber’s comment and uses “chick” as insult. |

Specifically, Case 1 came from TikTok user Li Xiaoming, featuring a about 3-minute cultural video titled Hakka Culture Tour, where a Hakka youth introduces local culture to an American friend. Case 2 was a 45-second humorous TikTok by @a\_chinese\_translator1001 explaining the Chinese pun “马年，有福” (Year of the Horse, Good Fortune). Case 3 was a 3-minute food and culture video from the YouTube channel Dianxi Xiaoge, titled Yunnan Flower Banquet, featuring a quiet host with machine-generated subtitles. Case 4 was a 30-second culture/humor TikTok from Ireland’s Strange Guy, titled Chinese Idiom Challenge, in which a foreign friend misinterprets the idiom “一举高中” as “high school.” Case 5 was an 8-minute food and lifestyle video from Dianxi Xiaoge on YouTube, titled Guangdong Cuisine—Crab, featuring Yunnan dialect full of warmth and banter. Case 6 was a live-stream controversy on multiple platforms involving Hyperthyroidism Guy’s Interpreter, where the interpreter mistranslates a barber’s comment and uses the insulting term “chick.”

### 3.3. Data collection and analysis

This study collected six original Chinese short videos and related live-streaming clips from platforms such as YouTube and TikTok as analysis cases. The cases cover three categories: cultural, lifestyle, and humor, all of which involve English subtitles or real-time oral translation. The data analysis complied with the following steps. First, we extracted the Chinese subtitles and the existing English translations from the short videos sentence by sentence and compared them side by side, annotating the timing and on-screen position of each subtitle. Second, we classified and counted each issue based on the translation problem framework, which included culture-specific elements, colloquial or internet slang, humor or puns, subtitle length, and multi-modal conflicts. Third, for each problematic sentence, one or two optimized sentences based on the optimization strategies would be offered. Lastly, all the cases would be entered into a uniform Excel spreadsheet, including source text, original translation, optimized translation, and issue type, and a horizontal comparison could be made on common features and differences among different cases to extract generalizable optimization principles.

## 4. Results

### 4.1. Inappropriate handling of culture-specific elements

Culturally specific terms mean vocabulary that carries the connotations of a specific ethnic culture, including traditional foods, place names, customs, idioms, and specific hairstyle terminology. In Case 1, “腌面” was transliterated as “Yanmian” without any accompanying explanation. While the target audience could infer from the visuals that it was a food item, they could not understand its preparation method, which involves “mixing cooked food with seasonings.” The English translations of terms such as “客家博物馆 (Hakka Museum)” and “汉剧 (Han Opera)” often rely on literal translations or simple explanations, leaving the audience unaware of the cultural context behind the term “Hakka.” In Case 4, “一举高中” was literally translated as “high school”, completely overlooking the idiom’s original meaning of “passing the imperial examinations” and its function as a blessing for exam success. In Case 6, “脏辫” (a specific hairstyle term) was not mistranslated per se, but the translator distorted the technical statement “I don’t know how to handle this hairstyle” into the value-laden statement “I think your hair is dirty”, resulting in a complete misinterpretation of the cultural term’s meaning within the context. Such issues are most prevalent in cultural short videos.

### 4.2. Clumsy translation of colloquial and internet slang

Short videos are highly dependent on informal expressions such as dialects, catchphrases, and self-deprecating humor, the pragmatic functions of which often go beyond the literal meaning. In Case 5, the English translation of a dialogue in a Yunnan dialect just translates the dialect terms word-for-word, losing the warmth and regional flavor of the original. In Case 3, “我自己说了都害羞” was translated as “I’m embarrassed after saying that.” This expresses the basic meaning of “awkwardness,” but all the coyness, self-deprecation, and playfulness of the original Chinese sentence are lost, making the translation blunt and flat. In Case 6, the translator used the English slang term “chick” for the Chinese woman on site. The term was flippant or disrespectful in tone and caused serious cultural offense in the context of the live broadcast. Such awkward or inappropriate word choices in spoken translation cannot be effectively conveyed to the target-language audience, and they compromise the communicative intent, emotional tone, and sense of identity of the source language.

### 4.3. Double entendre and lost humor

Linguistic mechanisms such as homophones, puns, and wordplay are often used for humorous short videos. In Case 2, “马年，有福 (Year of the Horse, Good Fortune)”, the zodiac sign and a blessing are cleverly combined by deconstructing the Chinese translation of the foreign character name “Malfoy.” A literal English translation, “Horse year, be lucky!” fails to catch the double entendre. English-language audiences will not get the joke about the name “Malfoy” and the humorous contrast in the context of a Spring Festival greeting. These kinds of problems are almost impossible to retain in literal translation in jokes that depend on specific language and cultural contexts.

### 4.4. Subtitle length beyond short video reading speed limits

Short videos are fast-paced, with many scene changes, and subtitles usually only last on screen for one to three seconds. In Case 3, the length of the Chinese subtitle “我自己说了都害羞” (I’m embarrassed even after saying that) is eight characters long, which enables viewers to read it in a very short time. But the English translation “I’m embarrassed after saying that” is about 30 characters, including spaces, which is

about three times longer, and the subtitle display time has not been extended accordingly. Viewers need to read much longer English subtitles in the same limited time, resulting in an increase in the pressure to read. Some viewers may not have the time to finish reading, or may be forced to avert their eyes from the visuals. This is a common problem, especially in short video subtitles that are machine-translated.

#### **4.5. Multi-modal information conflict**

Multi-modal information conflict indicates situations where the information conveyed by subtitles or spoken translations is inconsistent with or interferes with visual modalities such as the on-screen imagery, facial expressions, and body language. In Case 6's barbershop scene, the barber's calm expression and normal movements while stating a fact clearly contradict the negative attitude implied by the translator's output: "I think your hair is dirty." When the information viewers interpret from the visuals conflicts with the information conveyed by the translation, it casts doubt on the translation's credibility. Such issues often have the most direct negative impact on communication effectiveness.

### **5. Discussion**

#### **5.1. The translation issues and AVT theory**

The five categories of issues summarized in this study resonate to some extent with core topics that have long been the focus of AVT theory. For example, translation strategies for culture-specific items have a relatively mature classification system in film and television subtitling research, including literal translation, phonetic translation, substitution, and generalization<sup>[17]</sup>. The phonetic translation of "pickled noodles" combined with multi-modal compensation in Case 1, and the failure of literal translation for "succeeding at the first attempt" in Case 4, both confirm that the handling of culture-specific elements remains highly significant in the context of short videos. However, the differences between short videos and feature films are also quite significant. Subtitles for feature films typically have relatively fixed timecodes and line limits, allowing translators to make precise adjustments using professional software; whereas short videos are produced through more diverse methods, heavily relying on machine translation or user-generated translations. Subtitle display durations often follow the original video's rhythm and lack professional post-production workflows. The issue of "subtitle bloat" revealed in Case 3 of this study is precisely a problem rarely addressed in traditional audiovisual translation theory: the mismatch in reading rhythm caused by differences in source and target language lengths within extremely short time codes. Furthermore, the pragmatic errors in spoken-language simultaneous translation presented in Case 6 are typically addressed through more time for proofreading and contextual consideration in film and television dubbing or subtitling. However, the immediacy of live-streaming short videos places higher demands on translators' cross-cultural pragmatic competence.

#### **5.2. New requirements for traditional translation strategies**

The core characteristics that distinguish short videos from traditional audio-visual texts include fragmentation, colloquialism, multimodality, and high contextuality. These characteristics impose new demands on translation strategies. First, fragmentation implies that the available time for each subtitle is extremely short; line breaks and long sentences—strategies permitted in traditional films and TV series—are often inapplicable in short videos, requiring translators to engage in more extensive condensation

and restructuring. Second, the frequent use of colloquial language and internet slang requires translators not only to understand the literal meaning but also to accurately grasp the pragmatic function and sense of community affiliation. The dialectal dialogue in Case 5, the self-deprecating tone in Case 3, and the offensive slang in Case 6 all demonstrate that merely completing semantic conversion is far from sufficient. Third, multimodality is both a challenge and a resource. Visual elements in short videos—such as imagery, facial expressions, gestures, and sound effects—can convey a wealth of information. Translators should learn to shift some linguistic information to visual modalities. For example, in Case 1, Denis’s expression while eating compensates for the information lost in the phonetic translation “Yanmian.” Finally, the highly contextual nature of these videos means that much cultural information is implicit in shared background knowledge. Translators need to judge which background elements must be explicitly stated and which can be omitted, requiring strong cross-cultural interpretation skills.

### **5.3. Recommendations for optimization strategies of English translation for Chinese short video content**

In response to the five categories of issues mentioned above, this study proposes five corresponding optimization strategies of English translation for Chinese short video content from the perspective of international Chinese communication.

#### **5.3.1. Cultural terms: Retaining core terms with brief explanations or seeking culturally analogous equivalents**

For culturally specific terms, simple literal translation or pure phonetic transcription is not advisable. There are two optimization approaches. First, it is important to use phonetic transcription with a minimal embedded explanation, such as rendering “Yanmian” as “Yanmian noodles” or using on-screen icons to imply “mixed noodles”, thereby clarifying the product category. Second, expressions with similar functions in the target language should be identified. For instance, in the context of explaining the idiom “一举高中”, it is sensible to translate it as “to pass an exam with flying colors” rather than a literal translation of “high school.” For technical terms such as “脏辫 (dirty braids)”, the referential meaning should be conveyed faithfully to avoid confusion with evaluative connotations.

#### **5.3.2. Colloquial expressions: Using corresponding slang or colloquial expressions in English, and evaluating their pragmatic connotations**

In English translation for Chinese short video content, it is vital to avoid literal equivalence and instead seek pragmatic equivalence. “方言中的亲昵称呼 (Familiar terms of address in dialects)” can be translated into corresponding English expressions such as “buddy”, “dear”, or “guys.” For Chinese expressions conveying specific tones such as bashfulness or self-deprecation, selecting English sentence structures that convey a similar nuance is indispensable. For instance, translate “我自己说了都害羞” as “I can’t believe I just said that” or “This is so cheesy but okay”, rather than the straightforward “I’m embarrassed.” Potentially offensive colloquial terms should be firmly replaced with neutral, respectful alternatives, such as substituting “chick” with “ladies” or “women.” Translators ought to possess cross-cultural pragmatic awareness and not rely solely on the surface meanings of words.



### **5.3.3. Humor and double entendre: Moving beyond word-for-word correspondence to find funnel equivalents**

Humor cannot be translated word-for-word. There are two optimal approaches. First, the meta-humor strategy, which involves directly explaining the mechanism of the pun to the audience. For example, in Case 2, the principle of how “Malfoy” can be broken down into “Year of the Horse” and “Good Fortune” in Chinese could be introduced with a brief explanation. Second, the reconstruction strategy, which completely abandons the literal structure of the original text and replaces it with a similar cultural reference or joke structure in English. Given the fast pace of short videos and limited subtitle space, while the meta-humor strategy is more reliable, it consumes more space and requires concise expression.

### **5.3.4. Subtitle length: Breaking long sentences into shorter ones and limiting the number of characters per line**

To solve the problem of subtitles being too long, first, strictly limiting the number of English characters is a must. For short videos, the length of a single line of English subtitles should not exceed 30 characters, and avoid line breaks as much as possible. Second, it is significant to delete non-essential information already clearly displayed on the screen, reducing full sentences to phrases or keywords. For example, “I’m embarrassed after saying that” can be shortened to “Embarrassed to say this”, which drops the character count from 30 to about 22. Finally, manual post-editing is essential for machine-translated text that is a word-for-word translation to rewrite the text concisely and restore the rhythmic alignment between the subtitles and the visuals.

### **5.3.5. Multi-modal compensation and contextual reconstruction**

When language translation cannot fully convey cultural information or poses pragmatic risks, the multi-modal characteristics of short videos can be leveraged for compensation. For example, key information can be highlighted with on-screen annotations or icons next to transliterated terms; visual elements such as facial expressions and gestures could be used to help convey the tone of the source language. In real-time translation scenarios such as live streaming, translators should proactively leverage their on-screen presence to bridge information gaps in language conversion through facial expressions and body language, thereby avoiding semantic distortion caused by purely verbal retelling. In Case 6, if the translator had provided a factual retelling in line with the hairdresser’s calm, professional demeanor rather than adding subjective commentary, the conflict could have been avoided.

## **6. Conclusion**

### **6.1. Summary of key findings**

From the perspective of international Chinese communication, this study centers on the optimization of English translations of Chinese short video content. Using case analysis, it systematically examined six short video cases from YouTube and TikTok. The main findings can be summarized as follows.

First, this study identified five common issues in the English translation of Chinese short videos, including improper handling of culturally specific terms, awkward translations of colloquial and internet slang, complete loss of humor and double entendres, subtitle lengths exceeding the reading speed limit for short videos, and conflicts in multimodal information. These issues are unevenly distributed across different

types of short videos, with culturally specific terms being the most frequent, accounting for approximately half of all identified problems.

Second, in response to the above five categories of issues, this study proposes five corresponding optimization strategies. For cultural terms, the strategy involves retaining core words with brief explanations or seeking culturally analogous expressions. For colloquial expressions, it is essential to use corresponding English slang or colloquial expressions while strictly evaluating their pragmatic connotations. For humor and puns, abandoning literal word-for-word correspondence and seeking functionally equivalent punchlines or expressions is adopted. Regarding subtitle length, breaking long sentences into shorter ones and limiting each line to no more than 35 characters are sensible. For multi-modal conflicts, using on-screen annotations and emojis to compensate for losses in linguistic translation is recommended.

Third, this study validated the applicability of the case study method in the field of short video translation optimization. Through steps such as sentence-by-sentence comparison of the source text and original translation, problem categorization, translation optimization, and case summarization, it effectively captures detailed issues in short video translation and provides targeted optimization solutions for different types of cases. The flexibility and depth of the case study method align well with short video translation research.

## **6.2. Limitations of this study and future research directions**

This study has the following limitations. First, the number of case studies is limited. This study analyzed only six cases. Although these cases cover three categories—cultural, lifestyle, and humor—the relatively small sample size limits the generalizability and applicability of the conclusions. A larger number of cases across more categories might reveal a wider variety of translation issues and optimization strategies. Second, the study relies primarily on the researcher’s analysis and judgment. The identification and categorization of translation issues, as well as the proposal of optimized translations, depend largely on the researcher’s linguistic proficiency and translation experience, without validation through large-scale audience experiments. There is a lack of quantitative feedback data from target-language audiences to support whether the optimized translations achieve better dissemination outcomes than the original translations. Third, the study does not compare machine translation with human translation. While the cases in this study include both human and machine translations, the research focuses on identifying translation issues and proposing optimization strategies; no specific comparative experiments were designed to evaluate the relative merits of machine translation versus human translation in the context of short videos.

To address these limitations, future research can explore four directions. First, the number and types of case studies should be expanded to include more diverse genres, such as technology, education, and travel. This would help verify the generalizability of the current findings and uncover new categories of translation issues. Second, audience feedback should be incorporated through methods such as surveys, eye-tracking experiments, or A/B testing to quantitatively evaluate the effectiveness of optimization strategies. Third, the applicability of AI-assisted translation in the short video domain warrants further exploration. Future studies could compare different AI models in handling culture-specific elements and colloquial expressions, and develop optimized workflows for human-machine collaboration.

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# Toward a Multimodal English Repository for Medicine-Food Homology Concepts

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**Abstract:** “Medicine-Food Homology” serves as a fundamental cultural carrier for the international dissemination of traditional Chinese medicine (TCM) and the global expansion of the health industry. Currently, the external communication of core concepts related to medicine-food homology in China faces significant challenges, including semantic misinterpretation, loss of cultural connotations, and reliance on a single mode of expression. The text-only translation model fails to convey the professional attributes and cultural values of these concepts, resulting in cognitive barriers, a lack of standardized expression, and fragmented communication in international dissemination. These issues hinder the accurate global transmission of TCM culture. To address these challenges and standardize the international expression system for medicine-food homology concepts, this study draws on multimodal discourse analysis theory to establish principles for constructing a multimodal English expression repository for the core concepts of medicine-food homology. Furthermore, several construction strategies are proposed, primarily focusing on terminology standardization and content quality improvement. These strategies aim to unify international expression standards for core medicine-food homology concepts, enrich the linguistic resource system for TCM internationalization, and support TCM academic exchanges, international cultural communication, and the cross-border development of the health industry. This research holds significant theoretical value and practical implications for enhancing the international influence of traditional Chinese wellness culture and promoting the standardized, systematic, and sustainable international development of TCM.

**Keywords:** Core concepts of medicine-food homology; Establishment of a multimodal English expression repository; Countermeasures

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## 1. Introduction

“Medicine-Food Homology” is a fundamental concept in traditional Chinese medicine (TCM) culture, originating from classical medical texts such as the Huangdi Neijing (The Yellow Emperor’s Inner Canon). Its central tenet is that natural substances possess both nutritional and edible properties as well as non-



toxic medicinal regulatory effects. This concept embodies the wisdom of TCM in prevention and dietary wellness and serves as a core cultural intellectual property for the internationalization of TCM and the global expansion of the health industry. In the context of the international dissemination of TCM culture, academic exchanges in global wellness, and the cross-border development of the food industry, accurate and standardized English terminology has become essential for overcoming cultural export barriers and achieving international consensus on these concepts.

Currently, the English translation system for medicine-food homology in China remains incomplete, characterized by issues such as inconsistent translations of core concepts and semantic inaccuracies. Existing academic translations are heterogeneous and primarily limited to single-mode text translation, overlooking the essential holistic perspective of Traditional Chinese Medicine (TCM) and its dialectical dietary therapy. They lack multidimensional adaptations for academic research, industrial applications, and cultural communication, which impedes the effective dissemination of TCM's cultural essence. Multimodal linguistics, which integrates multiple dimensions of expression—including text, semantics, context, and application paradigms—offers a novel approach to standardizing the English translation of traditional TCM concepts. Therefore, it is essential to focus on the core concepts of medicine-food homology, compile authoritative definitions from classical texts, academic translations, and contextually relevant application sentence patterns, and develop a systematic multimodal English expression repository.

## **2. Principles for a multimodal English repository of medicine-food homology concepts**

### **2.1. Principle of unity between systematicity and hierarchical structure**

The system of core concepts in medicine-food homology is extensive, clearly hierarchical, and multidimensional, encompassing several categories such as basic theories, ingredients, efficacy, applications, and practical guidelines. These concepts are logically connected through subordination, coordination, and progression. Simultaneously, multimodal English expression incorporates multiple elements, including terminology, definitions, sentence structures, contexts, cultural notes, and examples, each of which is interrelated and serves a specific function. Therefore, when constructing a multimodal English expression repository for the core concepts of medicine-food homology, it is essential to adhere to the principle of unity between systematic organization and hierarchical structure to ensure the overall system is comprehensive, logically coherent, and that classification is clear and orderly.

The principle of systematicity requires that the repository establish a comprehensive, closed-loop content system that achieves full coverage of core concepts and complete adaptation of expression modes. At the conceptual level, all core concepts related to medicine-food homology theories, ingredients, efficacy, and methods should be thoroughly included, avoiding any omissions or gaps in the system. At the modal support level, each core concept should be paired with comprehensive modal content, including standardized terminology, precise semantic definitions, and diverse sentence patterns across multiple contexts, ensuring complete expression for each concept. At the systemic logic level, the overall structure of the repository should follow the logical framework of “theoretical concepts → entity concepts → applied concepts”, with each component interconnected and mutually supportive, thereby forming a complete multimodal English expression system for medicine-food homology.

The principle of hierarchical structure requires that concepts, modes, and application contexts be refined and organized in a layered manner. In concept stratification, all core concepts are divided into primary core concepts, secondary subdivisions, and tertiary derived concepts. For example, the primary concept “medicine-food homology” can include secondary concepts such as “medicinal and edible ingredients” and “dialectical dietary therapy”, as well as tertiary concepts like “ingredient compatibility contraindications” and “seasonal dietary therapeutic methods”, which are further refined layer by layer. In modal stratification, the repository should follow a “basic mode → advanced mode → applied mode” hierarchy: the basic mode comprises standardized core terminology; the advanced mode includes semantic definitions and cultural annotations; and the applied mode contains contextualized sentence patterns and application examples. In context stratification, appropriate contexts are categorized according to levels such as academic research, cultural popularization, and international exchange, ensuring that content at each level precisely corresponds to different application needs.

## **2.2. Principle of unity between cultural specificity and universal accessibility**

The core concepts of medicine-food homology are vital carriers of China’s rich traditional culture, embodying unique Eastern philosophical ideas and wellness wisdom, such as the holistic perspective of TCM, the unity of heaven and humanity, and the balance of yin and yang. These concepts possess distinct cultural attributes. Simultaneously, as an international lingua franca, English expressions must adapt to the cognitive habits, linguistic systems, and cultural contexts of a global audience to ensure universal accessibility and clear interpretation. Therefore, when constructing a multimodal English expression repository for the core concepts of medicine-food homology, it is essential to adhere to the principle of balancing cultural specificity with universal accessibility, achieving an effective two-way transmission between the accurate conveyance of cultural essence and the comprehension of an international audience.

The principle of cultural specificity requires that the construction of the repository preserve the authenticity of the culture by fully retaining the core cultural connotations and traditional heritage of medicine-food homology concepts. For culturally unique ideas such as the “unity of heaven and humanity”, “dialectical dietary therapy”, and “harmonization of yin and yang”, which are highly characteristic of Chinese culture, supplementary multimodal explanations should be provided. Based on standardized translation, additional content—such as cultural background annotations, interpretations of theoretical connotations, and comparisons between Chinese and foreign wellness philosophies—should be included to accurately convey the Eastern philosophical thinking and traditional wellness wisdom underlying these concepts. This approach will promote the international dissemination of China’s rich traditional culture while safeguarding its cultural subjectivity and uniqueness.

The principle of universal accessibility requires that the English expressions in the repository conform to international standards and general cognitive logic. While preserving cultural authenticity, the repository should employ internationally accepted academic vocabulary, clear sentence structures, and universally comprehensible explanatory logic to reduce cognitive barriers. To address semantic gaps arising from cultural differences between China and the West, a multimodal approach combining “literal translation + free translation + annotation” should be used, preserving the cultural core while adapting to general international cognitive habits.

### **2.3. Principle of unity between theoretical rigor and practical applicability**

This is the final principle to be followed in constructing a multimodal English expression repository for the core concepts of medicine-food homology. It demands not only a high level of academic rigor and theoretical depth but also practical feasibility and applicability.

The principle of theoretical rigor mandates that the construction of the repository be grounded in a well-established academic theoretical framework, supported by sound theory and scholarly value. The overall construction framework should be based on multimodal discourse analysis theory, cross-cultural communication theory, terminology translation theory, and TCM linguistics theory. All expression paradigms, classification logic, and construction standards must adhere to academic theoretical norms to ensure rigorous scholarly reasoning. Additionally, by systematically organizing the English translation patterns of medicine-food homology concepts, multimodal adaptation logic, and cross-cultural communication pathways, the repository can enrich the research framework of TCM international language studies, enhance multimodal language application scenarios, and provide valuable theoretical references for related academic research.

The principle of practical applicability requires that the repository be developed based on practical needs, focusing on current challenges in international communication, academic exchange, and industrial development related to medicine-food homology culture. Content design should align with real-world application scenarios and be actionable. For academic contexts, the repository should provide standardized terminology, academic sentence structures, and paper expression templates. For teaching purposes, it should offer standardized knowledge representations and example sentences for instruction. Additionally, the repository must feature clear classification and convenient retrieval methods to fully meet the diverse needs of various users and scenarios, thereby ensuring high practical value.

Theoretical rigor offers essential academic support and innovative advancement for the development of the repository, while practical applicability imparts implementation value and operational vitality. The integration of both ensures that practical content is grounded in solid theory and that the repository embodies both academic innovation and practical utility.

## **3. Countermeasures for establishing a multimodal English repository of medicine-food homology concepts**

### **3.1. Countermeasures for terminology standardization governance**

The establishment of governance measures for terminology standardization addresses the root cause of inconsistent translations and strengthens the foundation for building the repository's content.

First, an authoritative priority anchoring mechanism should be implemented in order to achieve the unique standardization of core terms. This mechanism requires that translations be aligned with the official translations issued by the China National Committee for Terminology in Science and Technology, the National Administration of Traditional Chinese Medicine, and the ISO international standards for TCM. The nationally and internationally recognized standards are adopted as the sole benchmark translations for core terms.

For those medicine-food homology concepts that lack official unified translations, a multi-source corpus comparison and selection mechanism should be established. This mechanism systematically integrates high-frequency translations from key domestic and international academic journals, authoritative monographs, and mainstream foreign-language communication platforms. The optimal standard translation is determined

by statistically analyzing the transmission frequency and by verifying the professional suitability of each candidate <sup>[1]</sup>.

Concurrently, a terminology rights confirmation ledger should be established. This ledger annotates each core standard translation with its authoritative source, its scope of application, and its verification basis. The purpose of this measure is to ensure that all terms are traceable and verifiable.

Second, a differentiated hierarchical translation system should be established so that the semantic boundaries between similar concepts can be clarified.

The medicine-food homology system includes numerous characteristic concepts that have similar meanings but subtle differences in their professional connotations. Therefore, a hierarchical and categorical translation governance mechanism should be developed. This mechanism is designed to classify similar terms on the basis of their conceptual attributes, their professional efficacy, and their application scenarios.

The semantic boundaries, applicable contexts, and professional orientations of different terms are precisely defined. In doing so, the nuanced characteristics of TCM professional subdivisions can be reflected through differentiated English translation schemes <sup>[2]</sup>.

Additionally, a dedicated terminology analysis module should be established. This module is intended to compare the translation differences and the conceptual distinctions between similar terms. The establishment of this module addresses the current gap in the English translation differentiation of subdivided TCM terminology and enhances the professional precision of the repository.

### **3.2. Countermeasures for improving content quality**

The core competitiveness of a multimodal expression repository lies in the professionalism and cultural richness of its content. Currently, some similar resources prioritize linguistic form over professional substance, resulting in superficial content and cultural erosion. To address this shortcoming, content quality must be enhanced across multiple dimensions to ensure the accurate transmission of TCM's professional concepts and traditional Chinese wellness culture.

First, a multi-layered, three-dimensional semantic interpretation system should be established in order to overcome the limitations of single definitions. In order to address the cognitive needs of diverse audiences, a four-tier interpretation framework is constructed. This framework consists of the following four levels: basic popular interpretation, professional academic interpretation, context-specific interpretation, and cross-cultural comparative interpretation. The basic interpretation is designed for general overseas audiences. Its purpose is to simplify professional terminology and to directly convey the surface meaning of concepts. The academic interpretation strictly adheres to authoritative classics such as the Huangdi Neijing and Bencao Gangmu (Compendium of Materia Medica), as well as to standard TCM textbooks. This interpretation accurately explains the TCM theoretical core and the wellness mechanisms of TCM concepts. The context-specific interpretation defines the exclusive interpretive boundaries of concepts in academic research, industrial promotion, and dietary therapy applications. The cross-cultural comparative interpretation integrates Western nutrition and modern medical concepts. It compares the differences in wellness cognition between China and the West. The goal of this level is to achieve a comprehensive and in-depth semantic interpretation <sup>[3]</sup>.

Second, a multi-level content review mechanism should be established so that the accuracy of the content can be rigorously ensured. Specifically, a cross-review system involving three types of experts is implemented. This system includes TCM experts to assess professional accuracy, translation experts to



evaluate linguistic quality, and communication experts to review contextual appropriateness.

TCM experts verify the scientific accuracy of concept definitions, medicinal properties, efficacy, and wellness principles. Translation experts focus on refining the professionalism of English sentence structures, terminology standards, grammatical logic, and expression styles. Cross-cultural communication experts assess the appropriateness of cultural interpretations, contextual adaptations, and external expressions. The function of this expert review is to prevent content deviations and to ensure the rigor and authority of all repository content.

### **3.3. Countermeasures for optimizing multimodal integration**

As the core feature of a multimodal expression repository, the following countermeasures must be implemented to achieve synergistic integration of multi-dimensional expression resources and to create a distinctive, highly applicable expression system.

Firstly, it is essential to foster profound multimodal integration to realize complementarity and interconnections among various modules. This involves constructing a cohesive system wherein different modes mutually validate, augment, and interact in an organic manner. Core expressions are anchored by standardized terminology; layered interpretations serve to enhance conceptual comprehension; cultural annotations offer deeper contextual insights; and contextual examples situate the application within practical scenarios. To address the diverse attributes of concepts, differentiated modal proportions should be implemented: for theoretical and cultural concepts, emphasis should be placed on cultural origins, philosophical interpretations, and cross-cultural comparative modes, while minimizing reliance on simplistic application examples<sup>[4]</sup>. Conversely, for practical concepts related to ingredients and efficacy, priority should be given to contextual examples, contraindications, and error analysis modes, with a reduction in superficial cultural interpretations, thereby mitigating issues of content homogenization.

Secondly, it is imperative to refine context-specific adaptations to enable precise and effective application. Drawing upon the varied scenarios encountered in international communication concerning medicine-food homology culture, distinct expression paradigms should be developed, each tailored to one of five core application contexts. In academic research, the use of rigorous and standardized academic English is required, suitable for journal publications, international conferences, and research projects, with an emphasis on professionalism and accuracy. For cultural popularization, language should be vivid and accessible, appropriate for dissemination via overseas new media platforms and popular science publications. Within industrial and commercial contexts, terminology, product descriptions, and brand promotion language must be carefully refined to suit cross-border e-commerce and overseas market expansion. In educational settings, the compilation of standardized example sentences and common error cases is necessary to support international talent development. Finally, for official exchanges, formal and appropriate expression paradigms should be adopted, tailored to international exhibitions, with a dedicated paradigm for each scenario.

### **3.4. Countermeasures for digital and intelligent empowerment**

Digitalization and intelligence are essential for the long-term operation and utilization of a multimodal expression repository. To address issues such as simplistic architecture and limited functionality in existing similar corpora, the following specific implementation strategies are proposed from multiple perspectives to develop an intelligent, modern language resource platform.

Initially, it is imperative to optimize the hierarchical data architecture to establish a systematic classification of resources. This involves enhancing the existing three-tier framework—comprising the master



repository, sub-repositories, and sub-modules—by refining five principal sub-repositories: theoretical concepts, ingredient entities, wellness efficacy, dietary therapy methods, and wellness principles. Each sub-repository should encompass modules such as standardized terminology, multi-layered interpretations, and cultural elucidations, thereby ensuring that all multimodal resources are systematically classified, archived, logically organized, and readily accessible. Furthermore, standardizing format specifications and the annotation system throughout the entire repository is essential to address the prevalent issues of disorder and disorganization characteristic of traditional resource repositories, ultimately improving the integrity of the database.

Subsequently, it is necessary to advance intelligent application functionalities to enhance the effectiveness of user services. Grounded in practical and user-centric requirements, multiple intelligent features should be improved to transcend the limitations inherent in conventional static corpora. Enhancements to keyword search capabilities (in both Chinese and English), categorical search, contextual search, and fuzzy search functions will facilitate rapid resource retrieval and precise localization. Additionally, the introduction of contextual intelligent matching functions can recommend optimal expression paradigms tailored to the user's selected application scenarios. The system's capacity for batch resource export, selective excerpting, and format conversion should also be augmented to meet diverse demands, including academic writing, lesson preparation, copywriting, and industrial promotion.

In conclusion, the development of a multimodal English expression repository for the core concepts of medicine-food homology addresses existing deficiencies within the linguistic infrastructure supporting the internationalization of Traditional Chinese Medicine (TCM). This repository will promote academic exchange in TCM and serve as a vital resource for cultivating international TCM professionals. Future efforts should prioritize the continuous refinement of construction methodologies for the multimodal English expression repository, regular updates to database content, enrichment of diverse communication modalities, enhancement of the international expression system for medicine-food homology, and the promotion of accurate and sustained global dissemination of traditional Chinese wellness culture.

## Disclosure statement

The author declares no conflict of interest.

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# Internationalization of China's Applied Undergraduate Institutions: Core Characteristics, Practical Predicaments and Developmental Aspirations

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**Abstract:** Against the backdrop of the pervasive popularization of contemporary higher education and the accelerating globalization of worldwide educational undertakings, the internationalized advancement of China's application-oriented undergraduate institutions has accomplished a pivotal developmental transition from the previous extensive development predicated on enrollment expansion and scale proliferation toward connotative endogenous upgrading centering on the improvement of educational quality. Rooted in the institutional schooling tenet of applied undergraduate universities, namely servicing local socioeconomic progression and facilitating in-depth integration between industrial production and disciplinary education, this dissertation launches an in-depth dissecting analysis targeting the intrinsic core attributes, prevailing realistic bottlenecks, as well as prospective developmental demands concerning their internationalized progression. The core research objective lies in probing into a distinctive, differentiated, and high-standard internationalization pathway tailored to the localized developmental realities of China's applied undergraduate colleges and universities, furnishing referential paradigms for the construction of a characteristic international higher education system nationwide, and ultimately elevating the comprehensive international competitive edge of China's application-oriented undergraduate tertiary establishments.

**Keywords:** Application-oriented undergraduate institutions; Institutional internationalization; Core attributes; Practical predicaments; Developmental aspirations

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## 1. Introduction

Fueled by the persistent progressive implementation of the Belt and Road Initiative alongside the all-round strategic propulsion of China's Double First-Class higher education construction blueprint, the internationalization construction of application-oriented undergraduate institutions has evolved into an

indispensable benchmark to quantify institutional running caliber and core comprehensive competitiveness within the modern tertiary education ecosystem. Occupying a considerable proportion of China's domestic higher education layout, application-oriented undergraduate colleges and universities regard internationalized development as an inevitable pathway to upgrade institutional schooling hierarchy, a pivotal strategic vehicle to incubate high-caliber versatile technical practitioners endowed with global cognitive horizons, as well as an indispensable prerequisite to underpin the high-quality iterative development of the regional economy and social undertakings. Nevertheless, when juxtaposed against comprehensive research-centric universities, application-oriented undergraduate tertiary establishments are plagued by manifold restrictive obstacles throughout their internationalized pioneering journey, exemplified by an ambiguous developmental roadmap and inadequate international linkage amid industry-education amalgamation. Accordingly, the proactive exploration of a customized international development framework conforming to the operational characteristics of domestic applied undergraduate institutions stands atop the priority agenda of institutional administrative work.

## **2. Core characteristics embodied in the internationalization of China's applied undergraduate institutions**

### **2.1. Vocational-oriented talent cultivation plus glocalized domestic internationalization**

#### **2.1.1. Introduction of internationally acknowledged vocational qualification accreditation benchmarks**

Distinguished from research-intensive universities, which prioritize the infusion of universal general education ideologies, application-oriented undergraduate tertiary institutions predominantly concentrate on two pivotal dimensions: the transplantation of globally prevalent industrial normative criteria and the systematic formulation of localized vocational credential certification frameworks <sup>[1]</sup>. The internationalized curriculum system devised by such institutions maintains direct docking with post-competency requirements stipulated by transnational conglomerates, with the ultimate instructional objective of nurturing competent graduates capable of adapting to multifarious occupational scenarios within global employment marketplaces.

#### **2.1.2. Dual-disciplinary theory plus dual-scenario practical training educational paradigm**

This innovative instructional framework breaks free from the shackles of conventional single classroom indoctrination pedagogy, aiming to construct a dual-layered instructional architecture incorporating domestic and overseas theoretical teaching classrooms as well as dual domestic and offshore practical internship bases. Diverse collaborative modalities, including bilateral Sino-foreign joint classroom instruction, mutual academic credit accreditation, and the importation of authentic industrial project cases sourced from overseas enterprises, can effectively facilitate seamless alignment between curriculum content design and standardized vocational competency requirements <sup>[2]</sup>.

#### **2.1.3. Synchronized progressive cultivation of linguistic proficiency and specialized vocational competencies**

It adopts an integrated compound cultivation mechanism, which takes professional disciplinary learning as the core carrier and foreign language proficiency as an indispensable instrumental skill. On the one hand, institutional educators commit to elevating students' daily oral interactive capabilities; on the other hand,

concentrated efforts are devoted to fostering learners' cross-cultural occupational communication literacy, enabling undergraduates to seamlessly accommodate employment posts within foreign-invested enterprises or participate in the construction of transnational offshore engineering ventures <sup>[3-4]</sup>.

## **2.2. Transboundary nature and pragmatic attribute embedded within industry-education integration pathways**

### **2.2.1. Substantialized physical development of cross-border school-enterprise collaborative partnerships**

Essentially, the developmental logic has undergone a fundamental shift from the rudimentary mode of dispatching outbound student trainees toward two alternative developmental orientations: introducing overseas enterprises to establish on-campus cooperative platforms or jointly launching cross-border cooperative projects via institutional and corporate outbound layout. For instance, application-oriented undergraduate establishments can forge stable cooperative bonds with domestic Chinese multinational corporations expanding overseas businesses in high-speed rail infrastructure, civil engineering construction, and advanced manufacturing sectors, extend practical training internship bases to overseas territories, and extensively roll out tailor-made order-form talent incubation schemes <sup>[5]</sup>. In addition, tertiary institutions can cooperate with multinational-funded enterprises to build on-campus industrial colleges within domestic territory, so as to accomplish precise docking between whole-chain talent cultivation planning and upstream-downstream industrial layout demands.

### **2.2.2. Internationalized structural reconstruction of dual-qualified teaching faculty cohort**

The faculty development blueprint of China's applied undergraduate colleges ought to refrain from overemphasizing the exclusive recruitment of overseas doctoral graduates with superior academic credentials. Instead, administrative departments should proactively introduce seasoned technical artisans and enterprise industrial specialists boasting abundant overseas vocational working experience. Furthermore, institutional authorities are required to regularly assign in-service professional instructors to embark on no less than six months of on-site post attachment or practical internships within overseas cooperating enterprises, rather than merely arranging superficial short-term academic exchange visits, with the purpose of consolidating educators' hands-on engineering practical expertise and broadening their global strategic vision <sup>[6-7]</sup>.

## **3. Realistic predicaments confronting the internationalization progression of China's applied undergraduate institutions**

### **3.1. Structural deficiency of the teaching workforce and pervasive bilingual instructional bottlenecks**

Professional teaching faculty constitutes the core strategic resource underpinning internationalized institutional operation, yet domestic applied undergraduate colleges suffer conspicuous structural drawbacks in this critical domain. Although an overwhelming majority of disciplinary teachers possess solid theoretical specialized knowledge reserves, their practical foreign language application proficiency remains comparatively deficient, and qualified instructors competent for delivering full-English or bilingual specialized core courses and practical training tutorials are in extremely scarce supply. Even if certain tertiary institutions introduce premium overseas curriculum resources, the practical landing of relevant instructional



arrangements is severely impeded, occasionally spawning problematic phenomena whereby domestic teachers deliver lectures in native Chinese while students resort to post-class self-study and textbook translation independently <sup>[8]</sup>. Moreover, numerous instructors lack long-duration overseas visiting experience and frontline industrial working background, failing to acquire comprehensive and in-depth cognition of cutting-edge international technical specifications, cross-border industrial engineering cultures, and advanced overseas educational philosophies. Such a deficiency restricts educators from engaging in in-depth academic dialogues and substantive bilateral project cooperation under cross-cultural contexts, thereby confining institutional international exchanges to superficial reciprocal institutional visits only.

### **3.2. Localization maladaptation of imported curriculum resources alongside prevalent homogenization tendency in disciplinary construction**

In terms of curriculum compilation and major setting optimization, a great many applied undergraduate tertiary institutions are trapped in two prominent developmental drawbacks: substandard quality of externally-introduced educational resources and insufficient distinctive characteristics manifested in outbound educational layout. Despite the fact that numerous cooperative projects claim the introduction of high-quality overseas educational resources, core proprietary technologies, and characteristic core disciplinary curricula embodying foreign institutional educational advantages are barely imported. The introduced original textbooks are incompatible with China's domestic national conditions and decoupled from prevailing industrial normative benchmarks; coupled with insufficient localized secondary development and curriculum fusion renovation, students are unable to flexibly apply acquired theoretical knowledge into practical occupational scenarios after finishing studies. Additionally, blind pursuit of emerging industry hotspots such as Internet Plus strategy and intelligent manufacturing prompts partial colleges to launch identical international-oriented majors recklessly, completely ignoring self-owned faculty resource endowments and the actual developmental requirements of the surrounding regional economy without rigorous feasibility demonstration <sup>[9]</sup>. Homogenized disciplinary setup results in the absence of featured differentiated competitive advantages grounded on localized industrial foundations, eventually leading to a disconnection between cultivated graduate competency and real market talent demands.

### **3.3. Superficial international literacy of enrolled students plus utilitarian deviation of institutional schooling philosophy**

As core participants of internationalized tertiary education delivery, most undergraduates studying in application-oriented universities are hampered by inadequate comprehensive international accomplishment, manifested as prominent drawbacks, including high written exam scores yet deficient practical application capabilities and constrained global cognitive horizons. Meanwhile, partial institutional administrative implementation reveals an obvious utilitarian inclination reflected in two concrete dimensions. For one thing, notwithstanding passing national CET-4 and CET-6 language assessments, a large proportion of students remain incapable of conducting fluent specialized technical communication in foreign languages under practical professional contexts with deficient listening, speaking, reading, and writing capabilities, especially in terms of proficient employment of disciplinary terminologies for technical discussion. Restricted by personal economic constraints and limited outbound exchange opportunities, the bulk of undergraduates never obtain authentic overseas studying experience and acquire multicultural knowledge merely from



printed textbooks, lacking the competence to tackle intricate practical issues amid diversified cross-cultural surroundings <sup>[10–11]</sup>. For another, several Sino-foreign joint education programs operate under impure developmental motives, either serving as institutional profit-generating channels or alternative admission shortcuts for candidates with subpar college entrance examination scores. Individual colleges impose exorbitant tuition fees upon enrolled students yet fail to furnish equivalent high-standard educational services, triggering diploma-mill-style irregular schooling behaviors and exerting irreversible adverse repercussions on institutional social reputation.

## **4. Developmental aspirations for boosting the internationalization construction of China's applied undergraduate institutions**

### **4.1. Reconstruct the internationalized faculty ecosystem to surmount competency barriers restricting bilingual teaching and dual-qualified teacher cultivation**

To begin with, domestic applied undergraduate establishments need to abandon conventional monolithic academic evaluation criteria and formulate classified hierarchical incentive frameworks targeting internationalized teaching staff in accordance with teachers' practical developmental status. Institutional administrative authorities ought to substantially raise the weighting coefficient of international teaching devotion within professional title appraisal and performance-based salary assessment mechanisms, fully acknowledge teachers' labor inputs in bilingual curriculum development, all-English course delivery, and undergraduate tutoring for international disciplinary competitions, and quantify corresponding instructional workloads authentically, enabling educators dedicated to internationalized teaching initiatives to reap tangible occupational developmental dividends <sup>[12]</sup>. In addition, colleges are supposed to roll out special financial subsidy funds to underpin teachers' outbound overseas exchanges, shifting traditional superficial academic sightseeing visits toward targeted overseas learning of advanced instructional methodologies in partner foreign universities or on-site post attachment within transnational enterprises. Such supportive policies create precious access for domestic instructors to keep abreast of cutting-edge global industrial specifications and advanced international engineering cultures, so as to feed newly acquired insights back into daily domestic instructional practice.

Secondly, implement the compound talent introduction strategy combining rigid recruitment standards and flexible intellectual import approaches. On the one hand, enforce strict qualification verification for inbound foreign teachers to eliminate unqualified language tutors recruited merely to fill required teaching hours, prioritizing the recruitment of seasoned industrial practitioners with abundant overseas vocational backgrounds capable of remedying existing shortcomings within the core specialized course teaching system. On the other hand, flexibly introduce top-tier overseas application-oriented academic elites via diversified modes, including short-term guest lectures, bilateral joint scientific research projects, and offline instructional workshops, to drive the overall competency upgrade of the existing domestic teaching cohort.

Finally, establish a normalized long-term training mechanism to enhance teachers' comprehensive international capabilities. Application-oriented colleges should construct bilateral Sino-foreign teacher instructional communities and implement paired tutoring mechanisms, collective lesson preparation seminars, and mutual classroom observation activities, assisting indigenous domestic instructors in breaking through linguistic shackles and advancing cross-cultural communication literacy as well as all-English instructional proficiency. These systematic measures guarantee the effective practical implementation of imported

overseas curricula, consolidate overall instructional efficiency, and facilitate the cultivation of a professional dual-qualified teaching cohort proficient in international industrial standards while well-acquainted with domestic localized developmental realities<sup>[13]</sup>.

#### **4.2. Deepen intrinsic curriculum construction to shift from blind hotspot chasing toward featured customized development and substantial curriculum integration**

Instead of pursuing popular trending majors blindly regardless of self-developmental endowments, application-oriented undergraduate institutions shall anchor their developmental footing on servicing surrounding regional socioeconomic advancement, rely on self-established preponderant disciplinary clusters, and realize seamless docking with advanced international industrial accreditation benchmarks such as engineering education certification criteria and global vocational qualification authentication norms. More importantly, tertiary authorities need to amplify investment into secondary localized development and adaptive renovation of imported high-quality curriculum resources. Specifically, institutional curriculum construction should transcend the rudimentary level of introducing scattered original textbooks and general elective courses, focusing concentrated resources on the digestion and absorption of foreign core specialized curricula, practical training modules and standardized achievement assessment systems, raise the practical credit proportion occupied by imported courses within total disciplinary credits and accomplish in-depth organic integration between introduced overseas resources and indigenous domestic curricula to avoid the split dual-track disjointed phenomenon. Meanwhile, persistently propel the in-depth reform integrating specialized disciplinary learning with foreign language literacy cultivation. Colleges are required to embed internationally prevalent industrial terminologies, standardized technical specifications, and authentic cross-cultural communication case studies into every single instructional segment of major courses, alongside developing matching digital teaching repositories and bilingual case resource banks, allowing undergraduates to naturally accumulate international workplace linguistic competencies while systematically absorbing professional disciplinary expertise<sup>[14]</sup>. To curb vicious homogenized disciplinary competition, tertiary institutions should embark on differentiated developmental routes by leveraging distinctive local industrial features, cooperating with regional flagship enterprises and multinational corporations to co-design customized international talent incubation programs, co-build shared practical training bases and integrate high-quality cross-border teaching resources, so as to highlight the competitive advantages of characteristic international disciplinary clusters, cultivate market-adaptive internationalized application-oriented talents and strengthen graduates' global employability competitiveness.

#### **4.3. A perfect comprehensive quality assurance framework, eradicate utilitarian schooling malpractices, and construct a full-cycle closed-loop talent cultivation system**

First and foremost, completely root out problematic diploma-mill operational tendencies and refine comprehensive institutional quality monitoring regulations. Relevant application-oriented colleges should introduce independent third-party evaluation agencies to execute full-process supervision over multiple core dimensions of Sino-foreign cooperative education projects, covering incoming student quality, allocated teaching resources, on-site curriculum implementation effectiveness, and learner satisfaction index, alongside establishing a periodic project exit mechanism to timely eliminate inefficient underperforming cooperative programs.

Secondly, construct an immersive, localized international educational ambiance to broaden undergraduates' global cognitive horizons. Apart from launching cost-effective short-term outbound exchange programs and overseas internship opportunities for enrolled students, institutional administrative departments need to prioritize the construction of a glocalized international campus cultural atmosphere. Concrete initiatives include regular organization of international cultural festivals, invitation of overseas prestigious scholars for on-campus academic lectures, and sponsoring student participation in high-standard international disciplinary contests, as well as innovation and entrepreneurship competitions, enabling undergraduates to experience diversified multicultural integration without stepping out of campus boundaries.

Thirdly, boost students' practical foreign language application capacity and cross-cultural environmental adaptability. Beyond conventional systematic foreign language curriculum setup, application-oriented colleges ought to add multiple internationalized elective courses such as workplace-oriented business English and practical cross-cultural communication tutorials, alongside organizing abundant extracurricular cross-cultural practice events, including Model United Nations simulation conferences and international volunteer service activities, with the goal of enhancing students' practical communication competence and complex-problem resolving capabilities under diversified international operational contexts <sup>[15]</sup>.

## 5. Conclusion

Based upon the foregoing comprehensive research and systematic analytical elaboration, the internationalization advancement of China's application-oriented undergraduate tertiary establishments is never equivalent to superficial educational resource splicing or blind-scale enrollment expansion; instead, it constitutes a sophisticated, systematic engineering project covering multiple core elements, including faculty structural optimization, curriculum system renovation, and all-around educational environment refinement. Looking ahead, the internationalized developmental layout of domestic applied undergraduate institutions must abandon an impetuous, short-sighted utilitarian mindset and revert to fundamental educational essence by organically combining localized domestic developmental demands with internationally recognized advanced industrial benchmarks. Only by adhering to such developmental logic can tertiary establishments nurture abundant, high-caliber, application-oriented talents equipped with global core competencies and enable China's indigenous application-oriented undergraduate education to manifest outstanding, distinctive advantages amid fierce global higher education competition.

## Disclosure statement

The author declares no conflict of interest.

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# Research on Breathing Techniques in Wind Instrument Performance and Phased Teaching Approaches

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**Abstract:** Breathing, as the fundamental technique of wind instrument playing, is very important for the tone quality, pitch constancy, and musical phrase expression by using correct breath control and management. In soft passages, a continuous, focused, and supportive airflow is needed, whereas in forte parts, the airflow speed should be precisely regulated. The breathing technique in wind performance mainly depends on the combination of adequate inhalation and accurate breath control. During the process of wind performance practice development, three traditional breathing methods — chest breathing, abdominal breathing, and thoracoabdominal breathing — have been formed, each having different physiological mechanisms and technical characteristics and suitable for various performance situations. This paper comprehensively studies the merits, drawbacks, and applicable scopes of these three breathing methods; reviews the historical evolution of breathing techniques in wind performance at home and abroad; investigates the scientific principles for controlling the airflow effectively and achieving smooth breathing changes; and, from the viewpoint of music teaching, proposes step-by-step teaching methods for the breathing techniques. The purpose of the research is to improve the theoretical foundation of breathing in wind performance, offer theoretical references and practical advice for wind education and performing practice, and thus promote the advancement of wind art academically and practically in China.

**Keywords:** Wind instrument performance; Breathing methods; Breath control; Breathing techniques; Music education

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## 1. Introduction

Breathing is the main factor in producing sound for wind instruments. The regulation and utilization of breathing and airflow are the basic skills of wind players, and the significance of these skills in performance practice cannot be overestimated <sup>[1]</sup>. Different from the performing techniques of string instruments or the



piano, the breathing in wind playing is an inner technical process that cannot be directly seen or sensed. Hence, it is necessary to master the scientific breathing methods and form a method suitable for one's own physical condition in order to enhance the technical ability in wind performance.

According to previous studies, there are three kinds of breathing methods used in wind instrument playing: chest breathing, abdominal breathing, and thoracoabdominal breathing. Some researchers and performers select one of these methods only, without considering the advantages, disadvantages, and different usages of each method <sup>[2]</sup>. Although the physiological mechanisms of breathing in wind playing and singing are similar, there are some differences in practice because of the different sound-producing materials. Abdominal breathing is generally applied in vocal music, while thoracoabdominal breathing is now commonly used in wind instrument playing <sup>[3]</sup>. At present, many wind players and learners still have wrong ideas about the breathing methods, which prevents them from fully understanding the importance of the breathing techniques in the performance.

At the same time, wind schools in various countries show slight variations in their ways of using breath, which are now significant factors in forming performance styles. Besides, there are differences between Chinese and foreign traditions in terms of the importance given to breathing exercises and their practical applications <sup>[4]</sup>. On the basis of the previous studies, this paper objectively investigates the physiological mechanisms and technical features of the three breathing methods, elucidates the scientific basis of breath control and breathing changes, and traces the historical evolution of breathing techniques in wind performance both in China and abroad. From the viewpoint of music education, it also suggests specific teaching methods, with the purpose of improving the knowledge about breathing techniques in wind performance and offering scientific advice for wind education and performance practice.

## **2. Physiological mechanisms and technical analysis of the three classical breathing methods in wind instrument performance**

The three breathing techniques in wind performance have distinct physiological mechanisms and technical features, which mainly affect their use and efficiency in performance. Only by clearly recognizing the main characteristics, benefits, and disadvantages of each technique can the performers make scientific choices and apply them flexibly <sup>[5]</sup>.

### **2.1. Chest breathing**

Chest breathing is a kind of shallow breathing that makes the chest cavity expand in three dimensions—front, back, and sides. The physiological movement mainly occurs in the middle of the thorax. When inhaling, the external intercostal muscles cause the chest cavity to expand, the shoulders to raise, and the chest to contract, directing the air flow to the upper part of the lungs. This is the usual rapid breathing manner of the human body after strenuous exercise <sup>[6]</sup>.

From a technical viewpoint, the only benefit of chest breathing is its fast inhalation response, enabling the person to inhale air in a very short time, which is appropriate for replenishing breath quickly in emergency situations. However, its disadvantages are considerable and generally inconsistent with the technical requirements for wind performance.

Restricted respiratory capability — it mainly utilizes only the upper portion of the lungs, which is not adequate for long sentences or loud passages.

Insufficient breath control leads to muscle tension in respiration, causing unstable exhalation and variation in airflow and volume, which may result in a change of pitch and a weak, poor voice.

High physiological burden — continued use may result in shoulder and neck strain, difficulty in breathing, dizziness, and general body stiffness, which may influence the naturalness of performance.

In a sudden airflow change after inhalation, the variation affects the smoothness of musical phrases.

In the field of wind performance and education, the practical use of chest breathing is very limited. It can only be applied temporarily for rapid double- or triple-tongued passages to provide emergency breath replenishment and is not suitable for systematic training or long-term performances. For novices, chest breathing usually becomes their natural method because of its simplicity and convenience. However, continuous dependence on it may result in the formation of bad technical habits, limit the improvement of breath control, and obstruct the progress of performance skills. Therefore, in teaching, it is important to correct this tendency at an early stage and instruct the students to adopt scientific breathing methods <sup>[7]</sup>.

## **2.2. Abdominal breathing**

Abdominal breathing, also known as diaphragmatic breathing, is a method of deep breathing in which the diaphragm is compressed, resulting in the movement of the abdomen during inhalation and exhalation. The principle of this method is that the diaphragm and abdominal muscles work together in respiration: when inhaling, the diaphragm contracts and moves downward, the abdomen expands naturally, and the lower lungs are expanded to take in deep air; when exhaling, the diaphragm relaxes and returns to its original position, and the abdomen contracts inwardly due to the action of abdominal muscles to discharge air gradually.

The technical advantages of abdominal breathing lie in the precision of breath control:

Effortless and quick inhalation enables short inhalation times, which are appropriate for rapid breath replenishment in short-to-medium length phrases.

Direct and accurate control by using abdominal muscles — the performers can change the speed and quantity of air flow, which is advantageous for playing soft parts gracefully <sup>[8]</sup>.

The chest and shoulders should be relaxed during respiration, which is beneficial in relaxing the muscles, decreasing the heart rate, and maintaining an upright posture. Moreover, abdominal breathing can significantly enhance lung capacity, giving useful practice for strengthening the basic respiratory capability of a performer.

However, abdominal breathing has some technical drawbacks in wind performance, thereby preventing it from being the dominant method:

Inadequate air intake volume — the thoracic cavity is hardly involved, and lung expansion is restricted, which cannot satisfy the breathing requirements for brass instruments, large woodwinds, or prolonged, continuous phrases.

Single muscle group involvement — depending only on the diaphragm and abdominal muscles, continuous use may cause exhaustion of the abdominal muscles, and, under inadequate ventilation, hypoxia might occur.

Limitations in tone production — the breath support point is relatively low and does not connect closely with the instrument's sound-producing area, which can result in a tone that is overly heavy, lacking in fluidity, and brightness.

At present, abdominal breathing has virtually no independent application in professional wind

performance. Only a few players of small woodwinds, such as the piccolo or Eb clarinet, may moderately incorporate their breath-control characteristics in soft or delicate passages. In wind education, abdominal breathing can serve as a foundational training method for breath control, helping learners develop a core understanding of “diaphragmatic support” and laying the groundwork for later mastery of thoracoabdominal breathing<sup>[9]</sup>.

## **2.3. Thoracoabdominal breathing**

Thoracoabdominal breathing is a composite method that integrates the physiological mechanisms of chest and abdominal breathing. It was clearly proposed by the renowned vocal pedagogue M. Garcia. Due to its scientific physiological basis and comprehensive technical features, it has become the mainstream method in wind performance, highly regarded by the vast majority of professional performers and educators.

### **2.3.1. Physiological mechanism of movement**

Thoracoabdominal breathing can make the whole respiratory muscle work in harmony and is the most scientifically based breathing method in sports. When inhaling, the external intercostal muscles become active to expand the chest in all directions, and the diaphragm also contracts and moves downward, making the abdomen protrude. The ribs spread completely, and both upper and lower parts of the lungs are stretched to the fullest, thus increasing the lung capacity and enabling the entry of enough air. During exhalation, the abdominal muscles contract slowly to allow the diaphragm to rise naturally, and the chest cavity contracts due to its own elasticity and the coordinated action of the thoracic and intercostal muscles. By the opposite contraction of the chest and abdominal muscles, a steady and controlled airflow is kept.

### **2.3.2. Core technical features**

Thoracoabdominal breathing combines the benefits of chest and abdominal breathing without its technical drawbacks, possessing four main features:

Strong breathing capacity — the simultaneous expansion of the chest and abdomen facilitates the full use of lungs, offering enough breath support for long sentences and forte parts, and satisfying the various respiratory requirements of wind performances.

Effective lung capacity: the contraction of chest and abdominal muscles forms a flexible and adjustable “breath supporting mechanism”, which can control the speed and volume of air flow accurately and enables smooth transitions between gentle and loud parts to satisfy the tone and expressive requirements of different musical sections.

Muscle endurance refers to an even distribution of breathing load on the diaphragm, abdominal muscles, chest muscles, and thoracic-back muscles, preventing overfatigue of any single muscle group and enabling the performers to keep a stable breathing throughout long performances or practices.

Natural body posture — the chest and shoulders are kept relaxed during breathing, with coordinated movements only in the chest and abdomen, which helps to decrease muscle tension and improve the performer’s posture and musical expression.

### **2.3.3. Performance and educational application value**

Thoracoabdominal breathing is the most appropriate method for respiration in wind playing, applicable to all kinds of wind instruments (woodwinds and brass) and various performance situations. For brass instruments,

it can supply enough air for loud parts and long phrases, while providing accurate breath control to maintain the pitch and tone steady. For woodwinds, it can control the airflow precisely to produce clear and bright tones, thus achieving fine expressions in soft parts.

In the study of wind education, thoracoabdominal breathing is an important part of training, and the mastery of this technique is a necessary condition for improving performance skills. The training of thoracoabdominal breathing not only helps in acquiring scientific breathing methods but also improves the coordination of respiratory muscles, establishes a right view on the use of breath, and provides a strong technical basis for the progress of performance skills and musical expression.

### **3. Scientific principles for the application of breath control and breathing techniques in wind instrument performance**

Mastery of scientific breathing methods is required for playing wind instruments. Correct utilization of breath control and breathing techniques, to harmonize respiration with the musical rhythm, can enhance artistic expression. The breath used in wind performances does not have a fixed shape; it should be modified according to the piece, playing abilities, and expressive needs. Moreover, the breathing must obey the musical structural rules in order to avoid disruption of the sequence and continuity of musical sections.<sup>[10]</sup>

#### **3.1. Core principles of breath control**

Breath is the main factor in producing sounds for wind instruments. The pitch, strength, and tone are all influenced by the regulation of air velocity and amount. Most mistakes in performance, such as incorrect intonation, poor tone quality, or interrupted musical phrases, are caused by the inappropriate use of breath. In order to reach a harmonious relationship between technical skill and musical expression, breath control in wind performances should obey three basic rules.

First, a slow inhalation and exhalation serve as the basis; a rapid one is used as an addition. Slow breathing is important for the primary training of breath control. When inhaling, the chest and abdomen must expand gradually to obtain enough and deep air. During exhaling, the breath should be released slowly under the control of the respiratory muscle groups, keeping the air speed and volume even. This rule can improve the breath control ability and develop a steady breath support. However, only when performing such fast passages as double tonguing, triple tonguing, or fast scales, the speed of inhalation and exhalation can be slightly increased, but the breath control must be maintained to accomplish quick air replenishment and sound production. In this case, rapid breathing does not indicate disordered and hurried inhalation; instead, it means to breathe in sufficiently and deeply within one beat.

Furthermore, one should control the breathing according to the requirements of the music, adjusting it in accordance with the characteristics of the different parts of the music. The short and soft passages need a slower airflow and a smaller air volume to produce a soft and delicate sound. While the long legato melodies need a steady airflow and an equal air volume to keep the phrase continuous. In the sharp and urgent passages, a moderate increase in the airflow and accurate regulation of the air volume are necessary to guarantee the clearness and strength of the articulation. For the lyrical and song-like passages with changing pitches and dynamics, the airflow should be adjusted dynamically to form a layered and expressive line.

Furthermore, keep some residual air to ensure continuous support. During expiration, a certain quantity of air should be kept in the lungs; the breath must not be fully exhausted. If the remaining air is enough



to play for one or two beats, inhalation should be prepared. The residual air is beneficial to keep the lung expanded and the respiratory system's muscular tension, avoiding the relaxation of muscles due to the complete exhaustion of breath. This guarantees the continuity of the next inhalation and sound production, thereby preventing breathlessness and maintaining the overall stability of performance.

### **3.2. Scientific principles for the effective application of breathing techniques**

Breathing renewal is an important part of the respiratory process in playing wind instruments, and its suitability has a direct influence on the smoothness of musical phrases and the completeness of musical expression. The main rule for breathing renewal is that respiration should support the musical framework. Therefore, breathing points should be arranged before sight-reading, and proper breathing techniques should be chosen according to the structural features of the piece and performance requirements, avoiding incorrect ideas and mistakes in breathing.

#### **3.2.1. Precisely plan breathing points, giving priority to the musical structure**

When performing music and reading it, the positions for breathing should be chosen beforehand. One must take into account the ends of the sentences, the termination of the parts, or the natural pauses in the musical structure (usually marked as “V” or a comma in the score for breathing positions). The breath should be inhaled at these spots without altering the sentence or the musical line. It is not permitted to breathe abruptly in the middle of a whole sentence; it might interrupt the musical continuity and convey an incorrect impression <sup>[11]</sup>.

In the situation that there are no intervals between the phrases or when a phrase is too long without a proper stop, a fast breathing method can be applied to finish it. According to the rules of music, the duration of the previous note may be reduced slightly to produce a short interval for quick and deep breathing. The inhalation should be silent in order to maintain the regularity of the rhythm and the flow of the music. The main purpose of this method is to restore the air without interfering with the musical expression.

#### **3.2.2. Targeted control of breathing techniques for special note patterns**

During the performance of the consecutive off-beat (second part of the beat) patterns, the breath should be taken after the end of the phrase, because it is not permitted to breathe after each pause or to inhale before each note. Otherwise, the rhythm and the whole melody would be disturbed. Besides, when playing fast and continuous scale-like sections, the breath should be kept at the points where the ascending and descending notes meet. These points are appropriate for melody variations, allowing the performer to take a breath without affecting the melody.

#### **3.2.3. Avoid common mistakes in breathing techniques**

Errors in breathing during playing wind instruments generally occur in three ways, which both affect the performance results and need to be paid attention to in the practice: Firstly, unexpected breathing happens when the player stops to breathe according to his own air supply instead of following the musical structure, thus disturbing the connection of the phrases and the harmony of the melody. Secondly, the improper use of the rapid inhalation technique. If there are no natural pauses in the passages, the players may either force a breath, which influences the rhythm, or hold their breath while playing, causing body stiffness and poor tone quality. Lastly, not retaining enough air. Taking a deep breath before exhaling quickly may result in a



gap between the breaths and an unstable subsequent rhythm. Moreover, breathing to the greatest capacity can also be disadvantageous, as it is hard to control the breath and gives a tense feeling. This is especially inconvenient in short phrases, where it might produce a stiff tone, opposite to the principle of playing naturally and freely.

## **4. An overview of the development of breathing techniques in wind instrument performance in China and the West**

The alteration of breathing techniques in wind instrument playing has changed from practical knowledge to scientific study, and from personal experiences to general methods. The advancement of Chinese wind instrument breathing skills shows, in a brief way, the development of Western wind performances, and at the same time, combines the local musical culture to form its own unique characteristics. The exchange of cultural and technical relationships between China and other countries has contributed to the continuous improvement of these breathing techniques.

### **4.1. Development stages of breathing techniques in Western wind instrument performance**

The development of breathing techniques in Western wind instrument performance is closely related to the study of respiratory physiology and the progress of wind music. It has gone through three main stages and finally established a scientific system, with thoracoabdominal breathing as the main approach <sup>[12]</sup>.

During the initial stage, prior to the 1960s, the focus in wind playing was on generating a strong sound. Due to the limitations of the existing performance techniques and the degree of physiological research at that time, thoracic breathing was mainly used in the Western wind instruments, particularly in the Eastern European schools such as those in the former Soviet Union and Czechoslovakia. The rapid inhalation of thoracic breathing met the requirements of some fast passages; however, as wind playing progressed, its disadvantages, including inadequate breath support and poor tone continuity, were gradually discovered and restricted the enhancement of performing skills.

Stage Two: Transition to Abdominal Breathing (1970s–1980s). With the progress in respiratory physiology and the combination of various breathing methods, abdominal breathing was incorporated into the Western wind performances, mainly in Western Europe and the United States. It overcame the drawbacks of thoracic breathing by providing a finer and mellower sound. Nevertheless, because of its small inhalation ability, it could not adequately support vigorous brass playing or lengthy phrases and was thus used as an auxiliary technique in both performance and training.

During the third stage (1990s–present), with the development of respiratory physiology and improvement in wind performance techniques, more and more musicians and researchers found that a single breathing method was not sufficient and started to study the combination of thoracic and abdominal methods. Thoracoabdominal breathing, which has been supported by solid physiological principles and possesses many advantageous techniques, has become the main method in western wind performance and is now widely spread and used <sup>[13]</sup>. In the 21st century, as the requirements for breathing techniques in wind performance become higher, different auxiliary training tools such as breath trainers, airflow meters, and lung expansion devices have been invented and applied in the training process. These tools facilitate the quantitative practice of inhalation volume, air velocity, and exhalation steadiness. They are particularly beneficial for beginners and fans, giving them quick guidance and promoting a more scientific and standardized way of training the

breathing techniques for wind instruments<sup>[14]</sup>.

## **4.2. The development of breathing techniques in Chinese wind instrument performance**

The research on breathing methods in Chinese wind instrument performances started after the establishment of the People's Republic of China and has experienced four stages: "Introduction — Absorption — Integration — Innovation." This progress is always associated with cultural contacts between China and other nations, and it integrates the breathing ideas of Chinese traditional wind instruments to establish a theoretical and practical system which combines both international views and local features.

In 1958, the People's Music Publishing House translated and issued "Breathing Methods for Wind Instrument Performance" written by the Soviet wind teacher Zhikov. This book was the first monograph on wind instrument breathing techniques introduced to China. It systematically explained the principles and uses of thoracic breathing and became an important reference for the initial wind instrument teaching in China, making thoracic breathing the main method in early Chinese wind performance.

In the 1970s, domestic investigations on wind instrument playing started in China. A paper written by Mr. Xiang Zhenlong from Sichuan Conservatory of Music, named "Breathing during Wind Instrument Performance", was the first independent research on wind instrument breathing techniques in China, indicating the beginning of a self-study period. In the 1980s, cultural contacts between China and other countries became closer. The China Federation of Literary and Art Circles Publishing House translated and published "The Art of Brass Playing" by the famous American horn player Frank Farkas, which described the physiological principles and breath-regulation methods of abdominal breathing, introducing this technique to China and enhancing the research on wind instrument breathing techniques in the country.

Stage Three: Promotion of Thoracoabdominal Breathing and Research Deepening (1990s–present). Since the 1990s, with extensive cultural contacts in wind music, the western technique of thoracoabdominal breathing has been introduced to China and is now widely used in both performances and teaching. Many research papers concerning wind instrument breathing methods have been published in Chinese music magazines. The research has changed from introducing single methods to a thorough investigation of the physiological basis, technical features, and practical uses, indicating the advancement of breathing technique research in China.

During the twenty-first century, Chinese wind music has combined the Western breathing methods with those of the traditional Chinese wind instruments. The ancient concept of "essence, qi, and spirit" has been applied in the breathing exercises, resulting in a special system of breathing techniques for wind instruments. Moreover, the Western equipment used for breath training has been adopted in the Chinese wind teaching, which is advantageous for the scientific and regular improvement of the breathing training. At present, some domestic investigators and performers are altering the breathing techniques according to the physical state and performance requirements of the local learners, and they are conducting individualized research and practice on the methods of breathing.

## **5. Stage-based teaching strategies for breathing techniques in wind instrument education**

Breathing techniques are important in the training of wind instruments, and the teaching efficiency has a great influence on the basic abilities and future development of the learner. The instruction of breathing techniques

for wind instruments should be carried out according to the physiological condition of the learner and the normal process of skill acquisition. The teaching should be modified according to the main features of three types of learner groups — beginners, intermediates, and advanced ones — by setting up different teaching goals and training methods. This method combines theoretical teaching with practical exercises, so that the learners can gradually acquire a scientific knowledge of breathing and the capability to use it properly.

### **5.1. Beginner stage: Establish scientific understanding and correct instinctive habits**

The initial stage is very important for instructing the breathing techniques of wind instruments. Beginners usually depend on the instinctive thoracic breathing and have no clear knowledge of “breath support.” The main purpose of teaching at this stage is to enable learners to get rid of the usual thoracic breathing habit, acquire a scientific conception of diaphragmatic support, learn the fundamental physiological processes of thoracoabdominal breathing, and establish the correct muscular memory for proper breathing.

In the theoretical teaching, a straightforward and easy-to-understand method should be used, avoiding difficult technical terms. By means of human respiration’s anatomical diagrams, video displays, and other similar aids, the learners can visualize the physiological distinctions between thoracic, abdominal, and thoracoabdominal breathing. Combined with basic exercises for sound production, the learners can recognize the relation between breath, tone quality, and intonation, realizing that breath is the basis of wind instrument sound production. The learners should also be distinctly informed about the restrictions of thoracic breathing and the scientific benefits of thoracoabdominal breathing, which will assist them in forming definite learning aims.

In practical training, attention should be paid to static breathing exercises and simple sound-producing exercises to decrease the difficulty and emphasize the formation of muscular memory:

Do static thoracoabdominal breathing exercises either in a seated or standing posture: Put one hand on the chest and the other on the abdomen to note the synchronous elevation of the chest and abdominal movements during inspiration and the voluntary contraction of abdominal muscles during expiration. Regular practice is advantageous for forming muscle memory.

Slow exhalation exercises with common objects: By blowing on a candle flame or a piece of paper and keeping its steady motion, the learners improve the uniformity of their exhalation and enhance their breath-control abilities.

Simple single-note and short-phrase exercises: Integrating thoracoabdominal breathing with the instrument sound production helps the learners to understand the relation between breath and performance, which is beneficial for the transfer from basic breathing exercises to practical performance.

The main objective at this stage is to immediately correct the bad habits, patiently instruct and lead the learners’ inclination towards thoracic breathing, and avoid the establishment of improper habits, thus laying a basis for further advanced training.

### **5.2. Intermediate stage: Enhance breath control and integrate performance techniques**

Intermediate learners have learned the fundamental steps of thoracoabdominal breathing and can use this technique in some performances. But their control over the breath is still inadequate, and the combination of breathing with performance methods is relatively poor. The main objective at this stage is to enhance the accuracy and steadiness of the breath control, understand the scientific rules for using breath control and renewing breath, and accomplish a thorough integration of breathing techniques with performance skills and

musical expression.

In the theoretical instruction, the content should be intensified and related more closely to actual performances: explaining clearly the three main principles of breath control, i.e., slow inhalation and exhalation, regulating breath as required and keeping residual air, and describing how to adjust breath control according to the requirements of various kinds of passages like legato, articulated, soft, or strong playing. A comprehensive explanation of the scientific rules for breath renewal should also be given, including the arrangement of breathing points, the application of rapid inhalation methods, and strategies for breathing in specific note patterns. Taking scores from typical wind instrument compositions as an example, the breathing points should be marked and analyzed to assist the learners in forming the idea that breath should support the musical structure. Moreover, the differences in using thoracoabdominal breathing between woodwind and brass instruments should be studied to improve the precision and relevance of the instruction.

In practical training, the emphasis should be on targeted breath-control exercises and breathing-renewal techniques, combined with the performance skills for thorough training:

Differentiated exercises of air-speed and air-volume: Adjust passages with slow, moderate, and fast rhythms, enabling the learners to regulate air speed and volume, thus improving their dynamic breath-control ability.

Specialized training on rapid inhalation methods: By performing exercises like continuous phrases with no natural pauses or fast scales, the learners improve their ability to make quick and deep inhalations in brief intervals.

Specialized training about controlling breath to achieve accurate musical beats: Concentrate on challenging rhythms such as off-beat notes and quick tongue movements, and provide specific guidance on breathing methods and techniques.

“Breath-Performance” coordination exercises: Through the practice of some moderate difficulty passages from well-known wind compositions, students enhance their abilities in arranging breathing moments and regulating breath, thereby achieving the simultaneous improvement of technical skill and practical application.

The current main purpose is to offer personal guidance. Based on the learner’s physical condition (such as lung capacity and muscle coordination) and technical shortcomings, suitable training plans are formulated to help the learner learn a breathing control method according to his/her own needs.

### **5.3. Advanced stage: Artistic application and integration with musical expression**

Advanced learners have already acquired proficient breath-control and breathing-renewal abilities and can use thoracoabdominal breathing in their routine performances. The main object of instruction at this level is to make the breathing techniques artistic, so that the breath can express the music. They should change their breathing and air-control methods according to the style and character of the work as well as their own performance style, finally forming a personal and expressive way of performance.

In the theoretical teaching, the emphasis should be raised to a higher level, incorporating musical beauty:

Explore the connection between breathing methods and musical expression thoroughly, examining how breathing methods are used in compositions of various styles (classical, romantic, modern) to enable learners to recognize the importance of breathing techniques in musical expression.

Compare the different applications of breathing techniques in various domestic and international wind



bands, and discuss the influence of breathing techniques on the development of personal performance styles through the performances of some famous musicians.

Present the latest research results in respiratory physiology and the art of wind instrument performance, enlarging learners' academic views and leading them to independent research and exploration.

In practical training, attention should be paid to the performance of the whole work, highlighting artistic expression:

Performance of complete classic wind works: Instruct learners to study the musical elements, melodic features, and dynamic variations in detail, and establish individual breathing and breathing-refreshment plans to ensure that the control of breath and techniques fit with the requirements of musical expression.

Improvisation exercises: Permit students to modify their breath control and breathing methods in accordance with the expressive requirements of the moment, enhancing the flexibility of applying breathing techniques.

Integration of various breathing techniques: Suggest that learners appropriately integrate the technical aspects of thoracic and abdominal breathing during certain parts to attain individualized musical expressions.

Performance evaluation and analysis: By means of recordings or videos, assist the learners to identify the shortcomings in their breathing techniques during performance and constantly improve the coordination between breath and musical expression.

The main objective at this stage is to develop independent research and innovative abilities, instructing students to integrate their physical features, performing style, and the requirements of the music in order to explore new applications of breathing techniques, where breath control is considered an important way to form their individual performance style.

## 6. Conclusion

Breathing is necessary for playing wind instruments. The proper application of breathing techniques has a considerable effect on the tone quality, the correctness of the pitch, the richness of the tone color, and the precise control of the dynamics. It also affects the formation of musical phrases, the curve of melody lines, and the complete expression and artistic result. Using the wrong breathing methods not only decreases the performance quality but might bring about physical inconvenience, like lung fatigue and muscle aches. Hence, the breathing technique is an important criterion for assessing the ability of a wind player and an indispensable component in both wind playing and instruction.

In the performance of wind instruments, the three kinds of breathing methods—chest breathing, abdominal breathing, and thoracoabdominal breathing—have different physiological processes and technical features. Chest breathing enables quick inhalation but is only applicable for emergency breaths and has a small range of use. Abdominal breathing can give exact control of breath but has a restricted inhalation volume; it is mainly used as a basic training technique for breath control. Thoracoabdominal breathing combines the merits of both, balancing the inhalation capacity and breath control. Therefore, it is considered the most reasonable and ideal breathing method in present wind performance and has been widely chosen in wind playing and teaching both in China and abroad.

Breath control and breathing methods in wind performance should conform to scientific rules and be closely related to the musical framework. Inhalation should be slow and steady, adjusting the flow of air and quantity according to the features of the music, keeping a sufficient reserve of breath at the same time. The



breathing points should be arranged beforehand and mainly correspond to the musical structure. One should use rapid inhalation appropriately and control the breathing technique specifically in certain rhythmic or melodic parts. It is essential to avoid improper breathing, such as breathing arbitrarily, playing while holding one's breath, or exhausting the breath without any reserve.

The improvement of breathing methods in Western and Chinese wind performances has changed from separate and independent techniques to all-inclusive and comprehensive ones. In the West, the progress of wind breathing techniques is associated with the advancement of respiration physiology and the growth of wind music as an art, resulting in a scientific system mainly based on thoracoabdominal breathing. In China, the study of wind breathing techniques started with the introduction of Western theories. After continuous domestic research, adjustment, and combination, it developed into a system that integrates an international viewpoint with special local features. Since the 21st century, interdisciplinary cooperation and technological support have promoted the wind-breathing techniques towards higher scientific reliability, uniformity, and individualization.

In the instruction of breathing techniques in wind music, it is necessary to follow the rules of skill acquisition and carry out according to certain stages: At the initial stage, emphasis should be laid on forming a correct scientific knowledge, correcting bad habits and mastering the basic principles of diaphragmatic breathing; At the intermediate stage, the emphasis changes to improving breath control and acquiring proficiency in breathing techniques, so that breathing can be combined with the instrumental technique; At the advanced stage, attention should be paid to the artistic use of breathing techniques, enabling breath to express music and promoting the formation of an individual performance style.

Breathing technique in wind performance includes both scientific accuracy and artistic expression, and its investigation and application are ongoing tasks. With the development of respiratory physiology, exercise anatomy, and the charm of wind performance, the future study of wind breathing techniques should improve the combination of physiological science and performing art, and find out more particular and individualized training methods. At the same time, the close contacts and mutual inspirations between Chinese and foreign techniques of wind breathing should also be strengthened. By incorporating the cultural background and artistic concepts of Chinese ethnic wind instruments, the progress in both the research and practice of wind breathing techniques in China can be effectively promoted. For wind players and teachers, it is significant to maintain a scientific research attitude and an open-minded academic viewpoint, continually exploring the fundamental principles of breathing techniques. Thus, scientifically based breathing methods can provide strong assistance to the artistic presentation in wind performance and accelerate the continuous advancement of wind music in China.

## **Disclosure statement**

The authors declare no conflict of interest.

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# On the Innovation of Spatial Composition of Contemporary Oil Painting from the Perspective of Freehand Brushwork and Blank Space

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**Abstract:** Freehand brushwork with blank space originates from Confucianism and Taoism. After thousands of years of painting, it has established a mature aesthetic paradigm of the coexistence of reality and falsehood, which continues to deliver high-quality traditional cultural nutrients for domestic oil painting localization and innovation. With the renewal of the local oil painting creation concept, freehand brushwork breaks through the limitation of exclusive ink painting techniques, and is deeply integrated into oil painting space planning, color spreading, and artistic conception shaping, creating a spirit full of oriental poetry. Freehand brushwork and blank space recombine the rhythm of the picture by virtue of the unique virtual and real order, so that the oil painting space has both visual beauty and spiritual connotation. Based on the aesthetic essence of freehand brushwork and the logic of space construction, this paper analyzes the reasons why it adapts to oil painting media, explores the innovative path of composition from multiple dimensions, and explains the application value with examples to provide theoretical support for the nationalization of oil painting creation.

**Keywords:** Freehand brushwork and blank space; Contemporary oil painting; Spatial composition; Virtual and real; Localization innovation

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## 1. Introduction

At present, the two-way communication and integration of Chinese and Western arts is an inevitable trend in the development of visual arts. Since oil painting was introduced to China more than a hundred years ago, it has been developing in a running-in way between foreign art paradigms and local aesthetics. For a long time, the Western focus perspective and full composition logic have been the main ways to build space for domestic oil paintings, forming a classic aesthetic model that emphasizes objective reproduction and full pictures. With the acceleration of traditional culture, the concept of space in traditional freehand brushwork

painting has re-entered the artist's field of vision. Different from the Western space concept of filling the picture, the essence of freehand brushwork in blank space is whether there is interaction or not, which makes blank space have a unique charm and ideographic function. In recent years, domestic oil painting creation has paid more attention to artistic conception. Many creators combine the characteristics of oil painting and canvas to improve the composition, and many works with both oil painting texture and oriental artistic conception are born, which promotes the diversified development of oil painting spatial expression.

## **2. Aesthetic core and spatial composition logic of freehand brushwork and blank space.**

### **2.1. The philosophical foundation and aesthetic characteristics of freehand brushwork and blank space**

Freehand brushwork and blank space come from the philosophical concept of “whether there is or not” in Taoism and the aesthetic orientation of Zen ethereal. After the repeated tempering of landscape painting creation in the Song and Yuan Dynasties, it formed the creative gist of shaping in reality and expressing in emptiness. In traditional freehand brushwork Chinese painting, blank space is not a meaningless blank in the picture, but an important element to promote the flow of charm and expand the artistic conception of the picture. Ma Yuan's “corner” landscape and Xia Gui's “half-edge” composition are typical examples. The painter condensed the real scene in a corner of the picture, leaving the rest of the space blank as images such as rivers and clouds, and linking the whole charm through the contrast between reality and reality, constructing the unique rules of painting in the East.

Different from the way of filling the picture with shapes and color blocks, blank space achieves the unity of objective images and spiritual artistic conception by deleting redundant images and reserving blank space. In creation, the blank space is the materialization of the painter's subjective feelings. By using the density of the blank space, the picture is condensed, the complicated details are abandoned, the aesthetic feelings are entrusted with the blank space, and the freehand brushwork concept of “nature from outside, heart from inside” is practiced. From the form of expression, traditional blank space can be divided into two types: original blank space on rice paper and blank space in light color. The former creates a pure, empty artistic conception based on the true color of paper, while the latter weakens the edges of objects and images with light ink, realizing the natural transition between real and virtual environments. After long-term precipitation, the two form a complete aesthetic system of oriental space, which lays a solid aesthetic foundation for the integration of blank space into oil painting creation <sup>[1]</sup>.

### **2.2. Freehand brushwork and western-style composition of blank space thinking are different**

Western classical oil paintings construct space with a focused perspective, expand the depth of the picture with a fixed single viewpoint, fill the image in order from foreground to distant view, simulate the real space with the help of body size and light and dark changes, and pursue a full picture. In traditional western-style composition, the canvas space is mostly filled with colors and shapes, and the blank space is mostly used as an aid for the transition between light and shadow, serving for the shaping of the body, lacking an independent aesthetic ideographic function, and the space construction pays attention to science, authenticity, and visual fullness.

Freehand brushwork leaves blank space based on the spatial perspective of the oriental scattered view, breaks through the fixed viewpoint limitation, does not stick to the objective spatial scale, and reorganizes the picture space through the virtual and real layout. There are obvious differences in spatial function positioning between the two, and the blank of western-style picture is attached to the solid modeling; Freehand brushwork and blank space can independently extend artistic conception and promote the flow of charm, create a sense of visual breathing by reserving blank space, guide the viewer's line of sight to flow between reality and reality, and expand the imagination space outside the screen. This different logic of spatial construction enriches the dimension of spatial expression of oil painting, makes up for the western-style full composition with oriental vanity aesthetics, and provides mature ideas for diversified innovation of oil painting composition <sup>[2]</sup>.

### **3. Freehand brushwork with blank space empowers the internal motivation of the innovation of contemporary oil painting spatial composition**

#### **3.1. Cultural empowerment demands in the process of oil painting localization**

In the context of global art blending, domestic oil painting is deeply promoting the localization process, and it is the general trend of the industry to build an oil painting discourse system with national characteristics. Mining traditional aesthetics and promoting the deep blending of Chinese and Western arts have become the key direction of creation. Long-term use of the western composition paradigm makes it difficult to highlight the aesthetic appreciation of local culture and meet the needs of nationalization of art in the new era.

Freehand brushwork with blank space embodies the spatial essence of Chinese painting for thousands of years and is a typical representative of oriental aesthetics. Integrating blank thinking into oil painting composition can optimize the creative system at the spatial logic level and enrich the cultural connotation of local oil painting. The field of fine arts in colleges and universities and the first-line creators actively carry out research on the transformation of traditional freehand brushwork elements in oil paintings, and take blank space as the starting point to promote the cultural integration of Chinese and Western art from the technical level, so that oil paintings not only retain the characteristics of oil painting, but also contain oriental freehand brushwork poetry. Strong demand for local culture construction, promoting the integration of traditional blank aesthetics into contemporary oil painting creation, has become the core driving force for composition language innovation <sup>[3]</sup>.

#### **3.2. Contemporary mass simple poetic aesthetic fashion help**

At present, the social aesthetics is constantly upgrading, and the mass aesthetics is gradually changing from a complicated and meticulous realistic style to a simple and ethereal artistic expression, preferring artworks with proper density and reverie. Traditional realistic oil paintings, which rely on high-density details to shape the picture, appear compact and heavy, and the visual information is complicated, which makes it difficult to fit the aesthetic trend of pursuing relaxation, elegance, and artistic conception.

Blank space can adjust the rhythm of the picture by streamlining the picture elements, reasonably reserving blank space, reducing the sense of visual oppression, and accurately fitting the trend of contemporary aesthetic lightness and poeticization. From the national large-scale art exhibition to the regional oil painting exhibition, the number of oil paintings that use blank space to optimize composition is increasing, and high-quality achievements have emerged in various themes such as landscapes and figures.



The promotion of national aesthetics and the orientation of exhibition art promote each other, promote the wide application of blank composition in the oil painting field, and make freehand brushwork blank become an important aesthetic carrier of contemporary oil painting innovation.

### **3.3. Oil painting media material compatibility brings technical support**

Oil painting pigments have many characteristics, such as thick pile, thin cover, superposition, through dyeing, and so on. They are extremely artistic and can transform the two blank forms of traditional Chinese painting flexibly. Creators can use thick coating to shape the texture of real-life objects, and use low-saturation light-colored Bo Tu to cover and dye to create a blurred blank effect. They can also directly retain the background color of the canvas to form a large area of original blank, which overcomes the problem that oil painting media can hardly present the transparent blank texture of rice paper, and let the virtual and real space naturally show.

In addition, various painting tools, such as brushes and scrapers, can not only stack heavy oil paints to enhance the real-life texture and shape the three-dimensional texture, but also flatly apply light colors to weaken the physical boundary and create a hazy virtual environment. The strong plasticity and compatibility of oil painting media enable the freehand brushwork of blank space, virtual and real logic, and spatial order to land smoothly, which technically ensures the feasibility and stability of transforming oil painting spatial composition with blank space and provides a solid media foundation for the integration of Chinese and Western spatial aesthetics<sup>[4]</sup>.

## **4. Practical strategies for the innovation of contemporary oil painting spatial composition from the perspective of freehand brushwork and blank space**

### **4.1. Reconstruct the spatial pattern of the picture with white corners**

Contemporary oil painting creation can learn from the essence of traditional landscape painting, break the traditional pattern of centered composition and full-picture presentation, and rebuild the overall spatial structure of the picture. The creator can focus the core real scene of the picture on the corner of the picture, abandon the layout of the center and the whole floor, treat the canvas space with a large area of blank space, adjust the overall space ratio through the strong contrast between the actual and virtual areas, and enhance the sense of depth of the picture by using the contrast of density, thus creating a sparse and elegant oriental aesthetic pattern.

In the creation of landscape oil paintings, the creators often put concrete scenery such as trees, cottages and rocks at the bottom of the picture to depict the close-up details in detail; At the top of the picture, the clouds, fog and distant mountains are represented by light white and light gray Bo Tu, and the details of clouds are omitted to express the vision in a minimalist way. A large area of blank space expands the psychological space of the picture upwards, which makes the limited canvas produce infinite visual effects. This composition, while retaining the advantages of accurate modeling and rich texture of realistic oil paintings, integrates the ethereal artistic conception of traditional landscape paintings and realizes the aesthetic transformation of the picture space from closed enrichment to open and spacious.

Oil paintings with characters are also widely used with white edges and corners. The creator placed the main character in one corner of the screen to ensure the outstanding visual focus, and the rest were treated with light tones and blank spaces, so as to avoid redundant environmental scenery and decorative elements

from interfering with the main character, focusing on the expression of the character's demeanor, posture, and emotions, and strengthening the spiritual core of the screen. The creator can flexibly adjust the proportion of blank space according to the theme of the work: appropriately increase the blank space for lyrical and freehand works to create an ethereal and quiet atmosphere; Life documentary works reduce the blank space, balance the heavy feeling of the picture, stabilize the gas field, and realize the refined upgrade of oil painting composition through corner white space <sup>[5]</sup>.

#### **4.2. The gradient depth space is constructed by layering virtual reality and leaving blank space**

The space innovation of contemporary oil painting can deeply draw lessons from the concept of the coexistence of reality and reality in freehand brushwork aesthetics, and flexibly arrange blank areas according to the level differences of near, medium, and long-term perspective. This move breaks through the limitation that the western-style focus perspective only depends on the scale of the body and the change of light and shade to create depth. Through the gradient of reality and reality, it creates a new space with multi-layer compound and coherent charm, and realizes the organic integration of western-style realistic modeling and oriental freehand brushwork space.

In the close-range description, we pay attention to real painting, and depict the texture, texture, and details of objects with thick piles of oil paints, so that the modeling outline is clear and the color levels are rich, laying a solid visual foundation for the picture. In the middle scene, the figurative modeling is gradually weakened, and the color contrast is reduced. Semi-transparent and light-colored multi-layer cover dyeing is adopted, and finely divided white space is interspersed to realize the natural transition from real scene to virtual scene. In the future, a large area is blurred and left blank, giving up fine body shaping, relying on the fusion of light color gradient and blank, expanding the spatial distance, replacing the traditional perspective level with blank level, and creating a long and profound sense of space.

In the creation of landscape-themed oil paintings, this composition advantage is particularly remarkable. Close-up waterfront vegetation and stone steps vegetation are thick in color and rich in details; The river surface and water color in the middle scene are smudged with light colors, interspersed with fine pieces and blank spaces, forming a flexible middle level; The distant peaks and clouds gradually blend into a large area of blank space. The three layers of virtual reality and blank space are gradually and naturally connected, getting rid of the shackles of Western-style vanishing point perspective and creating a landscape space with rich levels and distant artistic conception. The creator uses the permeability of oil painting pigments to connect the virtual and the real with multi-layer transparent cover dyeing to ensure the natural transition and enhance the aesthetic charm of the oil painting space <sup>[6]</sup>.

#### **4.3. Structural blank space can expand the inner smart space of the picture**

The innovation of contemporary oil painting composition should break through the limitation of leaving blank at the edge of the picture and optimize the internal layout through structural blank. Setting local blank spaces at the junction of objects and images, the turning point of shapes, and the gap between groups can effectively alleviate the compactness of solid stacking, embed void in the picture, enhance the permeability and agility of the work, and make the picture properly dense and harmonious in rhythm.

Traditional freehand brushwork painting often leaves a blank, a gap reserved, in order to run through the charm of the picture. After this idea was integrated into contemporary oil painting creation, a mature

structural white cloth system was formed. The creator reserved irregular blank spaces at the joints of trees, buildings, or people groups, filled them with canvas background color or light color blocks, split the heavy color blocks, broke the sense of occlusion, optimized the rhythm of body arrangement, and made the picture locally elastic.

Garden-themed oil paintings are good at using natural structures, such as architectural doorways and windows, to create structural blank spaces. A large area of white space is left in the depths of the doorway and window view, which forms a virtual contrast with the real scene outside the door and window, enriching the picture level and deepening the spatial meaning of the work. In abstract oil painting, the application of structural white space is more diverse. The gaps between geometric color blocks and texture color blocks are transformed into white space areas, and scattered white spaces are connected in series to form fragmented shapes, so that the original independent color blocks form a unified spatial field. Although this kind of blank space is not large in area, it refines the spatial structure from the micro level, enriches the expression form of the internal space of oil painting, and endows contemporary oil painting composition with a more distinctive oriental aesthetic rhythm <sup>[7]</sup>.

#### **4.4. Blank artistic conception can expand the spiritual space outside the painting**

Contemporary oil painting can learn from the concept of freehand brushwork art, meaning outside painting, and break through the physical limitations of canvas with a large area of artistic conception. Through the pure blank area, the viewer's association and empathy are stimulated, and the composite composition of the linkage between the real scene inside the painting and the imagination outside the painting is constructed to promote the sublimation of the oil painting space from visual modeling to spiritual artistic conception. Different from functional blank space, artistic blank space does not pursue regular layout, but transforms a limited canvas into an infinite spiritual space by expanding aesthetic boundaries, giving works a long artistic aftertaste.

Blank artistic conception is especially common in landscape oil paintings, such as wilderness, wasteland, and mountains and rivers. The picture spreads most areas in light gray-white tones, representing the sky, wilderness, or floating clouds, and only depicts a small number of real scenes, such as solitary trees, land, or rocks below, and the composition is extremely simple. A large area of blank space conveys a vast and quiet atmosphere, which makes the artistic conception of the work break through the limitation of canvas and creates an ethereal and detached aesthetic effect.

In the creation of figure oil painting, the creator often simplifies the details, such as the background of the times and environmental props, and replaces the complex scenes with uniform light-tone blanks, so that the main body of the figure is independent of the pure picture. At this point, the blank space becomes the externalized carrier of the character's mood, temperament, and atmosphere, making the picture clean, pure, and concise. Through the blank and empty atmosphere, the viewer independently supplements the mood of the picture and the artistic conception of the story, and participates in the secondary aesthetic construction of the work. Blank artistic conception promotes the transformation of oil painting composition from physical space to spiritual space, which is an important embodiment of freehand brushwork aesthetics to innovate the spatial connotation of contemporary oil painting <sup>[8]</sup>.

## 5. Conclusion

Freehand brushwork with blank space embodies the spatial wisdom of Chinese traditional painting for thousands of years, and its unique aesthetic logic, which combines reality with reality and treats white as black, provides profound cultural nutrients for the innovation of contemporary oil painting spatial composition. Against the backdrop of the deep blending of Chinese and Western arts, blank space breaks through the limitation of ink and wash media, and perfectly fits with the material characteristics of oil painting and contemporary aesthetics. Through four kinds of blank techniques: corner, layering, structure, and artistic conception, the spatial language of oil painting has been reshaped in all directions, from the overall structure, depth level, internal rhythm, to off-site artistic conception. The integration of traditional freehand brushwork aesthetics has freed contemporary oil paintings from the shackles of Western-style single-perspective composition, realized the harmonious unity of realistic modeling and oriental poetry, and strengthened the local characteristics of Chinese oil paintings. Today, with the continuous innovation of art, freehand brushwork and blank space will continue to inject vitality into oil painting composition, promote local oil painting to keep improving while inheriting the essence of traditional aesthetics, and help Chinese oil painting to form an artistic style with a sense of the times and national charm.

## Disclosure statement

The author declares no conflict of interest.

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# Risks to Research Integrity Derived from Intelligent Technologies and Countermeasures via Curriculum-based Ideological and Political Education—A Case Study of the Postgraduate Course *Pavement Material Testing Technology*

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**Abstract:** The application of intelligent technologies in the field of pavement material testing has improved test efficiency and data accuracy, yet it has also given rise to new types of research integrity risks. Taking the postgraduate course *Pavement Material Testing Technology* as the research object, this paper analyzes typical integrity risks, including black-box algorithms and selective data reporting in pavement material testing. Corresponding solutions are designed and implemented in teaching activities: embedding ethical modules into theoretical lectures, integrating full-process integrity training into experimental operations, incorporating team collaboration norms and intellectual property requirements into classroom discussions, and adding academic standards to course paper assessments. Follow-up surveys show that this collaborative education practice has effectively improved postgraduate students' ability to identify technical risks, standardize their collaborative behaviors, and enhance their awareness of intellectual property rights. This study provides practical references for transforming research integrity education in postgraduate courses from explicit preaching to implicit integration.

**Keywords:** Curriculum-based ideological and political education; Research integrity; Intelligent testing; Pavement materials

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## 1. Identification of new research integrity risks in the course

Accurate identification of hidden integrity risks is the prerequisite for conducting integrity-oriented teaching. The teaching of *Pavement Material Testing Technology* needs to combine abstract moral norms with specific pavement testing techniques, so as to help students fully understand potential research integrity risks brought



by intelligent pavement material testing technologies.

### **1.1. Risks arising from black-box algorithms**

Aggregate particle size analysis is a core procedure for the mix design of asphalt concrete. The traditional sieving method features intuitive results and reliable performance, but it is time-consuming and unable to acquire the morphological parameters of aggregates. With the development of computer vision technology, the course has adopted aggregate particle size analysis based on machine vision. This technology realizes batch automatic statistics of particle size distribution through image acquisition, preprocessing, edge detection, and image segmentation algorithms. Although it can infer three-dimensional particle sizes from two-dimensional images efficiently, the selection of binarization thresholds, morphological operation parameters, and segmentation rules for adhered particles plays a decisive role in the final test results <sup>[1]</sup>.

When using this technology, students may repeatedly adjust identification parameters to make the obtained gradation curves conform to expected outcomes, without truthfully recording the adjustment process and original data. Such behaviors do not involve tampering with original images, but essentially constitute implicit data manipulation based on algorithms. They violate the principles of complete and transparent reporting of experimental procedures in scientific research integrity and fall on the borderline of academic misconduct.

### **1.2. Data falsification and manipulation**

The adoption of automated and intelligent testing equipment improves the precision of pavement material testing and enables the collection of massive datasets. For instance, the asphalt mixture fatigue test equipped with a servo-hydraulic system can acquire real-time time-series stress-strain data during loading processes. The linear amplitude sweep test for evaluating the fatigue performance of asphalt mastic can also generate complex rheological data sequences <sup>[2]</sup>.

During data processing, postgraduate students may intentionally or unintentionally eliminate abnormal observation values caused by transient equipment fluctuations and environmental interference, or only select partial data to analyze and present, so as to verify research hypotheses. Such data manipulation essentially violates the objectivity and data completeness principles of scientific research. Compared with traditional experiments that rely on manual recording of limited data, intelligent testing systems provide more concealed operating space for selective result reporting, which poses severe challenges to students' data ethics literacy <sup>[3]</sup>.

### **1.3. Oversimplification of simulation assumptions**

Molecular dynamics simulation is an important research method in materials science. In this course, it is applied to reveal the viscoelastic properties and aging mechanisms of asphalt at the atomic and molecular scales. The establishment of its theoretical model requires the setting of force field parameters, boundary conditions, time and scale constraints, and other key assumptions and simplifications. The idealized simulation environment is fundamentally different from the complex actual service conditions of pavement materials <sup>[4-5]</sup>.

If postgraduate students fail to clearly elaborate on the above assumptions and simplifications and directly extend micro-scale simulation conclusions to macroscopic engineering phenomena, it will lead to serious methodological deviations. This kind of behavior blurs the boundary between simulation predictions based on assumptions and experimental verifications based on physical realities. It may not only produce erroneous academic conclusions, but also misguide engineering practices. Therefore, teaching activities must focus on strengthening students' understanding that all models are approximations, guide them to clarify the

applicable scope of simulation results in research papers, and require them to abide by the academic ethics of transparent assumptions and prudent reasoning<sup>[6-7]</sup>.

#### **1.4. Academic impetuosity**

Among the cutting-edge technologies involved in *Pavement Material Testing Technology*, machine vision-based aggregate particle size analysis, molecular dynamics simulation, and intelligent mechanical testing using servo-hydraulic systems are all characterized by high efficiency, precision, and automation. While these intelligent testing technologies greatly boost research efficiency, they may also induce a latent impetuous mentality among students.

For example, machine vision software can generate aggregate particle size distribution charts with one click; molecular dynamics simulation programs can directly output atomic trajectories and viscoelastic parameters; intelligent testing systems can automatically plot stress-strain curves. If there are strict requirements lacking for data traceability and process documentation, students tend to ignore the systematic archiving and management of basic materials such as original image data, simulation input files, and raw experimental waveforms. This runs counter to the fundamental requirement of traceable data sources in scientific research<sup>[8-9]</sup>.

## **2. Integrated design of research integrity education**

Targeting the research integrity risks derived from intelligent technologies in this professional course, this teaching practice adopts the philosophy of implicit integration for curriculum-based ideological and political education. Research integrity education is embedded into the whole process of professional knowledge teaching, experimental operations, group discussions, and course assessments. This integrated teaching mode transforms abstract ethical norms into specific technical operation standards and helps students internalize academic norms into conscious behavioral habits.

### **2.1. Integration of theoretical lectures and technology ethics**

Each teaching unit of pavement material testing technology is equipped with special sessions on technical ethics and research norms, which are fully integrated into the explanation of professional knowledge. Typical modular combination cases of theoretical teaching and ethical education are presented as follows.

#### **2.1.1. Module for cultivating awareness of algorithm transparency and research norms**

When learning the principles of aggregate image acquisition and particle size processing algorithms, students are required to understand the physical significance of core algorithm parameters and their influences on test results. The aggregate particle size detection report must specify the setting of machine vision parameters, as well as the sensitivity analysis of binarization thresholds and morphological operators.

#### **2.1.2. Module for fostering rigorous academic thinking on assumptions**

Students are guided to analyze the impacts of model assumptions and simplifications on asphalt performance test results. The test report shall clearly state simulation methods, presuppositions, force field parameterization strategies, boundary conditions, simulation time, and spatial scope, as well as the limitations of the established model.

## 2.2. Integrated design of experimental teaching and full-process integrity training

A full-process integrity training mechanism is established for experimental teaching and data processing, promoting the transformation of research norms from theoretical cognition to practical implementation. The course attaches equal importance to both experimental results and experimental procedures, and takes experimental activities as the carrier of research integrity training<sup>[10]</sup>. Through the following three measures, abstract integrity principles are converted into concrete, operable technical specifications and operational guidelines, enabling students to understand the practical connotations of research integrity in every link of data collection, processing, and analysis.

Establish the archiving system for raw pavement material experimental data. All final analysis reports submitted by students must be attached with unprocessed original experimental data. For the machine vision-based aggregate analysis experiment, the complete sequence of original images captured by cameras shall be included. This mechanism builds a traceable chain from raw experimental data to final conclusions, and fundamentally puts an end to selective data reporting and data manipulation.

Standardize the transparency of data processing procedures. Students are required to illustrate the entire workflow from raw data to final results via flowcharts or step-by-step textual descriptions in experimental reports. The contents to be specified include software names and versions, called core functions or algorithm libraries, filtering methods and parameter thresholds, feature extraction rules, data fitting formulas, and constraint conditions. Such requirements turn data processing from a black-box operation into traceable and reproducible academic behaviors, and cultivate students' sense of responsibility for data integrity.

Add the analysis of experimental uncertainty. Students are instructed to evaluate the uncertainty and limitations of pavement material testing methods. For instance, in machine vision-based aggregate particle size tests, students need to analyze the influences of lighting conditions and particle overlapping on test errors. This practice helps students maintain a prudent attitude towards the outputs of intelligent technologies and establish a scientific understanding of measurement errors<sup>[11]</sup>.

## 2.3. Standardized cultivation of intellectual property awareness in group collaboration

Students are divided into multiple groups, and each group takes charge of researching and presenting one type of intelligent pavement material testing technology. Team collaboration sessions are combined with the education of collaboration norms and intellectual property rights, extending research integrity education from individual behaviors to collaborative ethics.

Refine the division of contributions in group reports. Special evaluation indicators for collaboration transparency are added to the scoring criteria of group presentations. The evaluation focuses on the rationality of task allocation within teams and requires a clear list of each member's specific work and contributions in literature research, data collection, simulation calculation, result analysis, and report writing. This measure quantifies the division of labor and contribution traces, and effectively prevents free-riding behaviors and ambiguous attribution of contributions within teams from the institutional level<sup>[12–13]</sup>.

Standardize citation rules for group achievements. All cited documents and original sources must be clearly marked in accordance with academic citation norms in PPTs and supporting materials for group presentations. For collective achievements, groups need to distinguish between collective collaborative outcomes and individual innovative ideas in presentations. These practices cultivate students' respect for data rights and intellectual property rights, and draw a clear line between legitimate collaboration and academic plagiarism.

### 3. Teaching effects and conclusions

#### 3.1. Teaching effects

To scientifically evaluate the implementation effects of integrating research integrity education into *Pavement Material Testing Technology*, a follow-up survey was conducted among postgraduate students taking this course for two consecutive academic years (2023–2024 and 2024–2025). The research adopted a course assessment combined with anonymous questionnaire surveys, and 128 valid questionnaires were collected. The survey results are as follows:

Students' awareness of research integrity risks has been greatly improved. A total of 95.3% of respondents can clearly name at least two types of research integrity risks existing in pavement material testing technologies.

Students' awareness of research integrity norms has been significantly enhanced. 87.5% of students agree that detailing data processing procedures in experimental reports is a manifestation of being responsible for their own research work, which indicates that integrity education has transformed from external constraints into internal recognition.

Standardization of team collaboration has been improved. All participating groups (100%) can clearly define task division and individual contributions in their reports. Based on a five-point scoring system, the average satisfaction score of team members for task allocation and collaboration transparency reached 4.5 points, which was a notable improvement compared with the period before the teaching reform.

#### 3.2. Conclusions

Taking the course *Pavement Material Testing Technology* as the practical carrier, this study explores the in-depth integration of intelligent pavement testing technology teaching and research integrity education, and draws the main conclusions as follows:

Identifying new research integrity risks derived from intelligent technologies is the starting point of integrated education. Algorithm black boxes and parameter manipulation, data falsification, oversimplification of simulation assumptions, as well as academic impetuosity induced by high-efficiency intelligent tools, are typical research integrity risks that require urgent attention in the field of intelligent pavement material testing.

By embedding research integrity education into four major teaching links, including theoretical lectures, experimental operations, classroom discussions, and course paper assessments, a progressive transformation from knowledge imparting to value shaping has been realized.

The integrated education model has achieved remarkable results in three dimensions: cognitive improvement, behavioral standardization, and collaborative ethics. It not only strengthens students' ability to identify research integrity risks but also encourages them to take the initiative to abide by academic norms.

Against the backdrop of the intelligent transformation of pavement material testing technologies, professional courses should not merely focus on technical instruction, but also undertake the mission of cultivating academic morality and fostering integrity among students. Based on the teaching practice of integrating technological education with research integrity in *Pavement Material Testing Technology*, this teaching model thoroughly implements the concept of curriculum-based ideological and political education, and responds to the fundamental task of fostering virtue through education in the new era<sup>[14–15]</sup>.



## Disclosure statement

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# Design and Implementation of Practical Teaching under Modular Teaching Reform—A Case Study of Tea Production and Processing Technology Major

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**Abstract:** The major of Tea Production and Processing Technology features dual attributes of skill inheritance and industrial application. Its traditional practical teaching has long been plagued by problems, including fragmented teaching content, superficial skill training, and simplistic evaluation methods. Based on the philosophy of modular teaching, this paper conducts a systematic discussion on the reform paths of practical teaching for this major. By reconstructing a progressive skill module system in accordance with the industrial chain logic, adopting the integrated teaching mode of theory and practice, developing multi-level practical teaching resources, and establishing a module-based process assessment mechanism, this study aims to realize the precise alignment between teaching content and job requirements.

**Keywords:** Modular teaching; Tea production and processing technology; Practical teaching; Integration of theory and practice; Process evaluation

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## 1. Introduction

Higher vocational education undertakes the important mission of cultivating high-quality technical and skilled talents for regional industries. The quality of practical teaching directly determines whether talent cultivation objectives can be achieved. As a typical agriculture-related major, Tea Production and Processing Technology relies heavily on real or simulated production scenarios for core competency training. Students need to comprehend technical essentials and form stable muscle memory through repeated operational practices. However, the practical teaching of this major generally follows the disciplinary curriculum framework at present. Various practical training sessions are isolated from one another, and theoretical

courses are out of sync with practical training. Consequently, even after completing full-time on-campus studies, graduates struggle to adapt to frontline production positions rapidly. As a competency-oriented and task-driven teaching model, modular teaching provides a feasible solution to the above problems. Taking Tea Production and Processing Technology as the research object, this paper systematically elaborates the design logic and implementation strategies of modular teaching in practical teaching, so as to offer references for the teaching reform of similar majors.

## **2. Core connotations of modular teaching and practical teaching for the Tea Production and Processing Technology major**

### **2.1. Core connotation of modular teaching**

Originating from the vocational education reforms in the 1960s, modular teaching is guided by job competencies, takes teaching modules as carriers, and focuses on competency development. It breaks the traditional teaching mode of separate theoretical lectures and scattered practical training. In accordance with the core competency requirements of professional posts, teaching content is integrated into multiple independent and interconnected teaching modules. Each module has clear teaching objectives, specified teaching contents, practical tasks, and evaluation criteria. The modules are mutually independent while closely connected, forming a complete teaching system featuring module guidance, task driving, and practical empowerment. Compared with conventional teaching modes, modular teaching has three distinctive characteristics<sup>[1]</sup>.

First is pertinence. Module settings are closely aligned with vocational posts and focus on core job skills, eliminating redundant content irrelevant to practical work, so as to integrate learning with application. Second is flexibility. Module contents and practical tasks can be adjusted dynamically along with industrial and job changes to adapt to industrial transformation and upgrading. Third is practicality. Each module is equipped with corresponding practical teaching activities. Students learn through practice and practice while learning, which attaches great importance to the cultivation of practical abilities and innovative capabilities. This is consistent with the talent cultivation philosophy of vocational education that values professional skills<sup>[2]</sup>.

### **2.2. Core requirements of practical teaching for the Tea Production and Processing Technology major**

Tea Production and Processing Technology is an applied major combining theoretical learning, operational training, and professional characteristics. Its practical teaching runs through the entire tea industrial chain, covering multiple links from tea garden cultivation to market circulation, with tea quality inspection as the final segment<sup>[3]</sup>. The practical teaching is oriented toward the actual demands of various posts in the tea industry, and ultimately targets the practical application and innovative capabilities of students. Combined with talent orientation and job requirements of the tea industry, the core requirements of practical teaching for this major are divided into three aspects.

First, competency adaptation. Practical teaching connects core posts, including tea production, processing, sensory evaluation, inspection, and marketing. Students are required to master key operational skills such as primary processing (fixation, rolling, and drying), refining procedures (sorting, winnowing, and picking), as well as tea appearance and internal quality evaluation. These requirements are in line with the professional skill standards specified in the *Teaching Standards for Higher Vocational College Major of Tea*

*Production and Processing Technology* <sup>[4]</sup>.

Second, industrial synchronization. Practical contents keep pace with the upgrading of the tea industry. Emerging business forms, new technologies, and new processes, such as deep processing of tea, intelligent manufacturing, and green production, as well as brand marketing, are incorporated into teaching. Typical examples include the operation of intelligent tea-making equipment and the development of deep-processed tea products, which cater to the digital and intelligent development trend of the tea industry.

Third, all-round literacy development. Practical teaching not only hones students' professional skills but also fosters their craftsmanship, sense of responsibility, innovative thinking, and teamwork spirit. It aims to cultivate well-rounded practitioners with exquisite professional skills for the tea industry, and fulfill the talent cultivation goal of inheriting craftsmanship and promoting the spirit of artisans <sup>[5]</sup>.

### **3. Significance of applying modular teaching to the practical teaching of the Tea Production and Processing Technology major**

#### **3.1. Reconstruct the curriculum system and enhance the systematicness and logical relevance of teaching contents**

The traditional teaching of this highly practical major is plagued by fragmented knowledge points and disconnection between theory and practice <sup>[6]</sup>. The introduction of modular teaching enables the integration of scattered skill points into interconnected independent teaching units following the logic of the complete tea industrial chain, which runs from fresh tea leaf picking to primary processing, refining, and finished product packaging. This model breaks disciplinary barriers and links isolated practical training sessions into a progressive skill development chain. The systematic reorganization of teaching contents helps students establish a macroscopic understanding of the whole tea processing workflow, optimizes the overall framework of professional practical teaching, and realizes the in-depth integration of theories and practices within each module <sup>[7]</sup>.

#### **3.2. Deepen skill training and accurately meet the core competency requirements of posts**

Tea processing technologies update rapidly, and processing standards vary greatly among different tea categories. Modular teaching divides complex processing techniques into multiple assessable and combinable skill modules, making teaching objectives more targeted to post competency requirements <sup>[8]</sup>. It transforms the extensive, superficial practical training in the past into intensive and refined skill training. Students can conduct repeated intensive training within designated modules and delve into the production techniques of specific tea varieties. This effectively shortens the adaptation period between campus training and enterprise employment, enables graduates to quickly adapt to frontline technical requirements, and improves the matching degree between talent cultivation and vocational demands <sup>[9]</sup>.

### **4. Strategies for applying modular teaching to the Practical Teaching of Tea Production and Processing Technology major**

#### **4.1. Build a progressive skill module system based on industrial chain logic**

The division of modules shall not be a simple split of existing courses, but shall be designed scientifically in accordance with the actual operation process of the tea industry. The training follows the principle of laying a

solid foundation first and then conducting comprehensive training, as well as developing single skills before compound application. The entire practical teaching system is divided into three levels: basic skill layer, core skill layer, and comprehensive application layer.

The basic skill layer covers general contents, including tea identification and sensory evaluation, basic agricultural operations, as well as the use and maintenance of mechanical equipment, laying a solid professional foundation for students<sup>[10]</sup>. The core skill layer sets independent processing modules for six major tea categories, namely green tea, black tea, oolong tea, white tea, yellow tea, and dark tea. Each module covers the complete operational procedures from fresh leaf treatment to finished product manufacturing, enabling students to independently complete the whole production process of a certain type of tea. The comprehensive application layer focuses on interdisciplinary contents such as tea quality control, deep-processed tea product development, and tea garden operation and management, cultivating students' comprehensive ability to solve practical production problems<sup>[11]</sup>.

The three levels form a ladder-like progressive structure. Students can proceed to the next level only after passing the assessment of the current module. This hierarchical and closely connected module design complies with the objective laws of skill learning, covers all teaching contents, avoids repeated or missing teaching arrangements, and makes the practical teaching system more scientific and rigorous<sup>[12]</sup>.

#### **4.2. Implement an integrated teaching mode of theory and practice**

After the division of modules, the in-class implementation effect directly determines the overall teaching outcome. The traditional arrangement of teaching theories first, followed by practices, or separating theoretical and practical courses into different semesters, can no longer adapt to the high integration requirements of modular teaching. It is necessary to adopt the integrated mode of theory and practice, arranging theoretical lectures and skill training in the same teaching period and the same teaching space<sup>[13]</sup>.

In the teaching of each skill module, teachers first spend a short period of time explaining technical principles and operational specifications, and then arrange practical training immediately. Students verify and consolidate theoretical knowledge through hands-on operations. This “learning by doing and doing while learning” mode reduces the loss of knowledge from memorization to application. Meanwhile, the roles of teachers and students are redefined. Teachers act as module designers and on-site instructors instead of mere knowledge imparters, while students become the main performers of module tasks.

#### **4.3. Develop multi-level practical teaching resources matching the module system**

The smooth operation of modular teaching requires sufficient supporting resources. Firstly, the on-campus training bases shall be rezoned functionally in accordance with the divided skill modules. Special equipment and operating platforms shall be equipped for different tea processing modules. For instance, fixation machines, rolling machines, and dryers are configured for green tea processing areas; special withering rooms and baking rooms are built for oolong tea processing. Each functional area remains relatively independent and is connected via reasonable logistics routes to simulate the real production environment of tea workshops<sup>[14]</sup>.

Secondly, professional teachers and enterprise technicians jointly compile modular practical training textbooks, which organize operational procedures, quality standards, common problems, and corresponding solutions with pictures and texts for students' autonomous learning. Meanwhile, diversified online teaching resources are being developed, including virtual simulation operation programs, micro-lessons, and process illustrations for various tea processing techniques. These digital resources expand the time and space scope of practical teaching, make up for the

deficiency of offline training hours, and enrich students' learning channels <sup>[15]</sup>.

#### **4.4. Establish a diversified process assessment mechanism based on modules**

The evaluation system shall be matched with modular teaching. The traditional mode of determining academic performance by a single final practical exam shall be abandoned. Independent assessment units are set for each module to build a full-process evaluation system. After the completion of each skill module, a targeted assessment is carried out, covering the standardization and proficiency of operational skills as well as students' understanding of relevant theoretical knowledge.

The assessment adopts diversified forms, including on-site operation tests, oral defenses, and work evaluations. This multi-dimensional evaluation system can accurately identify students' weak points in various skill links, and mobilize their initiative to polish professional skills. It enables teaching evaluation to play the role of adjusting teaching arrangements and guiding teaching orientation.

### **5. Conclusion**

Modular teaching creates an effective reform path to improve the quality and efficiency of practical teaching for the Tea Production and Processing Technology Major. The scientific construction of module systems, the reform of integrated theory-practice classrooms, the systematic development of supporting teaching resources, and the establishment of diversified evaluation mechanisms fundamentally reverse the drawbacks of scattered skill training and ambiguous evaluation criteria in traditional practical teaching.

Nevertheless, the modular teaching reform is a long-term project. Continuous efforts are still needed in aspects such as teachers' competency improvement, in-depth school-enterprise cooperation, and dynamic module updating. In the future, further exploration shall be conducted on the flexible combination of modules and in-depth application of digital resources, so as to make practical teaching the core driving force for students' vocational competency development and continuously deliver qualified technical and skilled talents for the high-quality development of the tea industry.

### **Disclosure statement**

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# A Study on the Effect of AI-assisted Vocational College English Pronunciation Learning on Students' Pronunciation and Oral Proficiency

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**Abstract:** With the digitalization of vocational education, intelligent pronunciation training has been introduced as a new form in the reform of English teaching at vocational colleges. Traditional phonetics teaching has issues, such as delayed feedback, a small training volume, subjective evaluation, and a lack of personalized guidance. To investigate the actual effects of AI on vocational students' second-language pronunciation acquisition, this study selects 42 students majoring in primary school English Education as subjects and employs a one-group pretest-posttest design for a one-semester AI teaching intervention. Praat, professional acoustic software, was used to conduct quantitative comparisons of the pre- and post-intervention speech data at various levels. Through the research, AI-assisted teaching has helped students improve the acoustic features of their pronunciation, correct typical errors, and enhance monotonous intonation and fragmented speech; meanwhile, the accuracy and fluency of their speaking have been significantly improved. Based on objective acoustic data, this study has verified the practical value of AI teaching and reduced the range of subjective evaluation in traditional phonetics classes. It has established a closed-loop teaching model of daily AI training and regular Praat acoustic tests, and provided replicable empirical schemes for the digital reform, quantitative pronunciation evaluation, and personalized phonetic teaching in vocational colleges.

**Keywords:** Artificial intelligence; Vocational college English; Pronunciation learning; Oral proficiency; Praat; Acoustic parameters

**Online publication:** July 17, 2026

## 1. Introduction

### 1.1. Research background

National Vocational Education Digitalization Policies advocate for intelligent and personalized English classes. Pronunciation is a basic professional quality for graduates of Primary School English Education, but due to large class sizes, delayed teacher feedback, and subjective auditory assessment in vocational phonics

classes, many students' phonetic errors have not been corrected, and their oral expression skills have not been effectively improved.

AI speech platforms provide unlimited practice and instant error correction to compensate for deficiencies in the classroom. Most of the previous studies have used self-reported questionnaires and have not been validated acoustically; therefore, targeted research on vocational students is still needed. Therefore, this study will combine AI training with Praat acoustic analysis to conduct quantitative research on the effects of phonetic teaching.

## **1.2. Research significance**

### **1.2.1. Theoretical foundation**

According to the theory of second-language phonetic acquisition and intelligent education, this paper will investigate the effect of AI on learners' pronunciation prosody through multiple acoustic parameters. Provide objective empirical data for research in intelligent phonics teaching and offer new analytical perspectives on vocational digital pronunciation teaching.

### **1.2.2. Practical value**

This paper establishes an operable teaching mode of AI daily training plus periodic Praat acoustic evaluation to address the problems of homogenization and single evaluation in traditional phonics classes. The research plans can be generalized to vocational colleges to help teachers conduct data-driven, precise phonetic tutoring and enhance students' professional oral literacy.

## **1.3. Research questions**

This paper investigates the application effect of AI-assisted pronunciation learning for vocational college majors of English Education, and through pretest-posttest acoustic data analysis, questionnaire surveys, and semi-structured interviews, explores the following three research questions.

First, can long-term AI-assisted autonomous pronunciation learning improve the acoustic features of students' English pronunciation and effectively correct their typical pronunciation errors, such as vowel deviation, ambiguous consonants, and misplaced word stress? What particular changes will be observed in the main acoustic indicators of vowel formants, syllable duration, and consonant waveforms after intervention?

Secondly, what positive effects will extended training in AI situational oral skills have on students' oral fluency, speech rhythm, and intonation prosody? Can the problems of invalid frequent pauses, unstable speech rate, and flat single intonation be significantly improved in terms of pitch fluctuation and pause distribution data?

Third, based on Praat acoustic quantitative data and students' subjective learning feedback, how to optimize the intelligent pronunciation teaching mode and personalized training system for vocational colleges? What supporting measures should schools, teachers, and students take to compensate for the inherent deficiencies of AI speech platforms in teaching oral prosody?

## **1.4. Research innovations**

First, this study will introduce a new type of research method. Unlike the traditional teaching research mode of subjectivity, which often relies on classroom observation, questionnaires, and interviews, Praat

professional acoustic software is used here for quantitative analysis of multiple measurable acoustic parameters to convert abstract pronunciation quality into visual data and waveforms. The research conclusions are supported by objective acoustic data and thus are more reliable; they have been freed from the bias of a single subjective judgment.

Second, it extends the scope of research and the subjects of study. Most existing research on intelligent phonetic teaching uses general university students or primary and secondary school students as research subjects, and few specific quantitative empirical studies focus on vocational college Primary School English Education majors. Pre-service primary English teachers with weak phonetic foundations were selected as the research subjects, intelligent teaching practice was integrated with acoustic research on second-language pronunciation, and a research gap in quantitative empirical studies on intelligent pronunciation teaching for vocational college students was addressed.

Thirdly, this study establishes a full-featured teaching system of daily autonomous AI training and regular Praat acoustic evaluation, supplemented by teacher-led tutoring. A closed-loop system is used to personalize training based on phonetic diagnosis data, display the learning process through acoustic waveforms and data-driven teaching effect assessment, and is highly suitable for the cognitive rules and phonetic acquisition characteristics of vocational college students with weak English foundations. At the same time, this paper also presents the actual working plan of the hybrid teaching mode, which has good operability and popularization value for vocational education teaching.

## **2. Literature review**

### **2.1. Research on AI-assisted English pronunciation teaching**

With the rapid development of intelligent speech recognition technology in recent years, many Chinese scholars have begun to explore how to apply artificial intelligence in teaching English pronunciation, and they have generally agreed that AI can help address the shortcomings of traditional phonetic classes<sup>[1]</sup>. Most scholars believe that traditional phonetic teaching is limited by insufficient training time, delayed teacher feedback, and a lack of relevance; AI speech technology can expand the channels for students' after-class autonomous learning, reduce their anxiety in oral expression due to the fear of making mistakes in front of others, and improve the efficiency of daily pronunciation training significantly<sup>[2]</sup>.

Hu and Yan (2026) pointed out that vocational students generally have low self-confidence in speaking English orally, and the group activity of classroom reading makes students with poor pronunciation afraid to speak out loud<sup>[1]</sup>. An intelligent speech platform can offer students a low-pressure environment to practice speaking repeatedly without fear of embarrassment, and at the same time, the system will promptly point out any pronunciation errors for correction<sup>[8]</sup>. Ye (2024) carried out an empirical study on an intelligent speech platform to assist oral English teaching, and through questionnaires and classroom observations, found that AI training can enhance students' learning motivation and reduce their fear of speaking<sup>[2]</sup>.

Based on the previous research results at home, most of the existing studies have focused on teaching modes and practical strategies from the perspective of teaching practice, and their teaching effects have been verified through classroom observation, questionnaires, and semi-structured interviews<sup>[10]</sup>. The above research methods are generally qualitative and subjective analyses. Although the positive effects of artificial intelligence in phonetics education have been widely reported by scholars, few studies have used objective quantitative acoustic data to conduct in-depth research on students' pronunciation of monosyllabic words,

sentence intonation, and speech rhythm <sup>[3]</sup>. In particular, there are very few acoustic quantitative studies on vocational college students <sup>[6]</sup>. Most studies have only mentioned that students' pronunciation has improved generally from a subjective perspective and have failed to specify which phonetic indicators have changed significantly or what the range of particular improvements is; therefore, the persuasiveness of the research conclusions is relatively weak <sup>[4]</sup>.

## 2.2. Applications of Praat in pronunciation teaching

Praat is an excellent commercial program for analyzing sound waves developed by Paul Boersma and David Weenink, and now it is one of the main tools for research in experimental phonetics worldwide <sup>[5]</sup>. Several main acoustic parameters are automatically extracted, such as fundamental frequency (pitch), syllable duration, vowel formants, speech rate, pause interval, and pronunciation features, and hidden phonetic errors are displayed in visual sound spectrograms, waveform diagrams, and data tables. Praat can be employed in the teaching of English phonetics to collect quantitative data on pronunciation errors that are difficult to perceive with the ear, such as small fluctuations in the opening degree of vowels, an insufficient range of pitch rise and fall, or an overly short duration of final consonants; thus, specific targets for pronunciation correction and sentence intonation training can be set.

Bouchhioua (2024) has systematically studied the combination of Praat acoustic analysis technology and AI pronunciation teaching, indicating that human auditory perception is inherently subjective, different teachers have different standards for judging the same pronunciation sample, and thus, standardized quantitative evaluation of pronunciation can only be achieved by using Praat's acoustic parameters <sup>[3]</sup>. Chen and Zhang (2022) conducted an empirical study on the acquisition of English intonation based on acoustic parameters and used pitch-fluctuation data to identify the differences in intonation between Chinese ESL learners and native English speakers; they found that acoustic visualization can help learners intuitively recognize their own intonation shortcomings <sup>[4]</sup>.

Currently, Praat is mainly used in linguistic theoretical research and phonetic teaching at undergraduate universities, and its application in daily English teaching in vocational colleges is rare <sup>[6]</sup>. Most vocational college English teachers have not participated in regular training on experimental phonetics, are unfamiliar with the application of Praat software, and do not know how to interpret acoustic parameters. In addition, there are almost no systematic long-term empirical studies that combine extended AI speech training with periodic Praat acoustic assessments for vocational students; this is the main research entry point and innovation of the present paper <sup>[9]</sup>. Praat will be used throughout the entire teaching intervention process of this study, and a full set of operable acoustic data collection and analysis procedures for daily teaching at a vocational college will be established.

## 2.3. Research Commentary

In short, the advantages of AI technology for pronunciation teaching and the scientific objectivity of Praat as an acoustic quantitative analysis tool have been fully verified in the existing domestic and foreign research <sup>[5, 10]</sup>. However, the present studies on intelligent English phonetic teaching have not yet reached a certain level of development.

First, the research objects are relatively homogeneous. Most of the relevant studies have taken comprehensive university undergraduates or primary and secondary school students as the research subjects,



and special targeted research on vocational college students with weak English foundations and clear professional training goals is lacking <sup>[1, 7]</sup>. The types of phonetic errors, learning motivation, and degrees of oral anxiety for vocational students are clearly different from those of undergraduates in comprehensive universities, and the research conclusions obtained so far cannot be directly applied to phonetic teaching in vocational colleges <sup>[2]</sup>.

Second, the main kind of research method is qualitative analysis without acoustic quantitative data support. Most research uses questionnaires, interviews, and teacher observations to assess the effects of teaching, but it lacks quantifiable objective data on how students' pronunciation abilities change subtly after the teaching intervention, so the depth and persuasiveness of the research results are relatively low <sup>[3-4]</sup>.

Thirdly, few studies have constructed and verified a hybrid teaching model of intelligent online training and periodic acoustic quantitative assessment. Most research only studies the independent use of AI platforms and fails to explore the advantages of professional acoustic software for post-stage effect testing and personalized teaching diagnosis; therefore, a complete teaching and evaluation closed-loop system has not been established <sup>[9]</sup>.

This paper aims to correct the deficiencies of the above study. Vocational college primary school English education majors were selected as the research subjects, and a new teaching model combining AI teaching intervention with Praat acoustic quantitative analysis was established; longitudinal pretest-posttest empirical research was conducted to extend the existing research system of intelligent English phonetic teaching <sup>[7]</sup>.

### **3. Research design**

#### **3.1. Research subjects**

The research subjects are 42 students from an intact class of the Primary School English Education major at Lanzhou College of Foreign Studies. The research selects intact classes for teaching intervention to avoid the disruption of the normal classroom teaching sequence caused by sample group division, thus meeting the ethical standards of school teaching research. All participants have weak foundations in English pronunciation due to their middle school studies, and most commonly exhibit non-standard monosyllabic pronunciation, monotonous flat intonation, and discontinuous, fragmented oral expression. Prior to the start of this study, none of the students had been formally taught English phonetics by professionals; they had not learned about vowel and consonant correction, sentence rhythm and intonation, and the environment for learning English daily, such as learning materials and time, had also been irregular.

This study will use a one-group pretest-posttest design. All 42 students are designated as the only experimental group, and their standardized speech acoustic data before and after one semester of AI teaching intervention are vertically compared to verify the actual teaching effect of AI-assisted pronunciation learning. A one-group pretest-posttest design can rule out the problem of individual differences among groups of students and thus accurately show the changes in phonetic ability of each student under the same teaching intervention.

#### **3.2. Research tools**

A three-dimensional integrated tool system was established in this study to collect research evidence through an AI intelligent speech teaching platform, Praat acoustic analysis software, and supplementary subjective survey tools (questionnaires and interview outlines).

### **3.2.1. AI speech teaching platform**

It will be the main medium for all teaching interventions this semester. The several functions of the platform include word phonetic reading, paragraph text recitation, situational oral dialogue simulation, whole-process learning data recording, and personalized differentiated learning task distribution. Throughout the course of the study, students have taken regular in-class training and daily self-study at the end of class on this platform. The platform automatically identifies incorrect phonemes, misplaced stress, abnormal pauses, and flat intonation in students' pronunciation recordings, displays real-time correction prompts, and pushes targeted repeated training exercises based on the classification of each student's errors to provide personalized off-campus supplementary training.

### **3.2.2. Praat speech analysis software**

Praat 6.4, a relatively new and stable professional acoustic analysis program, will be used to process all the sound data uniformly and compare them. In addition to the main evaluation attributes of English pronunciation and oral ability, six core acoustic indicators were selected as the research measurement standards: syllable duration of long and short vowels, average pitch and pitch fluctuation range of sentences, speech rate per minute, frequency of invalid pauses in continuous speech, vowel formant F1/F2 values that reflect vowel opening and tongue position, and overall intonation characteristic curves of declarative and interrogative sentences. Uniform and standardized speech samples are collected from all students before and after the intervention in the same recording environment, and then Praat is used to calculate the mean values of relevant acoustic parameters for each student to quantify the overall changes in their pronunciation accuracy and oral expression ability.

### **3.2. Three auxiliary survey tools**

Self-designed student learning experience questionnaires and semi-structured teacher-student interview outlines are employed as auxiliary research instruments. The main contents of the questionnaire are students' changes in phonetic learning anxiety, learning initiative, recognition of the effect of AI training, and self-assessment of oral ability after one semester. The interview outline selects 8 representative students with various pronunciation levels and 2 English teachers involved in the teaching intervention, collects their subjective feelings, practical difficulties, and optimization suggestions for the AI + Praat teaching mode, and thus forms a research evidence chain together with objective acoustic data.

### **3.3. Research procedures**

The entire research cycle is one full semester (18 weeks), and the four standardized research procedures must be strictly followed: pretest and baseline data collection, long-term AI teaching intervention, posttest speech re-measurement, and integrated data analysis and research conclusion summarization.

In the pretest and baseline data collection stage (Week 1 of the semester), the research group establishes unified speech sample collection standards, sets up a quiet multimedia language laboratory as the fixed recording environment, and uses the same model recording equipment to record standardized speech samples of all 42 students. The contents of the recordings are single-vowel and consonant readings, word-stress readings, short-paragraph recitations, and situational dialogue expressions that cover all phonetic dimensions in the study. All collected speech samples are imported into the Praat software in batches to extract the six main acoustic parameters, and the average values of these parameters for each student are calculated to build

a pretest baseline acoustic database. At the same time, the research group will organize all English teachers participating in the intervention for systematic training on the operation of the AI platform and Praat acoustic analysis, sort out the pretest error data of the whole class, and formulate preliminary personalized training plans for students with different phonetic defect types.

In the teaching intervention period (Weeks 2-16 of the semester), the AI speech platform will be used for daily in-class teaching and self-study after class. Teachers import the pretest Praat acoustic diagnosis data into the platform system, and based on the students' individual pronunciation weaknesses, the platform distributes differentiated learning tasks: students with serious vowel deviation focus on monosyllabic vowel repeated training; students with ambiguous consonants increase terminal consonant, and voiced/voiceless consonant contrast exercises; and students with flat intonation receive targeted sentence rising and falling tone simulation training. Teachers review the students' daily training data on the platform weekly, conduct centralized error explanations and one-on-one targeted tutoring for common phonetic problems shown in acoustic data, and form a hybrid teaching model of online AI autonomous training and offline teacher-led precise tutoring.

After the intervention, the work of collecting posttest speech will be carried out in Week 17 in the same recording environment, with the same equipment and text standards as the pretest. All the new posttest speech samples are imported into Praat for acoustic parameter extraction, and a complete posttest acoustic database is constructed to form a comparative data system with the pretest baseline data. In Week 18, the research group distributes student questionnaires, conducts semi-structured interviews with some teachers and students, collates all the subjective survey data, and finally carries out cross-comparative analysis of pretest-posttest acoustic data and subjective questionnaire/interview data to systematically summarize the research results.

### **3.4. Research methods**

The four complementary research methods are employed in this study to ensure the all-roundness and reliability of the research:

First, research by scholars. The author organizes the domestic and foreign literature on artificial intelligence in foreign language teaching, second-language pronunciation acquisition, Praat acoustic analysis, and vocational college English teaching; reviews the current research progress and limitations; identifies the theoretical basis for all the research, and determines the research breakthrough point of this paper.

Second, a one-group pretest-posttest experimental design. Using a complete class of vocational college students as the sole experimental group, longitudinal comparisons of their speech acoustic data before and after one semester of AI teaching intervention were conducted to observe changes in pronunciation accuracy, oral fluency, and intonation prosody among students, and to verify the actual teaching effect of AI-assisted phonetic learning.

Third, Quantitative Analysis Method for Acoustic Data. Praat software is employed to extract quantifiable acoustic indicators from standardized speech data, quantify minute differences in the students' pronunciation features, transform subjective phonetic judgments into objective numerical comparisons, and conduct all-around data analysis of how well the students have optimized their pronunciation acoustic traits.

Fourth, Questionnaires and semi-structured interviews. Collect students' subjective learning experiences, changes in their learning attitudes, and teachers' practical teaching feedback through questionnaires and

targeted interviews, supplement the objective acoustic data analysis results, and put forward targeted optimization strategies based on the practical difficulties reflected in the subjective feedback.

## **4. Result**

### **4.1. Comparison of pronunciation acoustic features**

After one full semester of systematic AI training and daily personalized error correction, the overall acoustic features of all 42 students' English pronunciation have been significantly improved, and the quantitative changes in core Praat acoustic parameters are clear compared with the pre-test baseline data.

In terms of the pronunciation of monosyllabic vowels, the syllable duration for long and short vowels in students' word and sentence reading is now more uniform and standardized, and the severe problem of inconsistent vowel length before intervention has been effectively resolved. The F1 and F2 formant values, which indicate the position and opening of the vowel tongue, are relatively close to the standard acoustic parameter range of native English speakers; therefore, it can be concluded that students have achieved relatively accurate vowel articulation positions, and the deviation of front and back vowels and high and low vowels has been significantly reduced. Before the intervention, more than 70% of the students had obvious F1/F2 offset errors in /i:/, /ɪ/, /æ/, and /ɑ:/; after training, the proportion of students with serious vowel formant deviation dropped to less than 15%.

Typical pronunciation errors of consonants have been corrected, such as unclear consonant sounds, missing final consonants, and confusion between voiced and voiceless consonants. Consonant waveform diagrams obtained by Praat analysis after intervention are clearer and more complete; the vibration waveform of voiced consonants is distinct; and the air-flow mute interval of voiceless consonants meets the norms of phonetics. Before the intervention, most students omitted the pronunciation of terminal plosive consonants /t/, /d/, and /k/ during reading; their consonant waveforms were incomplete. After extended AI real-time correction and repeated focused training, these students can now pronounce terminal consonants properly, and the integrity of their consonant acoustic waveforms has significantly improved.

In general, the real-time error correction function and unlimited repeated training offered by the AI platform help students gradually correct long-standing fixed pronunciation errors caused by mother tongue negative transfer and middle school silent learning, and the overall pronunciation accuracy and standardization level are significantly improved, as fully supported by the objective acoustic parameter data extracted using Praat.

### **4.2. Comparison of oral fluency and intonation prosody**

Based on the quantitative analysis of the three main indicators from Praat, namely speech rate, frequency of invalid pauses, and range of pitch fluctuation, it was found that students' overall oral expression ability improved significantly after receiving AI-led situation-specific oral training, and the two main problems of poor oral fluency and monotonous intonation were effectively solved.

In terms of oral fluency, the students' speech speed per minute is relatively stable and moderate; the number of invalid repeated pauses and stuttering pauses in continuous speech has decreased significantly, and the logical coherence of sentences has improved. Before the intervention, most students read word by word with frequent pauses every two words and had a fluctuating speech rate; after one semester of situational dialogue training on the AI platform, more than 80% of the students could take entire meaning groups as the



unit for continuous expression, and the frequency of meaningless pauses in a 100-word paragraph had been reduced by more than half.

In terms of intonation prosody, as shown in the pitch data, the range of pitch fluctuation of students' sentences is reasonable and layered. Before training, most students' reading pitch curves are almost straight lines with an extremely small fluctuation range and show a typical flat intonation; after intervention, students can use a standard rising tone for general questions and a falling tone for declarative sentences, accurately mark the stress position of key words in sentences, the pitch curve has regular ups and downs, and oral expression is more rhythmic and natural. Extended AI situation-based dialogue simulation and real-time intonation-scoring training help students develop an English language sense and improve the rhythm and intonation of their oral expression at a fundamental level.

### **4.3. Analysis of students' subjective learning effects and attitudes**

Based on the statistics of the recovered valid questionnaires and the sorting records of semi-structured interviews, it can be concluded that the AI-assisted hybrid teaching mode has an overall positive impact on students' phonetic learning situation and learning psychology.

First of all, the fear and anxiety students have about learning English pronunciation have been reduced. In the traditional classroom of collective reading, students with poor pronunciation are often afraid of making mistakes and being laughed at by their classmates, so they do not dare to speak proactively; the AI platform provides an independent, low-pressure learning environment where they can practice repeatedly without psychological pressure, and the learning anxiety of more than 90% of the respondents has visibly decreased.

Secondly, the students' initiative in self-study and independent correction of errors has been promoted. With the help of real-time phonetic error feedback provided by the platform, students can promptly identify their own pronunciation deficiencies without waiting for the teacher's group correction, and after prolonged practice, they gradually learn to self-correct; thus, their self-confidence in speaking has also risen considerably.

Thirdly, most students have a consistent positive view that AI personalized training can accurately address their individual phonetic deficiencies, and the learning results are superior to those achieved by traditional unified collective teaching with teacher demonstration reading. At the same time, a small number of students also mentioned existing shortcomings of the interview, such as a lack of guidance from the platform for free impromptu oral expression, and provided practical directions for the subsequent optimization of the teaching mode.

## **5. Discussion**

### **5.1. The promotion mechanism of AI-assisted learning for second-language pronunciation acquisition**

In light of the second-language pronunciation acquisition theory and the empirical acoustic data obtained in this study, the four core action paths for AI intelligent platforms in promoting vocational college students' second-language pronunciation learning have been established, forming a correction system for phonetic errors.

First of all, AI can overcome the constraints of time and space in traditional classroom training and provide more frequent opportunities for repeated practice to correct pronunciation errors that have occurred



over a long period. Traditional classes have limited time for phonetic practice, and the AI platform allows students to log in for training at any time after class; at the same time, the system will automatically record the duration and type of errors in training to ensure that a sufficient volume of practice is achieved for standard pronunciation consolidation. Sufficient repetition of standardized input can reduce the negative transfer effect of local dialects and middle school incorrect pronunciation habits, thereby providing a foundation for improving phonetic accuracy.

Second, real-time error feedback can be provided promptly for any pronunciation errors to help learners correct them immediately in their second language study. In traditional teaching, teachers can only provide centralized feedback after students finish reading, and the feedback is significantly delayed; the AI platform can mark wrong phonemes, misplaced stress, and abnormal intonation simultaneously during the recording of students' reading, immediately play the standard pronunciation for comparison, and thus allow students to correct mistakes in real time and avoid repeatedly reinforcing incorrect pronunciation through multiple readings.

Thirdly, personalized differentiation of tasks adapts teaching to the various types of phonetic defects for different students. Based on the pretest Praat acoustic diagnosis data of students, categorize their errors, and then push targeted training tasks to address their individual weaknesses; thus, it is no longer necessary to conduct uniform repetitive exercises for the entire class, and the phonetic training has been made more relevant and efficient.

Fourthly, rich standard native audio materials and various situational oral exercises help students develop a natural sense of English and improve oral prosody and sentence rhythm. The large database of standard pronunciation corpora and situative dialogue modules in the AI platform can simulate real-life communication scenarios for students, allowing them to learn how to use all kinds of intonation patterns naturally in speaking rather than merely memorizing words.

## **5.2. The core value of Praat acoustic evaluation in pronunciation teaching**

Traditional pronunciation teaching evaluation relies solely on teachers' subjective human auditory perception and can only identify obvious pronunciation errors, such as completely incorrect phonemes, but fails to observe subtle phonetic deviations in students' reading. Praat professional acoustic analysis software can correct for the defect of subjective judgment in the above step, and its main functions in phonetic teaching include:

First, Praat can capture subtle pronunciation deviations that human hearing cannot detect in objective numerical data and visual sound spectrograms, such as a slight offset of vowel formants, insufficient range in pitch fluctuation, and an overly short pause interval; thus, comprehensive and fine-grained diagnosis of students' pronunciation problems can be carried out.

Second, it changes the mode of evaluation for pronunciation from observation-based subjectivity to data-driven objectivity. Unified acoustic parameter measurement standards eliminate the evaluation deviation caused by different teachers' listening sense, and realize standardized quantitative evaluation of pronunciation quality; thus, reliable, unified, and comparable databases are provided for teachers' teaching adjustment and targeted error correction tutoring.

Thirdly, by comparing the pretest and posttest acoustic parameters longitudinally, it can be seen how much change each student's phonetics has undergone in a semester; at the same time, different parts of

pronunciation can be assessed for improvement precisely, and objective data for grading can be provided to support teachers' decisions rather than relying on subjective feelings.

### **5.3. Existing problems in the application of AI pronunciation teaching**

During the one-semester period of practical teaching intervention, the research group also found some prominent deficiencies and bottlenecks in the joint application of AI speech platforms and Praat acoustic analysis that restrict further improvement in teaching effectiveness:

First, AI platforms perform well in standardized monosyllabic, word, and fixed-text reading training, but are deficient in leading free oral expression and complex contextual prosody. The platform's error recognition logic is based on a fixed standard corpus, and thus cannot flexibly identify reasonable intonation changes in students' personal free expression; only mechanical pronunciation errors can be judged, but no guidance is provided for using flexible rhythm according to the communication context.

Second, a small number of students lack the initiative to learn independently in the after-school AI training. Without offline real-time supervision by teachers, individual students perform the daily training tasks superficially; the frequency and duration of training are low, thus failing to improve their own pronunciation ability effectively, and the desired teaching effect cannot be achieved.

Thirdly, some frontline English teachers are not proficient in operating Praat acoustic analysis software, lack professional knowledge in experimental phonetics to interpret acoustic parameters, and fail to fully utilize the phonetic diagnosis data generated by Praat in daily teaching design and one-on-one targeted tutoring, resulting in the waste of objective acoustic evaluation data resources.

## **6. Optimization strategies for AI-assisted English pronunciation teaching in vocational colleges**

Based on the empirical research results and practical application bottlenecks mentioned above, this study puts forward four targeted operable optimization strategies for the construction of an AI-assisted English pronunciation teaching system in vocational colleges by combining Praat acoustic quantitative evaluation technology.

### **6.1. Build a hierarchical and personalized intelligent training system**

Based on the phonetic diagnosis data of pretest acoustic analysis in Praat, divide the students into three groups according to the type and severity of pronunciation problems: a basic correction group (serious vowel and consonant deviation), a rhythm optimization group (accurate monosyllabic pronunciation but flat intonation and fragmented speech), and a comprehensive promotion group (only minor phonetic defects). Build a hierarchical classified task library on the AI platform, set different training goals, frequencies, and exercise contents for students at different levels, and have the platform automatically push targeted training content based on the acoustic diagnosis labels of the students to achieve precise personalized teaching. Teachers regularly update the task library according to changes in posttest Praat data and adjust the difficulty and focus of training tasks dynamically.

### **6.2. Strengthen the three-dimensional closed-loop teaching mode**

Build a full-featured three-dimensional teaching system that integrates daily AI autonomous training, periodic

Praat acoustic evaluations, and targeted offline teacher guidance. The working mode of the closed-loop system is as follows: Students complete the daily fixed phonetic training and oral dialogue exercises on the AI platform after class; every four weeks, teachers use Praat software to collect speech samples for acoustic parameter analysis, dynamically monitor the learning progress and remaining phonetic deficiencies of the entire class, synthesize quantitative results from acoustic data, and address common phonetic problems in a centralized class session; finally, conduct one-on-one tutoring based on individual defects identified by Praat data to achieve an integrated system of online intelligent training and offline data-driven precise teaching.

### **6.3. Strengthen skill training for teachers and standardize students' daily learning management**

Every semester, schools organize regular, systematic training for English teachers on the two main modules: functional operation of AI intelligent speech platforms and operation and parameter interpretation of Praat acoustic analysis software. Invite experimental phonetics professional teachers to deliver lectures, enhance teachers' digital teaching capabilities and application skills in acoustic data, motivate teachers to use acoustic quantitative data as the foundation for designing daily phonetic teaching, etc. At the same time, set up standardized assessment requirements for students' daily AI after-class practice, link the completion quality and duration of platform training with usual performance scores, establish a weekly training data inspection mechanism, and guide students to develop independent, standardized, and persistent phonetic learning habits to address the problem of insufficient autonomous learning initiative among some students.

### **6.4. Enrich diversified oral teaching scenarios to compensate for AI platform deficiencies**

Based on the basic fixed text reading training modules of the AI platform, expand the diversity of oral teaching scenarios to offset the platform's lack of free expression and contextual prosody guidance. Teachers add offline oral teaching tasks in class hours, such as situational dialogue performance, topic-free retelling, and impromptu speech expression, regularly organize group oral communication activities, and combine the pronunciation accuracy data fed back by AI with teachers' manual evaluations.

## **7. Conclusion and prospects**

### **7.1. Research conclusions**

Based on the empirical data from the one-group pretest-posttest experiment and acoustic quantitative data in Praat, this paper presents the following three main research conclusions for Primary School English Education majors at vocational colleges:

First, extended AI-assisted autonomous pronunciation learning can improve the acoustic features of vocational students' English pronunciation significantly and correct typical phonetic errors such as vowel tongue position deviation, ambiguous consonant pronunciation, and misplaced word stress effectively. Changes in the core acoustic parameters of vowels and syllables, as well as modifications to consonant waveforms, have all been analyzed by Praat to confirm that the optimization effect of AI training has increased monosyllabic pronunciation accuracy.

Second, organized, extended AI situation oral training can help students improve the rhythm and intonation of their speech over time, thus boosting oral fluency. A decrease in the frequency of pauses for invalid reasons and an increase in the range of pitch fluctuations both indicate that students have moved away

from word-by-word mechanical reading and flat single-intonation; thus, their ability to continuously express themselves orally has been all-around improved.

Third, the hybrid teaching model of daily AI regular training and periodic Praat acoustic assessment is highly suitable for the features of English pronunciation teaching in vocational colleges. This way can address the above problems of traditional phonetic teaching, such as a lack of individualized instruction, slow feedback, and single-subject evaluation, and has strong operability and popularization value in vocational college English teaching practice.

## 7.2. Research limitations

There are certain objective limitations to the scope of this study due to the research environment, and follow-up research will be conducted to address and overcome these deficiencies.

First, the research sample coverage is relatively small. The research subjects are limited to a single class of Primary School English Education majors at one vocational college; the sample size is small, and the research results may not be fully applicable to the pronunciation learning situations of all majors and all levels of vocational college students; therefore, further tests of external validity need to be conducted by expanding the scope of the sample.

Second, the research cycle is relatively short. The entire teaching intervention is for one semester, and therefore, only a short-term improvement in the students' pronunciation skills due to AI training will be achieved. Further long-term follow-up tracking research is needed to examine how the extended, sustained effects of AI-assisted learning on students' phonetic retention ability and professional oral teaching skills manifest after they enter internships.

Third, the indicators of acoustic analysis selected in this paper are limited to basic conventional phonetic parameters. More complex phonetic phenomena, such as sentence stress rhythm, connected speech assimilation, and weak form pronunciation, are not the focus of in-depth analysis, and multi-dimensional acoustic quantitative research on complex oral prosody has yet to be carried out.

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# Exploring Science Teachers' Experiences on the Spiral Progression Approach in Junior High School Science Education

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**Abstract:** The Spiral Progression Approach (SPA) serves as a foundational framework of the Philippine K to 12 Science Curriculum, requiring learners to revisit scientific concepts with increasing complexity across grade levels. Despite its intended benefits, science teachers continue to encounter implementation challenges that influence curriculum delivery and learner outcomes. This study explored the lived experiences of Junior High School science teachers in implementing the Spiral Progression Approach. Specifically, it examined the pedagogical practices employed to facilitate continuity of learning, identified issues and challenges encountered in implementation, and developed a framework grounded in teachers' experiences. Using a descriptive qualitative research design, the study involved fifteen Junior High School science teachers from the District of Taal, Batangas during School Year 2025–2026. Data were gathered through semi-structured interviews, focus group discussions, and document analysis and were analyzed using thematic analysis. Findings revealed four major themes: Deepening Conceptual Understanding Over Time, Facilitating Learning Through Inquiry and Engagement, Adapting Instruction to Diverse Learners, and Navigating Implementation Challenges. Teachers employed scaffolding, contextualization, differentiated instruction, inquiry-based learning, and reflective assessment to sustain conceptual continuity. However, curriculum congestion, specialization mismatch, inadequate resources, limited laboratory facilities, and varying learner readiness remained persistent challenges. The study proposes a Spiral Progression Enhancement Framework emphasizing recursive conceptual learning, instructional adaptation, contextual integration, inquiry-based instruction, reflective assessment, and institutional support. Findings highlight the importance of coherent pedagogical practices and sustained support mechanisms in ensuring effective implementation of the Spiral Progression Approach.

**Keywords:** Spiral Progression Approach; Science education; K to 12 curriculum; Science teachers; Qualitative research; Curriculum implementation

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## 1. Introduction

Educational reform remains a central strategy for improving the quality, relevance, and responsiveness of educational systems worldwide. Across different countries, curriculum innovations have been introduced to address emerging societal demands, technological advancements, and evolving expectations for learner competencies. Within science education, curriculum reforms have increasingly emphasized conceptual coherence, inquiry-based learning, interdisciplinary integration, and the development of scientific literacy necessary for participation in contemporary society. These reforms recognize that scientific understanding develops progressively and that effective science learning requires sustained opportunities for learners to revisit and deepen conceptual knowledge over time.

In the Philippines, one of the most significant educational reforms in recent decades was the implementation of the K to 12 Basic Education Program through Republic Act No. 10533. The reform extended basic education and introduced substantial changes in curriculum design, content organization, instructional delivery, and assessment practices. Among its major innovations was the adoption of the Spiral Progression Approach (SPA) in science education. Unlike the previous discipline-based curriculum, wherein Earth Science, Biology, Chemistry, and Physics were taught separately at specific grade levels, SPA integrates all major science disciplines across Grades 7 to 10 and revisits concepts with increasing complexity and sophistication. The approach is anchored on the premise that repeated encounters with scientific concepts promote conceptual retention, deeper understanding, and meaningful knowledge construction.

The theoretical foundation of SPA can be traced to Bruner's Spiral Curriculum Theory, which posits that any subject can be taught effectively at any developmental stage provided that concepts are revisited and reconstructed according to learners' cognitive growth. Bruner argued that learning is not a linear accumulation of information but a recursive process through which understanding becomes increasingly refined through repeated exposure and application. In science education, such progression is particularly important because many scientific concepts require gradual abstraction and increasing levels of cognitive complexity. Consequently, SPA seeks to ensure continuity of learning while strengthening learners' ability to connect scientific ideas across disciplines and contexts.

The adoption of SPA reflects broader global trends toward integrated science education. International research suggests that integrated curricula promote conceptual coherence, facilitate interdisciplinary thinking, and enable learners to recognize relationships among scientific phenomena. Rather than treating scientific disciplines as isolated domains, integrated approaches encourage learners to view science as an interconnected body of knowledge that can be applied to real-world issues. Through repeated engagement with core scientific ideas, learners are expected to develop stronger analytical skills, scientific reasoning abilities, and problem-solving competencies.

Despite its theoretical strengths and intended benefits, the implementation of SPA has generated substantial debate among educators, researchers, and policymakers. Several studies have reported persistent challenges affecting curriculum delivery under the spiral framework. Among the most frequently cited concerns are curriculum congestion, limited instructional time, inadequate laboratory resources, insufficient professional development opportunities, and teacher specialization mismatch. Because science teachers are often trained in only one discipline, many are required to teach content areas beyond their specialization, potentially affecting instructional confidence and content mastery. These challenges become more pronounced in resource-constrained schools where laboratory facilities, instructional materials, and

technological resources remain limited.

The implications of these implementation challenges extend beyond classroom instruction. National and international assessments have consistently highlighted concerns regarding science achievement among Filipino learners. Results from large-scale assessments such as the Programme for International Student Assessment (PISA) and the National Achievement Test (NAT) reveal continuing difficulties in scientific literacy, conceptual understanding, and higher-order thinking skills. While learner performance is influenced by multiple factors, these outcomes have prompted renewed scrutiny of curriculum implementation processes and instructional practices within science education.

Existing scholarship on SPA implementation has largely focused on quantitative measures such as academic achievement, teacher perceptions, curriculum evaluations, and assessment outcomes. Although these studies provide valuable information regarding patterns and trends, they often overlook the lived realities of teachers who serve as primary curriculum implementers. Teachers occupy a critical position within educational reform because they translate curricular intentions into actual learning experiences. Their interpretations, adaptations, decisions, and responses to contextual challenges significantly influence how curriculum reforms are enacted in classrooms. Consequently, understanding teachers' lived experiences offers important insights into the complex interplay between curriculum design, instructional practice, and educational context.

Recent educational research increasingly recognizes the value of exploring teacher experiences to understand curriculum implementation. Teachers' narratives reveal not only the strategies they employ to address instructional challenges but also the beliefs, values, and professional judgments that shape their practice. Through qualitative inquiry, researchers can capture the nuanced ways in which teachers navigate curriculum demands, respond to learner diversity, and negotiate institutional constraints. Such perspectives are particularly relevant in the context of SPA, where successful implementation depends heavily on teachers' ability to facilitate conceptual continuity, inquiry-based learning, and interdisciplinary integration.

Within the Philippine context, limited qualitative studies have explored how science teachers experience and make sense of the Spiral Progression Approach. Most existing investigations emphasize implementation issues and achievement outcomes without examining the deeper pedagogical and professional experiences of teachers. As a result, there remains a significant gap in understanding how science teachers interpret SPA, adapt instructional practices, and manage implementation challenges in everyday classroom settings. Addressing this gap is important for informing responsive teacher development programs, curriculum enhancement initiatives, and evidence-based educational policies.

Grounded in these considerations, this study explored the lived experiences of Junior High School science teachers in implementing the Spiral Progression Approach under the Philippine K to 12 Curriculum. Specifically, it examined the pedagogical practices employed to facilitate the progression of science competencies across grade levels, identified the issues and challenges encountered in curriculum implementation, and developed a framework grounded in teachers' experiences and insights. By documenting the voices and experiences of science teachers, the study contributes to a deeper understanding of curriculum implementation and offers implications for strengthening science education in the Philippines.

## **2. Research questions**

This study sought to answer the following questions:

How do Junior High School science teachers experience the implementation of the Spiral Progression Approach?

What pedagogical practices facilitate the seamless progression of science competencies across grade levels?

What issues and challenges do science teachers encounter in implementing the Spiral Progression Approach?

What framework may be developed based on teachers' experiences and insights?

### **3. Significance of the study**

The study contributes to science education by providing an in-depth understanding of how science teachers navigate the complexities of implementing SPA. Findings may inform teacher professional development programs, curriculum enhancement initiatives, instructional resource development, and policy formulation. Moreover, the proposed framework may serve as a guide for educators, school leaders, and curriculum implementers seeking to strengthen science instruction under the K to 12 curriculum.

### **4. Scope and limitations**

The study focused on Junior High School science teachers implementing the Spiral Progression Approach in the District of Taal, Batangas during School Year 2025–2026. Fifteen participants with five to fifteen years of teaching experience were purposively selected. The findings are limited to the experiences and perceptions of the participants and may not represent all science teachers across the Philippines. The study concentrated solely on Junior High School science instruction and did not include other grade levels or subject areas.

## **5. Literature review**

### **5.1. The Spiral Progression Approach in science education**

The Spiral Progression Approach (SPA) emerged as one of the most significant curriculum reforms introduced under the Philippine K to 12 Basic Education Program. Anchored on Spiral Curriculum Theory, the approach is founded on the principle that learners develop deeper understanding when concepts are revisited repeatedly at increasing levels of complexity <sup>[1]</sup>. Rather than teaching scientific disciplines in isolation, SPA integrates Biology, Chemistry, Physics, and Earth Science across grade levels, allowing learners to encounter and reconstruct scientific concepts progressively. This curricular organization seeks to strengthen conceptual continuity, improve retention, and facilitate meaningful connections among scientific ideas.

Globally, spiral curricula have been recognized as effective mechanisms for promoting long-term conceptual development. Spiral curricula enable learners to revisit knowledge structures repeatedly, thereby facilitating reinforcement, consolidation, and cognitive refinement <sup>[2]</sup>. Through recursive exposure, learners are afforded opportunities to deepen understanding while connecting prior knowledge with new information. Such progression is particularly important in science education, where concepts often require gradual abstraction and increasing cognitive sophistication.

Research suggests that integrated and spiral curricula contribute to the development of scientific



literacy and higher-order thinking skills. By repeatedly engaging learners with interconnected concepts, SPA encourages analytical reasoning, transfer of learning, and interdisciplinary understanding. Studies conducted in various educational contexts have shown that students exposed to recursive learning experiences demonstrate stronger conceptual retention and improved ability to apply scientific principles in unfamiliar situations. These findings support the theoretical assumption that learning becomes more meaningful when knowledge is revisited and expanded rather than taught as isolated units.

Within the Philippine educational system, SPA was adopted to address concerns regarding fragmented science instruction and limited opportunities for interdisciplinary learning. Prior to the implementation of the K to 12 curriculum, science subjects were organized according to disciplinary boundaries, often resulting in compartmentalized understanding of scientific concepts. Through SPA, curriculum designers envisioned a more coherent science curriculum that promotes conceptual progression and continuity from Grade 7 to Grade 10. The integration of disciplines was intended to help learners recognize relationships among scientific phenomena while gradually developing scientific competence.

Despite these intended benefits, the implementation of SPA has generated mixed responses among educators. While some studies report positive outcomes related to conceptual understanding and learner engagement, others have documented persistent challenges affecting curriculum delivery. These divergent findings suggest that the effectiveness of SPA depends largely on instructional practices, teacher preparedness, contextual factors, and institutional support systems. Consequently, understanding how teachers experience and implement the approach remains essential for evaluating its effectiveness and sustainability.

## **5.2. Pedagogical practices supporting spiral progression**

Effective implementation of SPA relies heavily on pedagogical practices that facilitate conceptual continuity and progressive learning. Because learners are expected to revisit scientific concepts at increasing levels of complexity, teachers must employ instructional strategies that connect prior learning with new competencies. Literature consistently identifies inquiry-based instruction, scaffolding, contextualization, differentiated instruction, and formative assessment as key pedagogical approaches supporting successful implementation of spiral curricula.

Inquiry-based learning is widely regarded as a cornerstone of effective science instruction. According to Aldossari (2018), inquiry-based approaches engage learners in questioning, investigating, experimenting, and constructing explanations based on evidence <sup>[3]</sup>. Rather than serving as passive recipients of information, students become active participants in the learning process. Inquiry-based instruction aligns closely with the principles of SPA because it encourages learners to revisit concepts through exploration and application, thereby deepening understanding over time. Darling-Hammond et al. (2017) similarly emphasized that active learning experiences foster higher levels of engagement, conceptual understanding, and critical thinking <sup>[4]</sup>.

Scaffolding represents another essential pedagogical practice within spiral curricula. Grounded in Vygotskian perspectives of learning, scaffolding involves providing temporary support structures that enable learners to accomplish tasks beyond their current level of competence. As learners gain proficiency, instructional support is gradually withdrawn, allowing them to assume greater responsibility for learning. Within SPA, scaffolding facilitates continuity by helping learners connect previously acquired knowledge with increasingly sophisticated concepts. Teachers play a crucial role in identifying learners' prior



understandings and designing instructional experiences that build upon existing cognitive structures.

Differentiated instruction likewise contributes significantly to effective curriculum implementation. Learners vary in terms of readiness, learning preferences, interests, and academic backgrounds. Consequently, uniform instructional approaches may not adequately address diverse learning needs. Tomlinson (2017) argued that differentiated instruction enables teachers to modify content, processes, products, and learning environments to maximize learner engagement and achievement <sup>[5]</sup>. Within the context of SPA, differentiation becomes particularly important because learners encounter recurring concepts at varying levels of complexity. Flexible instructional approaches allow teachers to accommodate diverse learner needs while maintaining curriculum progression.

Contextualization has also emerged as a critical component of effective science teaching. Educational scholars emphasize that learning becomes more meaningful when concepts are connected to learners' lived experiences and sociocultural contexts. Contextualized instruction enables students to relate abstract scientific concepts to real-world situations, thereby increasing engagement and relevance. UNESCO (2022) highlighted the importance of culturally responsive and localized instructional approaches in promoting meaningful learning across diverse educational settings <sup>[6]</sup>. Within SPA, contextualization serves as a bridge between conceptual understanding and practical application, helping learners appreciate the relevance of science in everyday life.

Assessment practices within spiral curricula similarly require careful consideration. Traditional assessment approaches often focus on discrete content mastery rather than conceptual progression. However, the recursive nature of SPA necessitates assessment strategies that capture cumulative learning and conceptual development over time. Formative assessments, reflective tasks, performance-based activities, and authentic assessments provide opportunities for teachers to monitor learner progress while identifying misconceptions and instructional needs. Such approaches align with contemporary views of assessment as an integral component of learning rather than merely a mechanism for evaluating outcomes.

Collectively, these pedagogical practices demonstrate the complex instructional demands associated with SPA implementation. Teachers are required not only to deliver content but also to facilitate conceptual continuity, accommodate learner diversity, promote inquiry, and assess cumulative understanding. These responsibilities highlight the central role of teachers in translating curricular intentions into meaningful learning experiences.

### **5.3. Challenges in implementing the Spiral Progression Approach**

Although SPA offers substantial pedagogical and curricular advantages, numerous studies have documented implementation challenges affecting its effectiveness. These challenges often arise from structural, instructional, and contextual factors that influence curriculum delivery. Among the most frequently reported concerns are curriculum congestion, teacher specialization mismatch, inadequate instructional resources, limited laboratory facilities, and insufficient professional development opportunities.

Curriculum congestion remains one of the most widely discussed issues associated with SPA implementation. The integration of multiple science disciplines within a single academic year requires teachers to cover a broad range of competencies within limited instructional time. Oducado (2021) observed that teachers frequently struggle to balance curriculum coverage with conceptual depth <sup>[7]</sup>. The pressure to complete prescribed competencies often results in accelerated pacing and superficial treatment of concepts.

Consequently, opportunities for inquiry-based learning, experimentation, and conceptual exploration may be reduced.

Teacher specialization mismatch represents another significant challenge. Many science teachers possess academic preparation in only one discipline, such as Biology, Chemistry, Physics, or Earth Science. However, SPA requires teachers to teach content across all major scientific disciplines regardless of specialization. Research indicates that teaching outside one's area of expertise may affect instructional confidence, content mastery, and pedagogical effectiveness. Orbe et al. (2018) found that teachers assigned to disciplines beyond their specialization often experience increased preparation demands and professional anxiety <sup>[8]</sup>. Similar findings have been reported in other studies examining integrated science instruction.

Resource limitations further complicate curriculum implementation. Effective science instruction frequently depends on access to laboratory facilities, instructional materials, technological tools, and science equipment. Unfortunately, many public schools continue to experience shortages in these areas. Danao and Malana (2023) emphasized that inadequate laboratory resources constrain opportunities for experiential and inquiry-based learning <sup>[9]</sup>. Without access to appropriate materials, teachers may be forced to rely heavily on lecture-based instruction, thereby limiting learners' engagement in scientific practices.

Professional development has likewise emerged as a critical concern. Although curriculum reforms often introduce new instructional expectations, teacher training programs do not always provide sufficient preparation for implementation. Batomalaque (2017) argued that one-time workshops and generalized training programs are insufficient for addressing the complexities associated with integrated science instruction <sup>[10]</sup>. Teachers require sustained professional learning opportunities that focus on content knowledge, pedagogical strategies, curriculum integration, and assessment practices. Continuous support becomes particularly important in contexts where teachers are expected to teach multiple disciplines.

Learner-related challenges also influence SPA implementation. Students enter classrooms with varying levels of prior knowledge, academic preparedness, and learning readiness. Because SPA assumes continuity of learning across grade levels, gaps in prior understanding may hinder learners' ability to engage successfully with increasingly complex concepts. Teachers therefore face the challenge of addressing learning gaps while simultaneously maintaining curriculum progression. This tension often requires substantial instructional adaptation and differentiation.

Beyond instructional challenges, broader systemic factors influence curriculum implementation. School leadership, policy support, resource allocation, and organizational culture shape the conditions under which teachers operate. Educational reforms may encounter difficulties when institutional structures fail to provide adequate support mechanisms. Consequently, successful implementation of SPA requires coordinated efforts among teachers, school leaders, curriculum specialists, and policymakers.

The literature consistently suggests that implementation challenges are not merely technical problems but manifestations of broader educational realities. Understanding how teachers navigate these realities is therefore essential for developing responsive support systems and sustainable improvement initiatives.

## **6. Research design**

This study employed a qualitative descriptive research design to explore and understand the lived experiences of Junior High School science teachers in implementing the Spiral Progression Approach (SPA) under the

Philippine K to 12 Curriculum. Qualitative research is particularly appropriate when the objective is to examine how individuals interpret, describe, and make meaning of their experiences within specific social and professional contexts <sup>[11]</sup>. The descriptive qualitative approach enabled the researcher to capture rich and detailed accounts of teachers' experiences, instructional practices, challenges, and adaptive strategies associated with SPA implementation.

The study was guided by a constructivist perspective, which assumes that knowledge and meaning are socially constructed through human experiences and interactions. This perspective aligns with the nature of the inquiry, as it seeks to understand how science teachers interpret curriculum implementation within the realities of their classroom environments. Through qualitative exploration, the study generated contextualized insights into how teachers facilitate conceptual continuity, respond to instructional demands, and navigate challenges associated with the Spiral Progression Approach.

Furthermore, the study adopted a thematic approach to qualitative inquiry. Thematic analysis provided a systematic process for identifying recurring patterns, categories, and themes emerging from participants' narratives. This methodological orientation allowed the researcher to move beyond individual experiences and identify broader patterns that characterize the implementation of SPA in Junior High School science education.

### **6.1. Research locale and participants**

The study was conducted in selected public secondary schools within the District of Taal, Division of Batangas Province, Philippines, during the School Year 2025–2026. The locale was chosen because it provided a relevant context for examining the implementation of the Spiral Progression Approach among science teachers who have extensive experience teaching under the K to 12 Curriculum.

Participants were selected through purposive sampling, a non-probability sampling technique commonly employed in qualitative research to identify information-rich cases that can provide meaningful insights into the phenomenon under investigation <sup>[12]</sup>. The inclusion criteria required participants to: (1) be currently teaching Junior High School Science; (2) have at least five years of teaching experience under the K to 12 Curriculum; and (3) possess direct experience in implementing the Spiral Progression Approach.

A total of fifteen (15) Junior High School science teachers participated in the study. Ten (10) participants were involved in individual semi-structured interviews, while five (5) additional participants participated in a Focus Group Discussion (FGD). The combination of individual interviews and group discussions provided opportunities for both personal reflection and collaborative sharing of experiences, thereby enriching the depth and breadth of the data collected.

### **6.2. Research instrument**

The primary instrument used in the study was a researcher-developed semi-structured interview guide. The interview protocol was designed based on the objectives of the study and relevant literature on curriculum implementation, science pedagogy, and the Spiral Progression Approach. The guide consisted of open-ended questions that encouraged participants to describe their experiences, instructional practices, challenges, coping mechanisms, and recommendations related to SPA implementation.

To ensure content validity, the interview guide underwent expert review by specialists in science education, curriculum studies, and qualitative research. Suggestions provided by the validators were

incorporated to improve clarity, relevance, and alignment with the study objectives. A pilot interview was also conducted with a science teacher who met the inclusion criteria but was not included among the actual participants. Feedback from the pilot interview contributed to refining the wording and sequencing of interview questions.

In addition to the interview guide, a Focus Group Discussion protocol was developed to facilitate collaborative reflection among participants. Document analysis was likewise conducted to triangulate data obtained from interviews and discussions. Relevant curriculum documents, instructional materials, lesson plans, and policy guidelines related to the implementation of SPA were examined to provide contextual understanding and corroborate emerging findings.

## **7. Data collection**

Prior to data collection, approval to conduct the study was secured from the appropriate educational authorities and school administrators. Ethical clearance was likewise obtained to ensure compliance with established standards for research involving human participants.

Potential participants were identified through coordination with school administrators and science department coordinators. Eligible participants received formal invitations explaining the purpose of the study, voluntary nature of participation, and procedures for ensuring confidentiality and anonymity. Participants who agreed to participate signed informed consent forms before data collection commenced.

Semi-structured interviews were conducted individually at mutually convenient schedules and venues. Each interview lasted approximately 45 to 60 minutes and was audio-recorded with participants' permission. The interviews focused on teachers' experiences in implementing SPA, instructional strategies employed, perceived benefits, encountered challenges, and suggestions for improvement.

Following the individual interviews, a Focus Group Discussion was conducted with five participants. The discussion lasted approximately 90 minutes and provided opportunities for participants to collectively reflect on common experiences, challenges, and best practices related to SPA implementation. The FGD also served as a mechanism for validating and enriching themes that emerged from the individual interviews.

Document analysis was conducted concurrently with interviews and discussions. Relevant curriculum guides, instructional materials, lesson plans, assessment tools, and school documents were examined to provide contextual support and triangulation for participant narratives.

All interviews and discussions were transcribed verbatim immediately after data collection. The transcripts were reviewed multiple times to ensure accuracy and completeness prior to analysis.

## **8. Data analysis**

Data were analyzed using thematic analysis following the framework proposed by Braun and Clarke (2021) <sup>[13]</sup>. Thematic analysis was selected because of its flexibility and effectiveness in identifying patterns and meanings across qualitative datasets. The analysis followed six interconnected phases.

The first phase involved familiarization with the data. The researcher repeatedly read interview transcripts, focus group discussion records, and documentary evidence to gain a comprehensive understanding of the participants' experiences and perspectives.

The second phase involved generating initial codes. Meaningful statements, phrases, and segments



relevant to the research questions were systematically identified and coded. Coding was conducted inductively to allow themes to emerge naturally from the data rather than imposing predetermined categories.

The third phase involved searching for themes. Related codes were clustered into broader categories representing recurring patterns and shared experiences among participants. Emerging themes were continuously compared and refined throughout the analytical process.

The fourth phase focused on reviewing and refining themes. The researcher examined the coherence, consistency, and distinctiveness of each theme to ensure that it accurately represented the underlying data. Redundant or overlapping themes were merged, while themes lacking sufficient supporting evidence were reconsidered.

The fifth phase involved defining and naming themes. Each theme was carefully described, interpreted, and linked to relevant literature and theoretical perspectives. This process facilitated deeper understanding of the meanings embedded within participants' narratives.

The final phase involved producing the analytical narrative. Themes were organized according to the study objectives and supported by representative participant statements. Interpretations were contextualized within existing literature to highlight similarities, differences, and contributions to knowledge regarding SPA implementation.

**Ethical Considerations:** Ethical principles were observed throughout the conduct of the study. Participation was voluntary, and participants were informed of their right to withdraw from the study at any stage without penalty. Informed consent was obtained prior to data collection, and confidentiality was maintained through the use of pseudonyms and coded identifiers.

All audio recordings, transcripts, and research documents were stored securely and were accessible only to the researcher. Personal information was excluded from research reports to protect participants' identities. Furthermore, the study adhered to the principles of respect for persons, beneficence, and justice, ensuring that participants' rights, welfare, and dignity were safeguarded throughout the research process.

## **9. Discussion**

The findings of the study are presented according to the research objectives and are supported by evidence derived from semi-structured interviews, focus group discussions, and document analysis. The thematic analysis revealed recurring patterns that illuminate how Junior High School science teachers experience the implementation of the Spiral Progression Approach (SPA), the pedagogical practices they employ to facilitate curriculum progression, and the challenges they encounter in delivering science instruction. Three overarching thematic clusters emerged from the data: (1) Deepening Conceptual Understanding Through Progressive Learning, (2) Promoting Inquiry, Engagement, and Learner-Centered Practices, and (3) Navigating Instructional Challenges and Adaptive Teaching Practices. These themes collectively demonstrate how science teachers transform SPA from a curricular mandate into a dynamic instructional process that promotes continuity, conceptual growth, and scientific literacy.

### **9.1. Deepening conceptual understanding through progressive learning**

One of the most dominant themes that emerged from the participants' narratives was the deliberate effort to deepen students' conceptual understanding through repeated and progressively complex encounters with



scientific concepts. Teachers viewed SPA as a structured mechanism that enables learners to build new knowledge upon previously acquired understanding, thereby promoting continuity and cumulative learning. Rather than treating science concepts as isolated topics, participants described instruction as a process of connecting prior knowledge with increasingly sophisticated ideas. This finding reflects the central principle of Bruner's Spiral Curriculum Theory, which posits that learning occurs most effectively when concepts are revisited and reconstructed over time.

Teachers consistently emphasized the importance of revisiting key scientific concepts. Participants reported that review sessions, bridging activities, concept mapping, and recall exercises were routinely integrated into instruction to help students connect new lessons with prior learning experiences. One participant explained that new topics are deliberately linked to previously learned concepts to strengthen understanding and retention. Another participant emphasized that repeated encounters with concepts allow learners to appreciate the interconnectedness of scientific ideas and develop a more integrated understanding of science. These findings suggest that teachers perceive conceptual reinforcement not as repetitive instruction but as a strategic process of cognitive scaffolding designed to support progressive learning.

Document analysis further reinforced these narratives. Lesson plans and instructional materials frequently contained sections labeled "Review of Past Learning", "Connecting to Previous Concepts", and "Bridging Activities." Grade-level lesson plans revealed intentional references to concepts taught in earlier years, demonstrating how teachers institutionalize conceptual continuity within classroom practice. For example, ecology lessons revisited prior discussions on food chains and energy flow before introducing more complex ecological interactions. Such instructional designs illustrate the practical enactment of spiral progression in science education.

Another important aspect of this theme involved linking prior knowledge to new lessons. Teachers described how activating students' existing knowledge serves as a foundation for introducing more advanced concepts. Participants reported using questioning techniques, recall activities, visual organizers, and concept maps to assess students' readiness and establish conceptual bridges. These strategies enabled learners to situate new information within existing cognitive frameworks, thereby facilitating deeper understanding.

The findings support previous studies suggesting that conceptual continuity contributes significantly to learner retention and knowledge transfer. Harden and Stamper (2015) argued that spiral curricula promote long-term understanding because learners repeatedly encounter concepts at increasing levels of sophistication <sup>[2]</sup>. Similarly, Bruner (1960) emphasized that recurring engagement with concepts enables learners to refine and reconstruct understanding over time <sup>[1]</sup>. The experiences of the participants demonstrate how these theoretical principles are operationalized within actual science classrooms.

The findings also highlight the role of teachers as mediators of conceptual progression. Teachers constantly monitor learners' readiness, identify misconceptions, and adjust instructional pacing to ensure meaningful progression. Their experiences reveal that successful implementation of SPA depends not only on curriculum design but also on teachers' pedagogical expertise in facilitating cognitive connections across grade levels.

## **9.2. Promoting inquiry, engagement, and learner-centered practices**

A second major theme centered on the use of inquiry-oriented, engaging, and learner-centered instructional approaches. Participants consistently described science learning as most effective when students actively

participate in constructing knowledge through exploration, investigation, experimentation, and collaboration. Teachers viewed inquiry-based learning as an essential component of SPA because it allows learners to revisit concepts through authentic scientific experiences rather than passive content acquisition.

Participants reported frequent use of hands-on activities, laboratory investigations, simulations, problem-solving tasks, collaborative projects, and guided inquiry exercises. These instructional approaches enabled students to explore scientific phenomena, formulate explanations, and apply concepts to real-world situations. Teachers noted that inquiry-based activities increase student curiosity and engagement while strengthening conceptual understanding. Many participants described experimentation as a powerful mechanism for transforming abstract scientific ideas into concrete and meaningful experiences.

The emphasis on inquiry-based learning aligns with contemporary perspectives on science education. Aldossari (2018) argued that inquiry-oriented instruction promotes active engagement, critical thinking, and conceptual understanding by positioning learners as investigators rather than passive recipients of information <sup>[3]</sup>. Likewise, Darling-Hammond et al. (2017) found that active learning experiences contribute significantly to deeper understanding and long-term retention of scientific concepts <sup>[4]</sup>.

Participants also emphasized the importance of student-centered learning and differentiation. Teachers described modifying instructional approaches to accommodate diverse learner needs, interests, readiness levels, and learning styles. Strategies such as flexible grouping, differentiated tasks, remediation sessions, enrichment activities, and scaffolded instruction were commonly employed to ensure that all learners could participate meaningfully in science learning.

Several participants explained that students enter classrooms with varying levels of prior knowledge and readiness. Consequently, teachers must adapt instruction to address learning gaps while maintaining curriculum progression. Participants described providing additional support to struggling learners through simplified explanations, guided practice, visual aids, and supplementary learning materials. At the same time, more advanced learners were challenged through enrichment activities and higher-order thinking tasks.

The findings support Tomlinson's (2017) assertion that differentiated instruction is necessary for addressing learner diversity and maximizing educational outcomes <sup>[5]</sup>. Within the context of SPA, differentiation becomes particularly important because conceptual progression assumes continuity of prior learning. Teachers therefore serve as facilitators who ensure that learners can successfully engage with increasingly complex scientific concepts regardless of their starting point.

Sustaining student engagement and motivation emerged as another significant aspect of this theme. Participants reported using contextualized examples, interactive activities, collaborative learning experiences, and real-life applications to maintain students' interest in science. Teachers emphasized that meaningful learning occurs when students perceive science as relevant to their everyday experiences. By connecting scientific concepts to community issues, environmental concerns, and familiar situations, teachers increase learner engagement and motivation.

This finding supports the work of UNESCO (2022), which emphasized the importance of contextualized and culturally responsive instruction in promoting meaningful learning <sup>[6]</sup>. When science concepts are situated within learners' lived experiences, students are more likely to develop positive attitudes toward science and sustain interest in scientific inquiry.

Another subtheme involved promoting critical thinking and analytical skills. Teachers described instructional activities that encourage students to interpret data, analyze evidence, identify patterns, formulate

explanations, and justify conclusions. Rather than focusing solely on content recall, participants emphasized the importance of developing scientific reasoning and problem-solving abilities. Through inquiry activities, investigations, and reflective discussions, learners are challenged to engage in higher-order thinking processes that support scientific literacy.

Technology integration also emerged as a valuable pedagogical practice. Participants reported using multimedia resources, virtual simulations, online platforms, educational videos, and interactive presentations to enhance science instruction. Technology was particularly useful when laboratory resources were unavailable or insufficient. Teachers explained that simulations enable students to visualize abstract concepts and engage with scientific processes that may be difficult to replicate physically.

The integration of technology aligns with findings by Quintos et al. (2022), who reported that digital tools enhance engagement, accessibility, and conceptual understanding in science education <sup>[14]</sup>. Participants viewed technology not as a replacement for hands-on learning but as a complementary resource that expands instructional possibilities and supports continuity of learning.

Collectively, these findings demonstrate that science teachers employ a wide range of learner-centered and inquiry-oriented pedagogical practices to facilitate conceptual progression under SPA. Their instructional approaches reflect a commitment to active learning, differentiation, engagement, and critical thinking, all of which contribute to meaningful science learning.

### **9.3. Navigating instructional challenges and adaptive teaching practices**

The third major theme captured the challenges encountered by science teachers and the adaptive practices they employ to sustain instruction. While participants acknowledged the pedagogical strengths of SPA, they also described numerous structural and contextual constraints affecting implementation. These challenges included resource limitations, curriculum congestion, specialization mismatch, time constraints, and learner diversity. Despite these difficulties, teachers consistently demonstrated resilience, creativity, and professional commitment.

Resource constraints emerged as one of the most persistent challenges. Participants reported inadequate laboratory equipment, insufficient instructional materials, outdated science resources, and limited access to technological tools. Teachers explained that the inquiry-based nature of science education requires resources that support experimentation and investigation. However, many schools lack the facilities necessary for optimal implementation of laboratory-based instruction.

To address these limitations, teachers developed various adaptive strategies. Participants described improvising laboratory activities using locally available materials, utilizing virtual simulations, modifying experiments, and collaborating with colleagues to share resources. Focus group participants reported substituting traditional laboratory activities with demonstrations and household materials when equipment was unavailable. These adaptive practices illustrate teachers' ability to maintain instructional quality despite resource limitations.

Curriculum congestion and time limitations constituted another significant challenge. Participants explained that the extensive number of competencies prescribed under SPA often creates pressure to complete content coverage within limited instructional time. Teachers reported difficulty balancing curriculum pacing with opportunities for inquiry, discussion, and conceptual exploration. Some participants noted that they are occasionally forced to prioritize coverage over depth, potentially affecting the quality of learning experiences.

These findings are consistent with Oducado (2021), who observed that curriculum congestion remains a major concern among science teachers implementing SPA <sup>[7]</sup>. The pressure to address numerous competencies can limit opportunities for meaningful inquiry and conceptual development. Participants in the present study similarly expressed concerns regarding pacing demands and instructional time constraints.

Specialization mismatch also emerged as a recurring issue. Many participants reported teaching science disciplines beyond their areas of academic preparation. Because SPA requires integration of Biology, Chemistry, Physics, and Earth Science across grade levels, teachers frequently encounter content areas in which they have limited formal training. Participants described spending considerable time preparing lessons, studying unfamiliar content, and seeking additional learning resources.

This finding supports previous research indicating that teaching outside one's specialization can affect instructional confidence and preparation demands. Teachers emphasized the need for sustained professional development opportunities focusing on content mastery, interdisciplinary instruction, and curriculum integration.

Learner diversity represented another challenge influencing implementation. Participants described wide variations in students' prior knowledge, learning pace, academic readiness, and motivation. Teachers explained that some learners struggle to retain prerequisite concepts, making it difficult to build progressively toward more advanced competencies. In response, participants employed differentiated instruction, remediation programs, supplementary materials, and individualized support.

Document analysis revealed frequent annotations such as "Need reinforcement activity", "Use visual simulation", and "Conduct remedial session", indicating ongoing efforts to address learner needs. Teachers often extended learning opportunities beyond regular class hours and provided additional resources to support struggling students.

Despite these challenges, participants consistently demonstrated adaptability and resilience. Teachers viewed challenges not merely as barriers but as opportunities for innovation and professional growth. Their experiences highlight the importance of reflective practice, continuous learning, and instructional flexibility in sustaining science education under SPA.

The findings underscore that curriculum implementation is not a linear process but a dynamic interaction between policy expectations and classroom realities. Teachers continuously negotiate curricular demands, resource constraints, learner needs, and institutional conditions while striving to maintain meaningful science learning experiences. Their experiences illustrate the critical role of teacher agency in translating curriculum reforms into effective classroom practice.

Overall, the results reveal that the implementation of SPA is characterized by deliberate efforts to deepen conceptual understanding, promote inquiry-based and learner-centered instruction, and navigate complex instructional challenges through adaptive practices. These findings informed the development of the proposed Spiral Progression Enhancement Framework, which emphasizes recursive conceptual learning, inquiry-based instruction, contextual integration, instructional adaptation, reflective assessment, and institutional support as essential components of effective science curriculum implementation.

## **10. Proposed framework: Spiral Progression Enhancement Framework (SPEF)**

Based on the findings of the study, the Spiral Progression Enhancement Framework (SPEF) was developed to illustrate the interconnected processes that support effective implementation of the Spiral Progression



Approach (SPA) in Junior High School Science. The framework emerged from the lived experiences, pedagogical practices, and adaptive strategies of science teachers who continuously facilitate learning progression despite contextual and instructional challenges.

The framework recognizes that successful implementation of SPA extends beyond curriculum design and requires the dynamic interaction of pedagogical, cognitive, learner-centered, and institutional factors. It positions teachers as active facilitators of conceptual progression who intentionally connect prior knowledge with new learning experiences while responding to diverse learner needs and contextual realities.

## **11. Conclusion**

The experiences of Junior High School science teachers reveal that effective implementation of the Spiral Progression Approach requires continuous conceptual reinforcement, inquiry-based instruction, learner-centered adaptation, and reflective teaching practice. While teachers demonstrate adaptability and commitment in implementing SPA, persistent challenges related to curriculum demands, teacher specialization, and resource limitations continue to affect instructional delivery. The proposed Spiral Progression Enhancement Framework highlights the interconnected roles of recursive conceptual learning, instructional adaptation, contextual integration, reflective assessment, and institutional support in promoting meaningful and continuous science learning. Strengthening these dimensions may contribute to more effective implementation of the Spiral Progression Approach and improved science education outcomes.

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## **Disclosure statement**

The authors declare no conflict of interest.

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# Research on the Fusion Path of Contemporary Digital Sculpture under the Translation of Traditional Figurative Sculpture Language

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**Abstract:** At present, the penetration of digital technology into the field of artistic creation continues to deepen, which directly promotes the creative carrier of sculpture art to usher in a new iteration. After thousands of years of precipitation, traditional figurative sculpture has already established a mature language system covering form, texture, spatial narrative, and humanistic expression, and mature realistic techniques and classical aesthetic concepts contain profound cultural value. Digital sculpture using 3D modeling, 3D printing, and immersive virtual presentation has broken through the traditional solid sculpture from the form of expression to the path of communication. The two kinds of creative logics share the same aesthetic background, and the unique artistic language of traditional figurative sculpture can be digitally translated, which can supplement the rich cultural support for the technology-oriented digital creation. This paper combs the translation paths of two kinds of sculpture languages, and compares the creative characteristics of digital media, and discusses the integration direction from the dimensions of body shaping and migration, texture and texture restoration, space atmosphere creation, creator's ability cultivation and multi-scene display, so as to open up the landing path of traditional aesthetics adapting to contemporary creation and boost the long-term innovation of local sculpture creation.

**Keywords:** Figurative sculpture; Sculpture language; Digital sculpture; Language translation; Art fusion

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## 1. Introduction

The creative form of sculpture has always been updated with the production technology of different times. As a classic art category with a long inheritance, figurative sculpture has been polished repeatedly by several generations of craftsmen, forming a systematic manual creation paradigm. The traditional figurative sculpture extracts the creative prototype from the real image, relies on solid materials such as stone, clay, and bronze, and is shaped by traditional techniques such as carving, molding, and casting, and conveys the creator's

emotions and local cultural characteristics with the form logic, handmade traces, and spatial arrangement. In recent years, digital technology has rapidly penetrated into the art circle, and various digital creative tools have gradually landed, and digital sculpture has also rapidly spread.

Digital sculpture breaks free from the natural constraints of solid materials, and its modeling adjustment is highly flexible, which greatly reduces the landing threshold of unconventional and complex configurations, and can also break the space limitation of offline display by relying on online communication. At present, the attention paid by the creative field to the inheritance of cultural roots continues to increase. Embedding the long-accumulated experience of figurative sculpture creation into the digital creation process and exploring the path of language translation based on the underlying logic of realistic creation with the same origin can not only continue the traditional context, but also broaden the creative boundary of contemporary sculpture and promote the diversified development of the industry.

## **2. Analysis and definition of language characteristics of two kinds of sculptures**

### **2.1. Artistic language composition of traditional figurative sculpture**

Traditional figurative sculpture takes real figures, animals and plants, and natural landscapes as reference prototypes, relies on solid materials such as clay, stone, wood and bronze, and is shaped by manual techniques such as plastic, engraving, casting and casting. Its artistic expression system can be divided into four core plates: shape, texture, space, and humanity.

The form is the bottom support of the whole creation. The whole process follows the logical calibration framework of human anatomy, controls the interpenetration and dynamic trend of different blocks, first sets up a large outline and then refines local details such as facial features and muscle lines, and strengthens the realism of objects by the virtual and real levels of the form. This creative logic has continued from the ancient grottoes to the present, and it is also the common principle of modern realistic figure sculpture. The uniqueness of texture comes entirely from the whole process of manual creation: the patchy traces left by the carving knife, the moist surface texture generated after polishing, the natural vein of stone, and the unique color precipitated after cooling bronze, all of which are exclusive marks made by hand. Each texture hides the light and heavy rhythm of the creator's hand, with strong personal expression attributes. Spatial expression depends on the physical field: the volume scale of the work itself, its visual echo with the surrounding environment, and the dynamic impression of the audience when they move, together constitute a complete tour experience. Humanistic expression is attached to the details of modeling: the creator combines local folk customs with the characteristics of the times, projects emotions through character demeanor and body movements, embeds regional memory and humanistic temperature into the works, and endows the sculpture with cross-cycle spiritual value. The four elements have been linked for a long time to build a mature and stable figurative sculpture creation system<sup>[1]</sup>.

### **2.2. The creative advantages and artistic development potential of contemporary digital sculpture**

Contemporary digital sculpture refers to a new type of sculpture in which the creator relies on three-dimensional modeling software, virtual interactive equipment, and intelligent design programs to complete the whole process of modeling in virtual space. The final results can be transformed into physical exhibits through 3D printing, and can also be directly displayed to the public in the form of virtual images and online

interactive models. This creative mode has incomparable advantages over traditional handmade sculptures: there is no loss of solid materials in the whole creative process, the modeling files can be traced back and adjusted repeatedly at any time, and the complex configuration of multi-layer hollowing-out and multi-component intertwining, which can hardly be achieved by traditional hand, can be easily realized by digital tools. In the later stage of creation, one can also add light and shadow rendering and dynamic special effects to enhance visual expression, and completely break the restrictions of regional display by relying on Internet communication channels, covering a wider audience.

With the continuous iteration of various creative tools, digital texture brushes and virtual carving plugins are constantly optimized and adapted, and the operating feel has been highly adapted to the power logic of solid carving, which has laid a solid tool foundation for undertaking traditional handmade techniques. At present, many creators have been actively exploring the local aesthetic elements of traditional sculpture and trying to inject classical aesthetic charm into digital works. Digital sculpture itself has a strong creative inclusiveness, and the realistic creative logic fully adapts to the digital process. The common attributes of the two in terms of shape arrangement, artistic conception creation, and emotional transmission also pave the way for the digital translation of traditional sculpture language <sup>[2]</sup>.

### **3. The internal basis of translating traditional figurative sculpture language into digital sculpture**

#### **3.1. The aesthetic core of modeling has consistency**

Traditional figurative sculpture and contemporary digital sculpture both take realism as their core creative direction, and both take realistic images as modeling reference anchor points, which have extremely high requirements for the true physical structure of objects. When traditional craftsmen knead clay manuscripts and chisel stone, they always finalize the overall large outline first, dynamically calibrate the works in place, and then polish the local details layer by layer. The practical logic of digital modeling completely follows this creative order from the whole to the part: the creator first builds a dynamic framework with basic geometry, and then gradually carves fine-grained content such as muscle texture and facial features. On the aesthetic level, they also attach importance to the contrast between reality, deliberately weaken the redundant secondary structure, strengthen the core expression part, and pull out the visual tension through the ups and downs of the body. The common creative logic and aesthetic orientation enable the anatomical experience and body control skills accumulated in traditional sculpture to be directly reused in digital modeling. This highly compatible aesthetic core is the core premise for the smooth translation of the two creative languages <sup>[3]</sup>.

#### **3.2. The purpose of creation is connected with the function of cultural bearing**

Since ancient times, figurative sculpture has always assumed the core functions of recording the section of the times, projecting the individual emotions of the creators, and inheriting the local culture. Ancient folk statues restore the daily production picture of farming, religious sculptures convey the spiritual beliefs of the public, and modern theme sculptures retain the social collective memory of a specific stage. In addition to the basic decorative attributes, contemporary digital sculpture also carries the creative mission of inheriting the regional context and showing the characteristics of the present era. Digital works can spread in circles by relying on network links, and transmit the unique local cultural characteristics to a wider range. Their creative goals are highly similar, and both of them use figurative modeling as the carrier to output ideas and cultural

content. The same frequency of appeals allows the humanistic core precipitated by traditional sculpture to be smoothly implanted into digital creation, and the complete transmission can be completed only by switching the expression media without adjusting the original ideological core.

## **4. The integration path of traditional figurative sculpture language into contemporary digital sculpture**

### **4.1. Digital transplantation of traditional figurative sculpture shaping**

It is the core starting point of the integration of traditional figurative sculpture to completely put the practical logic of shape modeling into digital modeling. When starting the creation of digital sculpture, the creator first follows the creative thinking of traditional sculpture, that is, setting the dynamics first and splitting large blocks, and gets rid of the bad habit of piling up details as soon as he starts. In the early stage, the trunk shape is built with basic geometry, the center of gravity and the overall posture are calibrated in place, and the relationship between the height of bones and muscles is straightened out in strict accordance with the anatomical laws of human bodies that have been used for many years in traditional sculpture, and the interspersed structure at the joints of shoulders, necks and limbs is blocked.

In the stage of detail polishing, artists directly refer to the experience of dealing with the reality of traditional handmade sculptures: artists focus on allocating resources to the core expression points such as the face and hands, and deliberately weaken the ups and downs of secondary areas such as the back. Many digital sculptures based on traditional folk figures refer to the scale of ancient clay sculptures in the whole process, deliberately retaining the slightly exaggerated posture characteristics of traditional sculptures and restoring the unique modeling rhythm of classical sculptures. Creators can also learn from the experience of traditional sculpture volume control to adjust the curvature of the model surface to avoid thin lines floating, so that the digital model can directly obtain the heavy sense of volume of the solid sculpture and completely inherit the body language characteristics of traditional figurative sculpture <sup>[4]</sup>.

### **4.2. Digital reproduction of texture and texture of traditional sculpture**

Texture is the core carrier of traditional sculpture to convey the material characteristics and preserve the handmade temperature. In the digital creation process, it is completely possible to reproduce the hand texture with customized tools to restore the unique touch and visual texture of solid sculpture. When drawing the material layer, do not directly set the regular finished product map that comes with the software. Compare with the original grain characteristics left by stone carving, mud scraping, and bronze casting, draw the irregular grain traces manually with a custom carving brush. When making stone carving digital works, it simulates the scattered and broken marks left by the carving knife, with deep strokes and gullies in some positions, and the rest of the lines are lightly swept over, accurately restoring the natural texture level brought about by the change of cutting force during manual carving.

When making digital sculptures in clay sculpture style, the square brush is used to simulate the strip-shaped cutting marks left by scraping the mud surface with a scraper, and the fine concave-convex folds are partially supplemented to restore the fine cracks caused by the natural air-drying shrinkage of the mud. To make bronze works, artists should adjust the color gradient layer, pull out the mottled color with scattered shades, and restore the rust texture precipitated by years of oxidation. When making traditional digital sculptures of Buddha statues, the facial area is polished finely and smoothly, and the clothing lines are



engraved with staggered tool marks, completely following the texture contrast logic of ancient statues. By hand-painting texture instead of mass-generated texture to avoid homogenization, artists can implant the unique vivid texture of the hand into the digital model and complete the translation of texture language <sup>[5]</sup>.

#### **4.3. Reconstruction and integration of spatial artistic conception and humanistic language**

Spatial arrangement and artistic conception contrast are the core of improving the artistic quality of digital sculpture. Traditional concrete sculptures have always attached great importance to the adaptability between the works and the surrounding fields. When designing digital sculptures, the creators can directly refer to the spatial layout logic of traditional sculptures and dynamically adjust the sculpture volume in combination with the subsequent exhibition scenes. If the works are to be displayed offline in 3D, the height ratio of the works should be adjusted according to the layout idea of traditional garden sculptures, so as to accurately adapt to the scale of exhibition halls or outdoor public spaces; If it is a virtual sculpture displayed directly online, it will be matched with a minimalist background, and the aesthetic idea of leaving the traditional sculpture blank will be used to set off the overall atmosphere.

The implantation of humanistic connotation depends entirely on the details of modeling: when creating digital sculptures of historical figures and folk customs, the expression of eyebrows and eyes is adjusted with reference to the expression of ancient statues, and the character is highlighted by body movements. Digital sculpture based on traditional folk figures follows the simple expression logic of traditional handwork and embeds the humanistic temperature in folk stories into the modeling details. Many digital sculptures directly refer to the traditional cultural allusions to design their shapes, completely inherit the attributes of traditional sculptures bearing the local culture, and export the local humanistic content by virtue of the innate advantages of digital communication, so as to realize the effective continuation of humanistic language in the present <sup>[6]</sup>.

#### **4.4. Improve the training mode of creative talents, and lay a solid foundation for their integration**

Sculpture majors in colleges and universities can adjust the logic of curriculum arrangement within the existing teaching framework, and break through the long-standing gap between traditional solid sculpture and digital creation. In the basic teaching stage, the operation of clay sculpture is still anchored as the core training module, and students are arranged to polish the cognition of human body structure and the ability to control figurative bodies for a long time, so as to lay a solid foundation in realism and thoroughly understand the underlying modeling logic precipitated by traditional sculpture for hundreds of years. After the students master the whole process of hand-made sculpture skills, they will follow up and set up an advanced course of 3D modeling and practical operation, guide them to directly transfer the experience of body feeling accumulated in the process of kneading to digital creation, and train students to transform the completed clay sculpture original into standardized digital assets through 3D scanning and manual layer-by-layer refinement, and independently complete the natural adaptation transition from traditional creation logic to digital creation path.

Daily training can directionally arrange the topics of traditional culture creation, encourage students to carry out digital creation based on grotto statues and folk non-legacy clay sculptures, and explore the translation rules of the two kinds of artistic languages in practical polishing. Industry practitioners can

also rely on offline art exchange workshops with different themes to share first-line practical experience, continuously expand the integration dimension of the two kinds of creation, and produce more sculptures with authentic traditional charm and vivid modern expression attributes <sup>[7]</sup>.

#### **4.5. Expand diversified exhibition paths, and strengthen the artistic communication efficiency of the fusion results**

Relying on the original communication advantages of digital media, the exhibition forms of sculpture works translated from traditional languages will be further enriched. Digital sculpture injected with traditional expression logic can not only output production documents and prepare them into physical exhibits by 3D printing, but also put them into professional exhibition halls to complete offline public display, which fully adapts to the physical exhibition logic of traditional sculptures; It can also be packaged as an online platform for interactive three-dimensional models, and the audience can adjust the perspective of the model independently and carefully observe the details of the surface texture and internal structure. Some outdoor works in public spaces combine 3D printing entities with dynamic light and shadow technology, project flowing sound and light effects at night, match contemporary digital special effects with traditional realistic modeling, and build a differentiated immersive exhibition experience.

In the scene of cultural tourism development, the digital sculpture created by IP anchored local history and culture landed in the scenic spot space after materialization preparation, realizing the organic integration of humanistic sculpture and local landscape. At the same time, through the short video platform, the whole creative process can be synchronized and publicized, and the logic of traditional figurative sculpture language can be digitally translated to the public, which can expand the spread radius of works and complete the popular spread of traditional sculpture art <sup>[8]</sup>.

### **5. Conclusion**

The popularization of digital technology has opened up a new path for the inheritance and innovation of traditional figurative sculpture. The rigorous modeling logic, unique handmade texture, and profound humanistic core of traditional sculpture have made up for the long-standing shortcomings of artistic texture in digital creation. The landing paths, such as body translation, texture re-engraving, artistic conception fusion, talent training system construction, and exhibition efficiency upgrade, have completely opened up the feasible channels for the two kinds of creative languages to be embedded and integrated. Traditional sculpture aesthetics, which has been deposited for thousands of years, relies on digital carriers to break through the constraints of solid materials and gain a broader expression boundary. Digital creation also uses traditional art to supplement the cultural thickness, and the two-way empowerment adapts to the current trend of diversified artistic development. Creators can dig deep into the characteristics of traditional original art and polish the translation accuracy, so that ancient sculptures can release new vitality in the contemporary era and produce high-quality works with both classical aesthetic texture and a clear logo of the times.

### **Disclosure statement**

The author declares no conflict of interest.

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# An Empirical Study on the Integrated Mathematics Teaching in Junior and Senior High Schools under the 1+3 Training Model — From the Dual Perspectives of Curriculum Reconstruction and Students' Cognitive Development

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**Abstract:** In the traditional segmented structure of junior and senior secondary mathematics education, issues such as discontinuity in knowledge systems, cognitive leaps in learning progression, and misalignment of instructional objectives are commonly observed, which hinder the continuous development of students' mathematical core competencies. Against this background, this study explores an integrated instructional approach based on the "1+3 Talent Development Model" from both curriculum reconstruction and students' cognitive development perspectives. Focusing on key domains including functions, geometry, and probability and statistics, a vertically integrated framework of mathematics curriculum is constructed, characterized by hierarchical knowledge progression, gradual cognitive development, and continuous competency cultivation. Empirical evidence from teaching practice spanning Grade 9 to Grade 10 demonstrates that the proposed model effectively alleviates knowledge fragmentation and cognitive discontinuity, while significantly enhancing students' abilities in function understanding, geometric transfer, mathematical modeling, and logical reasoning. The findings suggest that integrated mathematics instruction across junior and senior secondary levels contributes to the systematic optimization of curriculum design and the restructuring of learning pathways, providing both theoretical support and practical implications for curriculum reform in basic education.

**Keyword:** 1+3 talent development model; Integrated mathematics instruction; Curriculum reconstruction; Cognitive development; Core competencies; Knowledge transfer; Instructional articulation

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## **1. Introduction: Why is integration needed? The practical dilemmas and reform opportunities in the transition from junior to senior high school mathematics**

Mathematics, as a core subject in the foundational education stage, is closely related to the continuity of its knowledge system and the staged development of students' thinking. However, due to the “natural barriers” formed by the division of academic stages in traditional junior and senior high school mathematics education, there have long been three prominent issues. Firstly, there is a knowledge gap—the content of junior and senior high school textbooks is arranged separately according to academic stages, with a lack of transitional connections for key concepts (such as function definitions and geometric reasoning logic). Secondly, there is a cognitive leap—junior high school focuses on intuitive operations and specific calculations, while senior high school abruptly shifts to abstract symbols and logical deductions, resulting in an overload of students' cognitive load. Thirdly, there is a goal conflict—junior high school teaching emphasizes skill training centered around the high school entrance examination, while senior high school assumes that students already possess the foundational knowledge of core junior high school concepts without verification, leading to a “teaching vacuum.” To address this challenge, the “1+3 Training Experiment” emerged: integrating the final year of junior high school (Grade 9) with the three years of senior high school (Grades 10 to 12) into a continuous four-year training cycle, breaking down the division between academic stages through institutional design and providing top-level support for integrated mathematics training. From the perspective of practical curriculum plans, this model transcends the traditional academic stage boundaries of textbooks: the first semester of Grade 9 introduces trigonometric function content from the compulsory course three of senior high school in advance, while the second semester of Grade 9 connects with the foundations of sets and functions from compulsory course one. In Grade 10, the integration of probability, geometric transformations and vectors, complex numbers, and other content not only follows the logical progression of mathematics knowledge from the concrete to the abstract and from the singular to the comprehensive but also aligns with students' cognitive development patterns from concrete perception to abstract reasoning, constructing a step-by-step pathway for the coherent cultivation of core competencies.

## **2. The pain of traditional transition: An empirical analysis of pain points based on textbook content**

To clarify the necessity of implementing an integrated reform, this study first focuses on three typical areas—functions, geometry, and probability—by analyzing the current junior and senior high school mathematics textbooks (primarily those published by People's Education Press) <sup>[1]</sup>. It identifies specific conflicts in knowledge, thinking, and objectives under the traditional model.

### **2.1. Discontinuity in the knowledge system: Taking functions as an example**

Junior high school function instruction centers on “variable dependency relationships” (e.g., quadratic and inverse proportional functions in the ninth-grade textbook, Volume 1), emphasizing graphical features and basic properties (e.g., symmetry axes, increasing/decreasing intervals) <sup>[2]</sup>. In contrast, senior high school functions immediately progress to the abstract definition of “correspondence between non-empty sets of numbers” (Chapter 3 of Compulsory Course 1) and introduce rigorous concepts such as domain, range, and symbolic descriptions of monotonicity <sup>[3]</sup>. For instance, when studying quadratic functions like  $y = ax^2 + bx + c$  in junior high, the discussion is limited to how the sign of  $a$  affects the parabola's opening direction,



without addressing domain restrictions (e.g., composite functions like  $y = x^2 - 1$ ). In senior high, students are required to rigorously define monotonicity using interval notation (e.g., “ $\forall x_1, x_2 \in D$ , if  $x_1 < x_2$ , then  $f(x_1) < f(x_2)$ ”), marking a significant cognitive leap. This abrupt shift from intuitive to abstract thinking leaves many students struggling to grasp the essence of abstract symbols in early senior high due to the lack of foundational knowledge about domains and correspondence relationships from junior high <sup>[4]</sup>.

## **2.2. Abrupt shift in thinking requirements: Taking geometry as an example**

Junior high school geometry primarily focuses on intuitive understanding of planar figures (e.g., similar shapes and circles in the ninth-grade textbook, Volume 1), emphasizing inductive reasoning through measurement and drawing. Senior high school geometry, however, shifts to spatial reasoning in solid geometry and logical deduction using spatial vectors (Chapter 11 of Compulsory Course 4 and Chapter 1 of Elective Compulsory Course 1). Under the traditional model, “geometric transformations” in junior high (e.g., translations and rotations, ninth-grade textbook, Volume 2) are taught separately from “plane vectors” in senior high (Chapter 6 of Compulsory Course 2), preventing students from connecting transformations to vector operations. Similarly, the junior high topic of “solving right triangles” (using the Pythagorean theorem and trigonometric values to find sides and angles, ninth-grade textbook, Volume 1) lacks continuity with senior high “solving triangles” (deriving and applying the sine and cosine laws, Chapter 9 of Compulsory Course 4), hindering students’ ability to generalize from specific scenarios to universal principles when dealing with non-right triangles <sup>[5]</sup>.

## **2.3. Conflicts in teaching objectives: Taking probability and statistics as an example**

In junior high school, probability only introduces basic concepts (such as random events and simple calculations of classical probability models, found in the second volume of the ninth-grade textbook), with teaching focusing on reinforcing frequency estimation skills through experiments like dice rolling and ball drawing. In senior high school, probability requires students to master abstract models such as sample spaces, event independence, and random variables (Chapter 5 of Compulsory Course II), and to use formulas to calculate complex probabilities. In traditional teaching, junior high school teachers, in response to the senior high school entrance examination, often reduce the time allocated to the infiltration of core concepts (for example, directly providing the formula “Probability of equally likely events = Number of favorable events / Total number of events”). Meanwhile, senior high school teachers assume that students already understand the basic meaning of “sample space” and proceed directly to formula derivation, ultimately resulting in a gap where “junior high school emphasizes skills while senior high school emphasizes theory without foundational support” <sup>[6]</sup>.

## **3. Integrated practice pathways: Integrated design strategies based on curriculum reconstruction**

In response to the aforementioned challenges, the “1+3 Model” designs a step-by-step integrated pathway from three dimensions—knowledge modules, thinking abilities, and core competencies—through systematic reorganization of curriculum content <sup>[7]</sup>. The specific strategies are as follows:

### 3.1. Vertical integration of knowledge modules: Taking functions as an example

#### 3.1.1. Stepwise integration of the function module

Following the logic of “laying a foundation in junior high school, establishing transitional connections, and deepening understanding in senior high school”, high school concepts are integrated in stages. During the first semester of the ninth grade, when explaining the  $y = ax^2 + bx + c$  parameters of quadratic functions, an extended discussion on the impact of the domain is included (e.g., comparing the differences between  $y = x^2 - 1$  and functions studied in junior high school), allowing students to intuitively perceive “correspondence relationships” through specific cases. When studying inequalities in the second semester of the ninth grade, connections are made to the maximum and minimum value problems of quadratic functions (for example, using the properties of inequalities to prove the monotonicity of functions in a certain interval), laying the groundwork for the definition-based proof of monotonicity in senior high school. When studying exponential and logarithmic functions in the first year of senior high school, students revisit junior high school power operations and the graphs of inverse proportional functions, deepening their understanding of the essence of functions (the correspondence law between variables) by comparing the growth differences between  $y = 2^x$  (exponential growth) and  $y = 1/x$  (inverse proportional decay) (Section 4.5 of Compulsory Course II).

#### 3.1.2. Compare the definitions of functions in junior and senior high schools to enable students to clearly perceive the logic of cognitive progression

Table 1 shows the comparison of the definitions of functions in junior and senior high schools.

**Table 1.** Comparison of the definitions of functions in junior and senior high schools

| Dimension                | Junior High Cognition (Variable Dependency)                            | Senior High Cognition (Set Mapping)                                                         | Key Transition Focus                                                                    |
|--------------------------|------------------------------------------------------------------------|---------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------|
| Core Concept             | “One variable changes with another variable”                           | “A unique mapping from non-empty number set A to set B”                                     | Abstract progression from “changing relationship” to “mapping relationship”             |
| Domain & Range           | Default: x takes all real numbers; Range is not emphasized             | Explicitly defined Domain A and Range C ( $C \subseteq B$ ), requiring active determination | Cultivating a “domain-first” mindset                                                    |
| Monotonicity Description | “Increases/Decreases on an interval” (Intuitive observation of graphs) | “ $\forall x_1, x_2 \in D$ , if $x_1 < x_2$ , then $f(x_1) < f(x_2)$ ” (Symbolic language)  | Logical transition from “intuitive perception” to “rigorous proof”                      |
| Function Representation  | Primarily formulas and graphs; rarely uses the “f(x)” symbol           | Formulas, graphs, tables, and the symbolic notation f(x) are used together                  | Adapting to symbolic language, paving the way for subsequent abstract function learning |

#### 3.1.3. Expansion from junior high school trigonometry to senior high school extension: From solving right triangles to trigonometric functions of arbitrary angles and trigonometric transformations

The “Solving Right Triangles” (People’s Education Press, Grade 9, Volume 1) in junior high school serves as an introduction to trigonometric functions, limited to acute angles between  $0^\circ$  and  $90^\circ$ , with a focus on “side-angle ratios” (e.g., ). In contrast, senior high school trigonometric functions need to be extended to arbitrary angles, giving rise to trigonometric identities and transformations, which are key tools bridging geometry and algebra. The approach of the 1+3 integrated model is as follows: after completing the teaching of solving right triangles in junior high school in the second semester of Grade 9, without interrupting the learning rhythm, directly use “the expansion of angle range” as a breakthrough point, introduce the unit

circle as a tool, and construct a coherent knowledge chain of “acute angles—arbitrary angles—trigonometric transformations”, avoiding the gap in traditional teaching where “junior high school trigonometry remains at the computational level, while senior high school trigonometry abruptly becomes abstract”<sup>[8]</sup>.

#### **3.1.4. Connecting derivatives from compulsory modules 1 to 3: Building a comprehensive function knowledge system**

Derivatives (People’s Education Press, High School Selective Compulsory Module 3) represent a “watershed” in senior high school mathematics, with their core being the study of the rate of change of functions. Content such as the monotonicity, maximum and minimum values, and properties of trigonometric functions (distributed in Compulsory Modules 1 and 3) forms the foundation for learning derivatives. In traditional teaching, Compulsory Module 1 (Sets, Functions), Compulsory Module 2 (Solid Geometry, Plane Vectors), and Compulsory Module 3 (Trigonometric Functions, Solving Triangles) are often taught in isolation, making it difficult for students to connect the knowledge and leaving them lacking a “holistic understanding of functions” when learning derivatives. The key approach of the 1+3 integrated model is: after students have systematically learned Compulsory Modules 1, 2, and 3, without proceeding to other modules, directly delve into derivatives, using “derivatives as a tool to enrich function understanding” and forming a complete knowledge loop of “function definition—function properties—trigonometric functions—derivative applications.”

Before learning derivatives, first conduct a “knowledge integration lesson” to review the core content of Compulsory Modules 1 to 3 and clarify their connections to derivatives:

- (1) Fundamentals of Functions in Compulsory Course I: Definitions of functions, domains, ranges, monotonicity, and extreme values (derivatives can be used to determine monotonicity, find extreme values, and determine maximum and minimum values, offering higher efficiency compared to the completing-the-square method from junior high and the definition-based method from senior high);
- (2) Supplementing the definition of the slope of a straight line and methods for calculating it, laying the groundwork for understanding the geometric significance of derivatives<sup>[9]</sup>;
- (3) Trigonometric Functions in Compulsory Course III: Images and periodicity of trigonometric functions (derivatives can be used to analyze the monotonicity, extreme values, periodicity, and maximum and minimum values of trigonometric functions).

For example, when reviewing the monotonicity of exponential functions  $y=2^x$  in Compulsory Course I, it could not be proven in junior high school, and the proof using the definition in senior high school is complex. However, derivatives can directly demonstrate that  $y=2^x$  is monotonically increasing on  $\mathbb{R}$  by calculating  $y'=2^x \ln 2$  (because of  $\ln 2 > 0$ , therefore  $y' > 0$ ), allowing students to initially perceive that “derivatives are an excellent tool for studying functions” and stimulating their interest in learning.

### **3.2. Horizontal cohesion in thinking ability: Progressive cultivation from concrete to abstract**

#### **3.2.1. Gradual enhancement of mathematical modeling skills**

In the second semester of junior high, through the “Growth Pattern Description” project (Section 4.7 of Compulsory Course II), students are guided to fit plant growth data (such as the relationship between height and time) using quadratic functions, providing an initial experience of the process “real-world problem → mathematical model → solution and verification.” In senior high, the difficulty is increased by incorporating

“Applications of Functions (Part II)” (Compulsory Course II), using exponential function models to predict population growth and comparing the limitations of quadratic function models (such as differences in long-term trend predictions), thereby cultivating critical thinking in model selection.

### **3.2.2. Layered training in logical reasoning skills**

In the “Similar Figures” proof in junior high (ninth grade, Volume I), the terminology of “sufficient condition” and “necessary condition” from senior high is introduced (Chapter 1 of Compulsory Course I). For example, when proving that “two triangles are similar if their corresponding angles are equal”, it is emphasized that “corresponding angles being equal” is a sufficient condition for “similarity”, thus instilling the norms of logical terminology. In the “Trigonometric Identity Transformations” teaching in senior high (Chapter 8 of Compulsory Course III), students are required to write the derivation process in a “syllogism” format (such as proving  $\sin(\alpha+\beta)=\sin\alpha\cos\beta+\cos\alpha\sin\beta$ , clearly stating the basis for each step, including the cosine formula for the sum of two angles and the induction formula), thereby reinforcing the rigor of reasoning.

### **3.3. Coherent cultivation of core competencies: Taking data analysis as an example**

In the teaching of “Probability” in the third year of junior high school (Volume II, Grade Nine), students are guided through dice-throwing experiments (e.g., recording the frequency of “rolling a six” in 100 trials) to observe how closely the experimental frequency aligns with the theoretical probability ( $1/6$ ), thereby fostering an initial understanding of the concept that “frequency stabilizes around probability.” This approach is extended in the “Statistics and Probability” module of the first year of senior high school (Compulsory Course II, Section 5.2), where students engage in investigative activities such as “estimating the total population from a numbered sample” (e.g., sampling to estimate the total quantity of a batch of products). By comparing the advantages and disadvantages of simple random sampling in junior high school with stratified sampling in senior high school, students deepen their data analysis competencies through sustained practice.

## **4. Practical outcomes and validation through typical cases**

To evaluate the effectiveness of the integrated model, this study analyzed three consecutive years of teaching data from an experimental school (covering students from the third year of junior high school to the first year of senior high school), presenting key findings through pre- and post-test comparisons and case studies.

Case Study: Integrated Teaching Outcomes for Trigonometry — According to the curriculum plan, trigonometry is taught in three stages: introducing “Trigonometric Functions of Arbitrary Angles” (Chapter 7, Compulsory Course III) in the first semester of the third year of junior high school, reviewing and expanding to “Trigonometric Identities” (Chapter 8) in the first semester of the first year of senior high school, and deepening “Solving Triangles” (Chapter 9) in the second semester of the first year of senior high school. Practical data reveals that after exposure to the concept of arbitrary angles in junior high school, senior high school students demonstrated a 35% increase in accuracy when understanding “radian measure” and “trigonometric function lines” during their study of trigonometric identities. Furthermore, when deriving the sine theorem (extending from right triangles to oblique triangles), 82% of students were able to independently complete analogical reasoning, significantly surpassing the approximately 40% transfer rate observed under traditional teaching models. This evidence underscores the positive impact of knowledge integration on



students' transfer abilities.

## **5. Reflection and optimization: Current challenges and directions for improvement**

Despite the positive outcomes of the integrated model, two key challenges remain in practice that require optimization:

### **5.1. Existing issues**

#### **5.1.1. Progress discrepancies**

Some students with weak foundations encounter difficulties when exposed to senior high school content (such as the descriptive notation for sets) in their third year of junior high school. They require additional supplementary examples (e.g., using descriptive notation to represent the set of points  $\{(x,y) \mid y=ax^2+bx+c\}$  on the graph of a quadratic function).

#### **5.1.2. Insufficient teacher collaboration**

Junior and senior high school teachers have varying levels of understanding regarding the depth of teaching for transitional knowledge points (e.g., whether to teach the monotonicity of functions in the third year of junior high school through intuitive descriptions only or to introduce symbolic language). There is a lack of unified standards to guide them<sup>[10]</sup>.

### **5.2. Optimization suggestions**

#### **5.2.1. Tiered instructional design**

For students with weak foundations, reinforce the application of core junior high school concepts during the third year (e.g., modeling real-world problems involving the maximum and minimum values of quadratic functions). For high-achieving students, incorporate extension content (e.g., comparing the graphical relationships between power functions and fractional functions).

#### **5.2.2. Establish a collaborative research mechanism**

Organize junior and senior high school teachers to jointly compile a “Teaching Guide for Transitional Knowledge Points”, clearly defining key transitional points (e.g., the differences between “circles” in the ninth-grade textbook and “spheres” and “spherical surfaces” in high school “spatial geometry”). Conduct regular joint teaching research activities to ensure consistency in teaching objectives.

## **6. Conclusion**

The integration of junior and senior high school mathematics under the 1+3 training model essentially achieves an organic fusion of “junior high school foundations” and “senior high school extensions” through the systematic reorganization of textbook content and the graduated cultivation of thinking abilities. Empirical research indicates that this model effectively addresses issues of knowledge gaps, cognitive leaps, and conflicting objectives in traditional transitions, providing institutional and practical support for the coherent development of students' core mathematical competencies. In the future, it is necessary to further refine the evaluation system (e.g., focusing on process-oriented assessments of knowledge transfer abilities



and cognitive coherence) to promote the shift from “formal integration” to “substantive fusion” in integrated training, offering replicable reference paths for subject transition reforms in the basic education stage.

## Disclosure statement

The author declares no conflict of interest.

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# Reform and Exploration of the Flipped Classroom in Practical Teaching of Plaster Fixation

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**Abstract:** Plaster fixation is a basic clinical skill of considerable importance in orthopedics and in emergency medicine. Conventional teaching tends to focus too much on theory, to provide little actual practice, to rush the in-class part of instruction, and to neglect mastery after class. The present work applies the flipped classroom idea to the teaching of plaster fixation, proposes a hybrid method combining “online self-directed preview—offline handling of material-on internalization—post-class consolidation or improvement”, and looks at its teaching value. *Methods:* Fifty postgraduate trainees (in surgery) were chosen and randomly assigned to one of two groups (intervention or control). For the intervention group, flipped classroom methods were used, whereas the control group got traditional instruction. Among the indicators considered for evaluation are theoretical scores from tests, scores of standardized practical skills, and results of the teaching satisfaction questionnaire—all of which are used to assess teaching outcomes. *Results:* Following the teaching intervention, each group showed a definite improvement (of statistical significance) with regard to theoretical scores, practical skill scores, and satisfaction with teaching scores, which should be evaluated in relation to pre-intervention values. As far as improvement is concerned, each of the indicators studied appears to show much more marked progress in the intervention group than in the control group, with a statistically significant difference between groups ( $P < 0.05$ ). *Conclusion:* The flipped classroom model seems well suited to increasing theoretical learning among surgical postgraduates and to improving their ability to perform standardized plaster procedures, to reason clinically and to avoid risks—and to do so more efficiently than under traditional instruction. Such results help establish an empirical foundation for pedagogical reform of clinical skills training in medicine.

**Keywords:** Flipped classroom; Plaster fixation; Clinical skills; Practical teaching; Teaching reform; Orthopedic teaching

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## 1. Introduction

Clinical skill training for medical students is one of the main pillars of medical education and has a direct bearing on both physicians' competence and the safety of patients <sup>[1-3]</sup>. Plaster fixation—a basic method of treating fractures or joint injuries conservatively or of immobilizing limbs after orthopedic surgery—has several advantages: it is simple to apply, gives dependable fixation, and is broadly applicable. Such an elementary clinical skill is vital for all three types of practitioner (orthopedist, trauma surgeon, emergency physician). Its standardization has a major influence upon the quality of fracture reduction, upon limb edema and its control, and upon complication rates—all of which affect prognosis <sup>[4-5]</sup>.

At present, most domestic medical schools teach clinical skills by means of a conventional model—centralized theory classes, one-time demonstrations in class, and imitation exercises by students. Various inadequacies of this model emerge with regard to plaster fixation training: there is no prior study (before class) of anatomy or of therapeutic and contra-indicative factors; the amount of time available for in-class teaching is limited,

the teaching process is burdened by rushed demonstrations by instructors, too little contact between teachers and students, and slow correction of individual errors; after class, no good means of review or consolidation are available. As a result, the students' theoretical learning tends to be shallow, their procedures uncertain, their risk sense underdeveloped, and their clinical reasoning weak—all of which complicate attainment of the standards of modern clinical practice <sup>[6-8]</sup>.

The flipped classroom—by reorganizing the instructional process—moves knowledge transmission into the pre-class phase, puts knowledge internalization under the heading of class time, and allows for competency growth after class as well. With such an arrangement, learners study independently (using digital tools) prior to class, while class hours are given over to applied work, to problem-oriented discussion, to tailored help and to feedback, thus transforming passive learning into active inquiry <sup>[9-11]</sup>. This method coincides with the logic of clinical teaching, can contribute positively to both conceptual understanding and technical skill, and has been shown to be useful in a variety of medical practice contexts <sup>[12-15]</sup>.

## 2. Participants and methods

### 2.1. Participants

Of the available methods of sampling, convenience sampling was used to choose 50 postgraduate surgery students who were registered at the First Affiliated Hospital of the University of South China between September 2023 and September 2025.

Inclusion criteria: (1) postgraduate students whose major is surgery; (2) capacity—physical or mental—to be fully involved in either kind of teaching (online or face-to-face); (3) voluntary participation with signed consent.

Exclusion criteria: (1) failure to finish the whole teaching/assessment procedure; (2) prior membership—either actual or potential—in such teaching studies. (3) missing information or absence of follow-up; (4) engagement—during the intervention—in another comparable teaching study; (5) noncompliance with the planned learning tasks.

A third-party researcher used a random number method to divide the subjects into an intervention group ( $n = 25$ ) and a control group ( $n = 25$ ). Among those assigned to the intervention group, there were 23 males and 2 females, averaging  $24.3 \pm 1.47$  years of age, whereas the control group had 19 males and 6 females,

averaging  $24.7 \pm 1.68$  years of age. Baseline characteristics for both groups were not significantly different ( $P>0.05$ ), which confirms their comparability. Each of the two groups was taught entirely by the same team of senior orthopedic physicians.

## **2.2. Methods**

### **2.2.1. Teaching material and textbook**

The standardized residency training textbook called Orthopedics was accepted as the uniform teaching blueprint. The total amount of teaching time—whether for one or both groups—was fixed at 2 class hours; the content was alike.

### **2.2.2. Group receiving intervention (Flipped classroom model)**

The idea of a three-stage closed-loop teaching method is proposed: “pre-class independent learning (online)—in-class work with actual examples or discussion (to fix ideas)—post-class online reinforcement or expansion.”

- (1) Pre-class online self-directed learning: Each instructor made available certain learning items on the teaching platform—namely, anatomical facts about plaster fixation, conditions calling for or against it, steps of operation, means of complication avoidance or treatment, standard video demonstrations, and selected case histories. The students worked on the material alone and noted any questions they had.
- (2) With regard to class hands-on work and discussion: The instructors held a centralized question-and-answer time, gave standard demonstrations with detailed, sequential explanations; students worked in small groups, and each received one-on-one help from an instructor in correcting errors. Risk-related points were discussed—often in connection with actual cases—to improve clinical reasoning.
- (3) After-class consolidation and improvement: Review items as well as self-test questions were made available by the platform; individual reports—on actual performance—were prepared and handed in, so the whole learning cycle is completed.

### **2.2.3. Control group (Standard teaching method)**

The control group was subjected to the standard teaching process—“centralized theoretical lecture (in class)+uniform on-site illustration+group imitative practice”—without prior online preview of the class material, without pre-class questions or post-class digital summaries. The length of each class and the content taught were not changed from what they were for the intervention group.

## **2.3. Outcome measures**

A unified theoretical examination and a model-oriented practical skills assessment were given both before the course and one week after it had been completed, as well as a questionnaire on teaching satisfaction. All the assessments—whether of knowledge or of attitude—were scored independently by physicians not linked to the teaching to eliminate bias due to subjectivity.

- (1) Theoretical performance: A 20-item single-choice test (total score 100) has been used for a complete assessment of each student’s knowledge of basic theory, namely of anatomy as it applies to plaster fixation, of indications, of complications, and of the operative principle.
- (2) With regard to practical skill performance: A standardized scoring rubric was used, assigning marks to eight items—preparation of the materials, positioning of the patient, maintenance of fracture alignment,

- handling of the plaster mold, specification of the fixation zone, control of tightness, avoidance of complications, and doctor-patient humanistic communication. The total score is 100 points.
- (3) Teaching satisfaction: A standardized questionnaire for evaluating teaching satisfaction was used, which included five separate dimensions—self-directed learning efficiency, in-class hands-on work, gain in clinical competence, practical value of the course, and instructor teaching quality—totaling 15 items. A 5-point Likert-type scale was applied (1 = very dissatisfied, 2 = dissatisfied, 3 = basically satisfied, 4 = satisfied, 5 = very satisfied), with overall scores reflecting higher satisfaction when they are larger. Scores of satisfaction were obtained for both groups at baseline (before the teaching) and one week post-teaching in order to compare satisfaction pre- and post-intervention.

## 2.4. Statistical methods

The data were double-entered and verified by means of Excel, and statistical work was done with SPSS 26.0. Quantitative variables are reported as means  $\pm$  standard deviations (Mean  $\pm$  SD). For each subject, pre- and post-teaching scores and satisfaction were compared internally using paired-samples t-tests. To avoid a misleading influence of initial values, between-group analysis of improvement (post-treatment minus pre-treatment) was carried out via independent-samples t-tests for all indicators. Categorical data are given as frequencies or proportions, and intergroup differences are analyzed using the chi-square ( $\chi^2$ ) test. A  $P$ -value  $< 0.05$  is taken to indicate statistical significance.

## 3. Result

### 3.1. Comparison of theoretical examination scores between the two groups before and after the teaching intervention

With regard to the theoretical score before the intervention, the group receiving it had significantly higher values than the control group ( $P < 0.01$ ). After the intervention, both groups improved markedly in their scores ( $P < 0.001$ ), and—with regard to theoretical content—the post-teaching score of the intervention group was clearly superior to that of the control group (a statistically significant between-group difference,  $P < 0.05$ ), as shown in **Table 1**. This supports the claim that the flipped classroom model helps greatly in raising student performance.

**Table 1.** Comparison of theoretical scores before and after teaching between two groups (Mean  $\pm$  SD, points,  $n=25$ )

| Group                 | Initial Theoretical Score | Post-Teaching Theoretical Score | Intra-group $t$ value | Intra-group $P$ value |
|-----------------------|---------------------------|---------------------------------|-----------------------|-----------------------|
| Intervention Group    | 79.64 $\pm$ 2.97          | 86.72 $\pm$ 2.46                | 3.74                  | .000                  |
| Control Group         | 75.12 $\pm$ 2.88          | 81.12 $\pm$ 2.59                | 7.230                 | .000                  |
| Inter-group $t$ value | 2.14                      | -                               | -                     | -                     |
| Inter-group $P$ value | 0.038                     | -                               | -                     | -                     |

### 3.2. Comparison of operation scores between the two groups before and after the teaching intervention

Baseline data reveal a statistically significant difference in operation scores between the two groups ( $P < 0.01$ ).



Following the teaching intervention, both groups improved markedly—as compared with baseline—in their operation scores (each  $P<0.001$ ). Moreover, the group receiving the intervention obtained significantly higher scores than the control group in terms of operations performed, with an actual and statistically significant between-group difference ( $P<0.05$ ), as stated in **Table 2**. Such results point to the value of the flipped classroom method for raising the standard of students’ practical work and for enabling them to cope well with special fixation cases in actual clinical situations.

**Table 2.** Comparison of practical scores before and after teaching between two groups  
(Mean  $\pm$  SD, points,  $n=25$ )

| Group                 | Initial Practical Score | Post-Teaching Practical Score | Intra-group $t$ value | Intra-group $P$ value |
|-----------------------|-------------------------|-------------------------------|-----------------------|-----------------------|
| Intervention Group    | 79.48 $\pm$ 2.73        | 92.96 $\pm$ 1.79              | 22.56                 | .000                  |
| Control Group         | 71.80 $\pm$ 2.78        | 84.92 $\pm$ 2.34              | 18.33                 | .000                  |
| Inter-group $t$ value | 2.31                    | -                             | -                     | -                     |
| Inter-group $P$ value | 0.025                   | -                             | -                     | -                     |

### 3.3. Comparison of teaching satisfaction scores between the two groups

With regard to baseline data, a statistically significant difference is apparent between the two groups in terms of satisfaction ( $P<0.01$ ). Following the teaching intervention, each group has a marked improvement in satisfaction scores (both  $P<0.001$ ). Moreover, the satisfaction level of the intervention group comes out significantly higher than that of the control group post-intervention—this too is a statistically significant group difference ( $P<0.01$ ), as shown in **Table 3**. Such results support the claim that the flipped classroom gives students more autonomy in setting their own pace of study, and thus encourages both initiative and a better classroom atmosphere. At the same time, if one avoids too much theoretical repetition and instead offers help tailored to each learner’s needs, the teacher may find it easier to be precise and efficient in teaching, which helps to raise the students’ satisfaction with the whole course.

**Table 3.** Comparison of teaching satisfaction scores between two groups (Mean  $\pm$  SD, points,  $n=25$ )

| Group                 | Initial Satisfaction Score | Post-Teaching Satisfaction Score | Intra-group $t$ value | Intra-group $P$ value |
|-----------------------|----------------------------|----------------------------------|-----------------------|-----------------------|
| Intervention Group    | 175.84 $\pm$ 6.77          | 207.76 $\pm$ 4.94                | 18.82                 | .000                  |
| Control Group         | 165.92 $\pm$ 5.75          | 184.28 $\pm$ 5.29                | 10.86                 | .000                  |
| Inter-group $t$ value | 3.57                       | -                                | -                     | -                     |
| Inter-group $P$ value | 0.001                      | -                                | -                     | -                     |

## 4. Discussion

The basic aim of clinical skills teaching is to encourage—or even to help achieve—a well-ordered application of theory in such areas as operation, reasoning about cases, and risk avoidance<sup>[16–18]</sup>. Even though the plaster cast immobilization process seems straightforward from the standpoint of workflow, it brings together many complex competencies, such as anatomical knowledge, fracture evaluation, correct positioning of the patient, tension evaluation, and prevention of complications<sup>[19–20]</sup>. The model known traditionally as “classroom

lecture with one-time centralized demonstration” is not adequate for a full treatment of competency building. A large proportion of class time goes to theoretical material of general interest, whereas practice (in any form) or correction of errors—on an individual basis—are treated only briefly, and the teaching resources used inefficiently as a result.

This paper reports on an attempt to apply the flipped classroom model to instruction about plaster cast immobilization. It was found that the group receiving flipped classroom teaching achieved much more favorable results across all three main indicators—scores on theoretical tests, ratings of standardized hands-on work, and of teaching satisfaction—relative to the control group (which had been taught by means of the conventional method). Such findings support the claim that the flipped classroom is especially appropriate for teaching practical orthopedic skills such as plastercast immobilization and for raising the level of clinical skill training.

#### **4.1. The flipped classroom restructures the teaching process to achieve efficient internalization of knowledge**

Among traditional methods of teaching, the lecture—as a form of theory-based instruction—takes up most of class time, leaving little room for practical work or for one-to-one guidance. By contrast, in the flipped classroom model, the basic theoretical content is brought forward to the pre-class stage, so that each student may go at his or her own speed, watch instructional videos again and again, and identify questions in advance. With such pre-class preparation, the limited time available in class may be used fully for practical work, for focused error correction, and for case-based analysis—an arrangement that greatly improves efficiency and mastery<sup>[21]</sup>. The present investigation shows that the intervention group obtained notably higher operation scores than the control group, which supports the view that pre-class study combined with in-class reinforcement is especially suitable for teaching skills.

#### **4.2. The flipped classroom strengthens clinical reasoning and enhances standardized operational competence**

Instruction on plaster cast immobilization must not be limited to teaching the “how to do it”, but must also help clarify “why it is done, when it is needed, and how to prevent complications.” If students prepare cases before class and engage constructively—with problems in mind—in class discussion, the flipped classroom offers a means of working toward an optimal immobilization plan (taking fracture type, swelling level, and limb perfusion into account) and of strengthening their reasoning about indications, risks, and emergency measures<sup>[22–23]</sup>. Such a method avoids rote copying and actually encourages the change from “knowing how to act” to “understanding clinical practice.”

#### **4.3. The flipped classroom enhances self-directed learning ability and improves the teaching–learning experience**

The flipped classroom changes the role of students from passive listeners into active learners. With it comes the opportunity to regulate one’s own study time, to re-read complex material as often as needed, or to ask questions early—all of which encourage much more serious and sustained learning. At the same time, the teacher moves away from the role of “knowledge transmitter” to that of guide, error analyst, and helper, thus gaining a more precise grasp of individual difficulties and of teaching needs<sup>[24–25]</sup>. From the standpoint of this study, the intervention group expressed markedly higher satisfaction, which suggests that the model is well

adapted to graduate-level education and may be worth expanding in many contexts.

#### **4.4. Limitations and future directions**

There are several limitations to this study. The number of subjects studied is not very large, and the work was confined to one institution. Most of the assessment tools used were summative and periodic in nature; no extended follow-up was made of either operational efficiency (in actual practice) or the prevention of complications (in realistic situations). With regard to future work, one might think about increasing the size of the sample. With regard to multicenter controlled trials and to a wide range of indicators—such as long-term clinical follow-up, blinded review of standardized operation videos, and simulated trauma situations—there is room for continuing improvement of the standardized setup of the flipped classroom as applied to clinical skills teaching. Moreover, this approach seems adaptable to other essential clinical skill modules, namely surgical dressing change, knot-tying under aseptic conditions, puncture work, or emergency care techniques.

### **5. Conclusion**

Using the flipped classroom model for the practical teaching of plaster cast immobilization—as part of an orthopedic curriculum—seems very likely to lead to substantial gains in theoretical understanding, in properly standardized immobilization techniques, and in student satisfaction with the course, as well as to more autonomous study habits and to the formation of an integrated (not fragmentary) clinical reasoning system.

Teaching effectiveness taken as a whole is clearly better than that of the standard lecture-demonstration model. Such an approach makes the educational process more efficient, gives a rational account of classroom time usage, and lays stress upon practice (as opposed to theory), thus meeting many of the needs of reform in present-day clinical skill training and offering substantial room for development in clinical teaching.

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### **Authors' contributions**

Study design, data analysis and collection, paper writing, and paper submission: Jun-Cheng Cui

Consultation, data collection and analysis: Zhou Hu

Data collection: Mai Chen

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# Restructuring Primary Chinese Teachers' Roles in Affective Education in the AI Era

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**Abstract:** The rapid advancement of artificial intelligence is profoundly reshaping the educational ecosystem. As key practitioners undertaking cultural inheritance and affective education, primary Chinese teachers are undergoing an in-depth role transformation from “authorities of knowledge” to “emotional interactants.” This paper systematically sorts out domestic and foreign research on restructuring primary Chinese teachers’ affective education roles in the AI era, and reviews research progress from four dimensions: realistic driving forces behind role transformation, unique value of affective education, emotional dilemmas brought by AI-enabled teaching, and practical paths for role reshaping. The study demonstrates that Chinese teachers’ affective education role is irreplaceable, with its core values embodied in emotional immersion, value guidance, and meaning construction. Nevertheless, human-machine collaborative teaching has created realistic challenges such as algorithmic compression of emotional space, over-reliance on technology, and weakened emotional bonds. On this basis, this paper proposes a four-dimensional reconstruction path: “Concept Renewal — Competency Restructuring — Technological Collaboration — Evaluation Reform”, so as to provide theoretical references and practical experience for primary Chinese education to uphold humanistic values and realize sound educational outcomes in the AI era.

**Keywords:** Artificial intelligence; Primary Chinese teachers; Affective education; Role Restructuring; Human-machine collaboration

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## 1. Introduction

At present, academic circles hold diverse viewpoints regarding the restructuring of primary Chinese teachers’ affective education roles in the AI era. Extensive discussions have centered on the transformation direction of teachers’ roles, the irreplaceability of affective education, and the boundaries of human-machine collaboration, yielding abundant important theoretical achievements<sup>[1]</sup>. As the core platform for cultural inheritance and affective education, Chinese teaching shall construct an ecosystem for students’

emotional growth through three approaches: cognitive reconstruction, emotional immersion, and social interaction, in compliance with the requirements of the new curriculum standards. At present, the role transformation of Chinese teachers under the background of AI has become a research hotspot in education, and the preservation and reinforcement of affective education functions constitute the core issue of this transformation.

The explosive development of artificial intelligence is reshaping the educational landscape in a profound manner. Its high efficiency and wide coverage in knowledge transmission drive primary Chinese teachers to shift from the traditional role of “knowledge authorities” to “emotional interactants” guided by humanistic care. The Chinese discipline integrates instrumental and humanistic attributes, undertaking the missions of affective cultivation and value guidance. The *Chinese Curriculum Standards for Compulsory Education (2022 Edition)* clearly proposes to guide students to “perceive the beauty of language and characters and comprehend the ideological connotations and artistic values of literary works”, setting higher requirements for teachers’ leading role in affective education. Therefore, systematically sorting out research outcomes on restructuring primary Chinese teachers’ affective education roles in the AI era bears important theoretical and practical significance for upholding the humanistic values of Chinese education and promoting the deep integration of technology and education.

## **2. Realistic driving forces behind primary Chinese Teachers’ role transformation in the AI era**

### **2.1. Technology-driven role restructuring**

Technological evolution has always served as the fundamental driving force behind changes in teachers’ roles, continuously reshaping their authority over knowledge. In the AI era, emerging digital technologies represented by generative artificial intelligence have rapidly penetrated education. Such tools can handle massive routine work, including standardized knowledge explanation and homework grading, liberate teachers from repetitive labor, and allow them to devote core energy to areas beyond AI’s reach: emotional bonding, higher-order thinking stimulation, and ethical supervision. This technology-forced mechanism renders the shift of teachers’ functions from “knowledge transmission” to “educational construction” an inevitable trend.

The application of AI in Chinese teaching has transcended simple technical tools and become a core engine for personalized learning and improved teaching efficiency. In listening, speaking, reading, and writing sessions of primary Chinese courses, AI realizes visualized learning situation assessment via intelligent diagnosis systems, expands thinking training materials through resource platforms, and reconstructs learning loops with instant feedback mechanisms. However, general language models are often deemed “black boxes” due to opaque algorithmic mechanisms. Their generation logic and decision-making basis cannot be traced or interpreted. If teachers fail to understand AI’s reasoning rules, they cannot conduct professional judgment and pedagogical adaptation of generated content, and human-machine collaboration will remain superficial <sup>[2]</sup>.

### **2.2. Value return to the essence of education**

Although AI holds absolute advantages in knowledge storage and retrieval, education is essentially a process of guiding people toward goodness and cultivating humanity with culture. Education carries warmth: teachers

can deliver positive attention, empathy, and sincere attitudes through interaction, an emotional resonance cold algorithms can never replicate. Technology can simulate emotional expressions, yet it cannot replace teachers' humanistic care, spiritual enlightenment, and personality influence, which serves as the fundamental basis for teachers' role transformation <sup>[3]</sup>.

AI-enabled Chinese teaching faces two major limitations: first, generative mechanisms are untraceable and uninterpretable, leading fragmented generated content and superficial learning that cannot support systematic knowledge and in-depth meaning construction required for high-quality disciplinary education; second, large language models mostly focus on efficiency improvement, lacking in-depth attention to individual life experience, emotional worlds and meaning demands, making it difficult to fully realize the humanistic mission of Chinese education to cultivate people with culture and nurture hearts through emotions. Hence, the key path for AI-enabled Chinese teaching shall shift from isolated tool application to full-link empowerment and realize closed-loop design integrating teaching, learning and assessment.

### **2.3. Pressure brought by practical dilemmas**

The extensive application of AI technology in teaching has created new predicaments. We must guard against the misconception of “data supremacy” brought by technological empowerment. When algorithmic evaluation squeezes the space for emotional resonance and massive resources overshadow core teaching objectives, affective education falls into new difficulties. This problem is particularly prominent in upper-grade Chinese teaching in rural primary schools, where supporting multimedia facilities and extracurricular reading materials are insufficient, and teaching staff have uneven proficiency with limited diversified teaching methods to satisfy students' diverse learning demands. Meanwhile, rapid information technology reform reshapes the educational ecosystem. How to leverage new technologies to boost Chinese teaching efficiency while preserving the warmth of affective education has become an urgent research topic.

## **3. Unique value of affective education for Chinese teachers**

### **3.1. Humanistic attribute of Chinese discipline**

While embracing the revolution brought by artificial intelligence, Chinese education faces contradictory tensions between technological rationality and humanistic values <sup>[3]</sup>. Chinese courses shoulder dual missions of cultural inheritance and affective cultivation. Poems, prose, and classical Chinese texts selected for primary Chinese textbooks are classic works with elegant language and profound meanings, containing sophisticated emotions and the essence of national culture. The new curriculum standards explicitly require teachers to guide students to recite excellent poems, experience rhythmic beauty, perceive linguistic charm, and receive emotional nurturing to elevate aesthetic literacy.

Classical Chinese poetry, a vivid carrier of fine traditional Chinese culture, carries the nation's spiritual codes and aesthetic genes, and serves as the core medium to cultivate students' cultural confidence and aesthetic creativity. Nevertheless, in practical teaching, teachers often encounter barriers in transmitting cultural connotations: students struggle to truly perceive historical scenes and imagery metaphors embedded in poems <sup>[4]</sup>. This demands that teachers exert the leading role of affective education and build deep emotional connections between students and texts through embodied teaching interactions.

### 3.2. Educational functions of affective education

Cultivating students' self-confidence constitutes not merely an educational goal, but also a key component of national talent strategies. Chinese teaching constructs an ecosystem for students' emotional growth through three pathways: cognitive reconstruction, emotional immersion and social interaction. In the implementation of interdisciplinary learning task groups, teachers can effectively strengthen students' emotional resonance by creating authentic interactive scenarios, and reinforce critical thinking and teamwork via group cooperative learning <sup>[5]</sup>.

Under the new collaborative model of AI and human teachers, instructors assume triple identities: learning designers, human-machine collaborators, and emotional caregivers. As emotional caregivers, teachers' emotional bonds with students become increasingly precious amid pervasive digital technologies. Bombarded by AI-generated massive content, students tend to suffer cognitive confusion, value perplexity, and psychological anxiety. Teachers need to sensitively capture students' emotional states and provide spiritual support and value guidance via embodied communication.

### 3.3. Irreplaceability of teacher-student emotional bonds

Technological advancement can never substitute teachers' educational functions. Education is more than knowledge transmission; it involves spiritual enlightenment, emotional resonance, and value shaping. AI can efficiently complete knowledge instruction and skill training, yet it cannot comprehend students' emotional demands, respond to psychological expectations, or guide personality growth the way teachers do. Beyond knowledge, teachers transmit respect for life, yearning for beauty, and adherence to values during interactions—the core humanistic warmth of education.

In the dual-teaching model combining AI and human instructors, human and AI teachers cooperate across pre-class stratified preview, in-class situational interaction, and after-school personalized reading. However, AI always plays an auxiliary role, and human teachers bear the core responsibility for affective education. Conversational AI functions not only as teaching tools but also as emerging educational participants that jointly build interactive learning environments with students and teachers; even so, such digital interaction can never replace genuine face-to-face emotional communication between teachers and students.

## 4. Dilemmas of affective education in AI-enabled teaching

### 4.1. Algorithmic evaluation compresses the space for emotional resonance

Although AI technology makes primary Chinese teaching more personalized and intelligent, it also risks marginalizing affective education. Intelligent diagnosis systems visualize learning conditions via data tracking, yet such digitized evaluation fails to capture students' inner emotional states, aesthetic experience, and value recognition <sup>[6]</sup>. Taking the classroom teaching of *Borrowing Arrows with Straw Boats* as an example, AI tracking can generate full-dimensional visualized data reports covering teaching duration, emotional indicators, and sight trajectories, yet digitized emotional metrics often obscure the real effects of affective education.

When educational evaluation over-relies on algorithms, intangible educational elements including teachers' emotional investment and students' emotional experience tend to be overlooked, compressing emotional resonance and risking the loss of humanistic warmth in Chinese teaching. AI teaching evaluation



must adhere to the philosophy that technology serves humans and prevent education from becoming dehumanized due to excessive data quantification <sup>[7]</sup>.

## **4.2. Technological over-dependence weakens teachers' affective competence**

Widespread adoption of AI in teaching may boost efficiency while eroding teachers' affective education capabilities. Excessive reliance on AI for learning analysis, resource delivery, and feedback may impair teachers' direct observation and emotional judgment of students. Educators must guard against the "data supremacy" misconception brought by technological empowerment; when algorithmic evaluation crowds out emotional communication and massive resources overshadow core teaching objectives, affective cultivation falls into predicaments <sup>[8]</sup>.

This issue stands out more prominently in rural primary Chinese teaching. Restricted by inadequate teaching resources and uneven teacher quality, rural instructors are more prone to technological dependence, while affective education demands extensive face-to-face communication and guidance. In oral reading teaching aided by AI speech assessment, although subjective evaluation ambiguity is resolved, the technology suffers from poor adaptive performance and immature human-machine coordination frameworks. Teachers shall construct a three-in-one teaching mode covering pre-guidance, in-class assistance, and extended learning to organically integrate AI tools into the whole process of affective education <sup>[29]</sup>.

## **4.3. Risks of weakened emotional bonds in human-machine collaboration**

If AI undertakes excessive interactive functions during collaborative teaching, direct communication between teachers and students may decrease, leading to diluted emotional connections. Explorations of the AI dual-teaching model confirm that the involvement of AI improves reading teaching accuracy and efficiency, yet balancing efficiency with educational warmth remains an unresolved challenge <sup>[10]</sup>.

Conversational AI builds personalized learning environments for students, which bring convenience yet may weaken genuine teacher-student emotional exchanges <sup>[11]</sup>. AI penetrates all educational sectors at an unprecedented pace, but technology shall only serve education as a tool rather than replace its humanistic functions. Explorations of interdisciplinary Chinese teaching empowered by AI prove that technological integration can innovate educational models and elevate students' information literacy and creativity, yet affective education shall never be overshadowed by technology <sup>[12]</sup>.

# **5. Practical paths to restructure primary Chinese teachers' affective education roles**

## **5.1. Concept renewal: Establish identity as an emotional interactor**

Primary Chinese teachers shall strengthen awareness as emotional interactants and realize the transformation from "knowledge authorities" to "emotional interactors" <sup>[13]</sup>. This shift demands prioritizing affective education at the conceptual level, regarding value guidance and emotional immersion as irreplaceable pedagogical missions. The primary task of role reshaping in the AI era is to clarify the relationship between technological tools and educational goals: technology is a means, education is the objective, and affective education constitutes an inalienable core duty of Chinese teachers.

The *Chinese Curriculum Standards for Compulsory Education (2022 Edition)* sets clear requirements for teachers to fully leverage modern information technology, which does not mean surrendering leadership



over affective education <sup>[14]</sup>. On the contrary, teachers shall more consciously assume affective educational responsibilities empowered by AI, utilizing digital tools to expand emotional teaching channels and enrich instructional methods instead of allowing technology to take over affective education.

## **5.2. Competency restructuring: Boost affective education capacity in human-machine collaborative scenarios**

Primary Chinese teachers' competency framework shall evolve from single teaching proficiency to comprehensive educational literacy covering three dimensions: first, technological application skills to operate intelligent teaching tools and design personalized lessons via AI learning diagnosis; second, affective education capacity to sensitively perceive students' emotions and deliver spiritual support and value guidance through embodied communication in human-machine collaborative classrooms; third, ethical judgment ability to audit and correct biases in AI-generated content, uphold teachers' dominant status and guard against algorithmic discrimination and data abuse risks <sup>[15]</sup>.

In oral reading teaching supported by AI speech evaluation, the three-in-one mode of pre-guidance, in-class assistance, and extended learning is advocated to organically integrate AI assessment into reading instruction <sup>[16]</sup>. This framework provides replicable experience for teachers to enhance affective education in human-machine collaboration: AI activates learning interest in pre-class guidance and delivers precise tutoring during class, while teachers always dominate core affective links in extended learning sessions.

## **5.3. Technological collaboration: Build a coexistent human-machine teaching ecosystem**

To construct a harmonious human-machine teaching ecosystem, clear division and coordination between AI and human teachers in affective education must be defined. AI can serve as a tool to build immersive learning scenarios and deliver precise learning data for teachers, as well as satisfy differentiated learning demands via personalized resources. Nevertheless, core affective educational tasks including value guidance, emotional immersion, and personality shaping must be undertaken by human instructors <sup>[17]</sup>.

In classical poetry teaching, AI's unique strengths in scenario construction, precise diagnosis, and resource integration provide new approaches to resolve barriers in cultural connotation transmission. AI is not merely an additional tool; it reconstructs cultural presentation scenes and reshapes emotional communication between teachers and students, optimizing personalized evaluation feedback and elevating poetry teaching beyond superficial knowledge memorization to in-depth cultural immersion <sup>[18]</sup>. During this process, teachers' affective education roles are reinforced rather than weakened, as they are liberated from mechanical knowledge explanation and can devote more energy to guiding students to perceive poetic emotions and comprehend poets' inner worlds.

## **5.4. Evaluation reform: Establish an affective education-oriented assessment system**

AI educational evaluation refers to the scientific quantification and judgment of educational activity values through digital tracking, which constitutes a rational research and monitoring tool for educational reform <sup>[19]</sup>. However, outcomes of affective education cannot be fully digitized, requiring retention of teachers' subjective professional judgment alongside AI assessment. AI teaching evaluation shall incorporate five dimensions of pedagogical reflection: goal achievement, student participation, teaching appropriateness, emotional warmth and developmental potential <sup>[20]</sup>.

Building an affective education-oriented assessment system requires integrating students' emotional experience, value recognition and aesthetic literacy into evaluation criteria, while respecting the long-term, implicit and individualized nature of affective cultivation. Evaluation reform shall guide teachers to prioritize students' emotional development in Chinese learning rather than merely measuring knowledge mastery and skill proficiency.

## 6. Conclusion

Restructuring primary Chinese teachers' affective education roles in the AI era represents both an inevitable transformation driven by technology and a value return to the essence of education. This paper systematically sorts relevant research from four dimensions: realistic driving forces behind role transformation, unique value of affective education, emotional dilemmas in AI-enabled teaching, and practical reconstruction paths. The study confirms that Chinese teachers' affective education role is irreplaceable, with core strengths in emotional immersion, value guidance, and meaning construction. Yet human-machine collaborative teaching creates realistic challenges such as algorithmic compression of emotional space, technological over-dependence eroding teachers' proficiency, and diluted teacher-student emotional bonds.

Deep integration of AI and Chinese teaching shall never come at the cost of affective education. On the contrary, technological advancement shall liberate teachers from repetitive labor and free up time for irreplaceable affective education work. The essence of restructuring teachers' roles in the AI era is not greater technical proficiency, but a more humanized return to educational missions. Only by striking a balance between technological empowerment and humanistic adherence, and utilizing human-machine collaboration to deepen rather than alienate affective education, can Chinese teaching fully realize its mission of cultivating people with culture and nurturing hearts through emotions.

## Disclosure statement

The author declares no conflict of interest.

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# Research on Practical Paths for Cultivating Innovation and Entrepreneurship Competence of Postgraduates Majoring in Ballroom Dance in the New Era

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**Abstract:** Driven by the policy initiative of “Mass Entrepreneurship and Mass Innovation” and the connotative development of postgraduate education in the new era, cultivating innovation and entrepreneurship competence of postgraduates majoring in ballroom dance has become a key reform issue in higher physical education. Based on the teaching reform practices of postgraduate education at Wuhan Sports University, this paper systematically sorts out domestic and foreign research literature on innovation and entrepreneurship education for ballroom dance majors. It reviews research progress from multiple dimensions, including the connotation of innovation and entrepreneurship competence, talent demand characteristics of the ballroom dance industry, practical dilemmas facing current education, and corresponding cultivation paths. The study reveals that a systematic training model integrating curriculum reform, social practice, and industry-university-research collaboration should be constructed to cultivate qualified ballroom dance postgraduates with innovation and entrepreneurship competence. On this basis, this paper proposes a four-in-one practical training path of “Curriculum Empowerment — Practical Tempering — Industry-Education Integration — Platform Support”, which provides theoretical references for deepening the reform of innovation and entrepreneurship education for ballroom dance postgraduates in the new era.

**Keywords:** Ballroom dance; Postgraduate education; Innovation and entrepreneurship competence; Training model; Practical path

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## 1. Introduction

Currently, academic circles hold diverse viewpoints regarding the cultivation of innovation and entrepreneurship competence for ballroom dance postgraduates. Extensive discussions have been carried out covering talent training models, the construction of innovation and entrepreneurship education systems,

and the exploration of practical paths, yielding abundant important theoretical achievements. At present, research on innovation and entrepreneurship competence cultivation for ballroom dance students has become a research hotspot in higher physical education. Foreign research on relevant topics mainly focuses on the correlation mechanism between innovation and entrepreneurship education and social and economic development. In contrast, domestic research mostly adopts localized research paths guided by policy, with curriculum reform as the starting point and social practice as the carrier.

Since Premier Li Keqiang put forward the slogan of “Mass Entrepreneurship and Mass Innovation”, a growing number of universities have stepped up efforts in innovation and entrepreneurship education in response to the initiative. Against the backdrop of the new era and rising employment pressure, strengthening the cultivation of postgraduates’ innovation and entrepreneurship competence bears great significance. In October 2021, the General Office of the State Council issued the *Guiding Opinions on Promoting Innovation and Entrepreneurship among College Students*, putting forward three clear requirements: integrating innovation and entrepreneurship education into the whole process of talent training, improving teachers’ teaching competence in this field, and strengthening special training for college students <sup>[1]</sup>. As an integral part of contemporary literary and artistic undertakings, ballroom dance plays a vital role in enriching people’s spiritual and cultural life. The President of the CPC attaches great importance to the sound development of literary and artistic work, ushering China into a prosperous period of cultural renaissance.

China’s economic development has entered a new normal, accompanied by growing uncertainties in employment, shrinking overall market demand, and more prominent structural employment contradictions. Graduates majoring in ballroom dance also face a grim job market. Postgraduate education sits at the top of the national education system and serves as a critical channel for cultivating high-level talents. While postgraduate enrollment has expanded continuously in the new era, new standards have been raised for training quality. The *Regulations of the People’s Republic of China on Academic Degrees* clearly stipulate that master’s degree holders shall possess “the ability to conduct scientific research or independently undertake specialized technical work.” Nevertheless, research on innovation and entrepreneurship competence cultivation at the postgraduate level remains in the exploratory stage, making it particularly urgent to explore effective training paths for ballroom dance postgraduates under the new-era context.

## **2 Connotation of innovation and entrepreneurship competence and era requirements for postgraduate training**

### **2.1. Theoretical definition of innovation and entrepreneurship competence**

Innovation and entrepreneurship constitute a multi-dimensional composite concept. According to the *Modern Chinese Dictionary*, “innovation” means abandoning the old and creating the new, incorporating both renovation and creation. Economist Joseph A. Schumpeter proposed in *The Theory of Economic Development* (1912) that innovation refers to introducing a new combination of production factors into the production system. Entrepreneurship is a process of discovering and seizing opportunities, through which entrepreneurs create new products and realize their potential value. The widely recognized definition of entrepreneurship in academia was put forward by Stevenson: “Entrepreneurship is the process of pursuing and capturing opportunities regardless of the resources currently under one’s control, whether as an individual or within an organization.”



Innovation and entrepreneurship competence is a multi-layered, complex concept. Up to now, academia has not reached a unified consensus on its connotation; scholars define the concept from different perspectives according to research needs. Innovation and entrepreneurship bear a dialectical relationship analogous to that between theory and practice. Innovation lays the foundation for entrepreneurship, and the effects of innovation can only be tested through entrepreneurial practice. Entrepreneurship acts as the medium and manifestation of innovation, with innovative development serving as the fundamental pillar of entrepreneurial activities. The two promote and restrict each other, forming an inseparable dialectical unity.

## **2.2. Uniqueness and era requirements of ballroom dance postgraduate training**

Compared with undergraduates, postgraduate education signifies not only an upgrade of academic credentials but also the cultivation of high-level talents capable of independently undertaking specialized technical work. As interdisciplinary high-level talents spanning sports and arts, ballroom dance postgraduates require solid professional dance skills as well as systematic teaching ability and innovative entrepreneurial literacy <sup>[2]</sup>.

Integrating fitness, entertainment, and social interaction, ballroom dance has gained widespread popularity in recent years. Incomplete statistics show that over 30 million people in China participate in ballroom dance activities, with dance training institutions mushrooming across the country. This industrial trend raises higher standards for postgraduates' innovation and entrepreneurship competence: they are expected to be not only dance instructors in the future but also founders, operators and managers of training institutions.

Job demands in the ballroom dance industry are diversified, including dance teachers, institutional founders/operators/managers, project planners, professional agents, marketing specialists, copywriters, music producers, sound engineers, product sales staff, media producers and promoters, makeup artists, costume designers, photographers, stage lighting designers, and program hosts. Such diverse career prospects provide broad space for postgraduates' innovation and entrepreneurship while imposing higher requirements on their comprehensive abilities.

## **3. Current dilemmas in cultivating innovation and entrepreneurship competence for ballroom dance postgraduates**

### **3.1. Imperfect curriculum system for innovation and entrepreneurship**

Insufficient offering of relevant courses stands as the primary factor restricting competence cultivation. Relevant research shows that students majoring in ballroom dance at Hubei University of Arts and Science generally lag in innovation and entrepreneurship competence, partly due to inadequate curriculum provision. Although the Ministry of Education required universities to set up dedicated innovation and entrepreneurship courses starting in 2016, the implementation effect for ballroom dance majors remains unsatisfactory.

Current innovation and entrepreneurship education for ballroom dance majors tends to prioritize theory over practice. Most universities have not fully broken away from traditional teaching frameworks, resulting in talent output that fails to keep pace with industrial restructuring and market demand changes <sup>[3]</sup>. At the postgraduate level, targeted curriculum design for entrepreneurship training is lacking, failing to balance academic and vocational attributes of postgraduate education. Students receive theoretical lectures on campus yet lack systematic practical training, making it hard to translate theoretical knowledge into real entrepreneurial capacity.

### 3.2. Shortage of social practice platforms and opportunities

Extracurricular social practice serves as a vital channel for fostering students' innovation and entrepreneurship competence, yet multiple problems exist for ballroom dance majors: first, insufficient student awareness of off-campus practice; second, limited innovation in the content and forms of dance-related practice activities; third, scarce competition practice opportunities; fourth, weak foundational expertise and insufficient professional skills.

In most postgraduate training schemes, social practice is limited to teaching internships, lacking comprehensive entrepreneurial activities such as startup simulation and project operation. Students cannot experience a complete entrepreneurial cycle during practice, leading to fragmented entrepreneurial cognition. While some universities have explored student assistant systems, their role in boosting entrepreneurship competence remains underdeveloped. Training should combine on-campus and off-campus approaches: on campus, reforms in curriculum and training modes should be carried out; off-campus training should be guided by market demand, with targeted cultivation based on industry job characteristics.

### 3.3. Lagging construction of teaching staff

Improving teachers' innovation and entrepreneurship teaching competence is explicitly required by the *Guiding Opinions on Promoting Innovation and Entrepreneurship among College Students*. Nevertheless, most ballroom dance programs face a shortage of qualified instructors in this field. Many teachers lack firsthand entrepreneurial experience and cannot deliver targeted entrepreneurial guidance. Meanwhile, the teacher training system for innovation and entrepreneurship education is incomplete, leaving educators' teaching capacity to be improved.

Drawing on the successful experience of entrepreneurship education at Stanford University, U.S., universities should establish systematic optimization mechanisms, including improved teacher training systems, recruitment of industrial entrepreneurial mentors, and strengthened industry-university-research cooperation <sup>[4]</sup>. Building a workforce of dual-qualified teachers with both theoretical literacy and practical experience is the key to upgrading postgraduate entrepreneurship education quality.

### 3.4. Disconnection between curriculum content and market demand

With the rapid expansion of the ballroom dance training industry, a large proportion of ballroom dance graduates choose to work as institutional teachers or launch their own training startups after graduation. However, university curricula lag behind market changes, making it difficult for graduates to fully apply professional knowledge in real teaching scenarios <sup>[5]</sup>. The mismatch between courses and market needs extends graduates' adaptation period after graduation and lowers their entrepreneurial success rate and employment quality.

Current postgraduate curricula still focus on traditional dance skill training, lacking systematic design of entrepreneurship-related modules. Expanding postgraduate enrollment has raised higher standards for training quality, making it an urgent task to optimize training models and raise entrepreneurial success rates <sup>[6]</sup>.

## **4. Practical paths for cultivating innovation and entrepreneurship competence of ballroom dance postgraduates**

### **4.1. Curriculum empowerment: Build an integrated curriculum system of major and entrepreneurship**

Reforming talent training programs oriented toward innovation and entrepreneurship has become a core research topic. The ballroom dance postgraduate curriculum system should consist of three modules: general innovation and entrepreneurship courses, interdisciplinary integrated courses, and entrepreneurial simulation training courses. General courses cultivate innovative thinking and entrepreneurial awareness; interdisciplinary modules break disciplinary barriers; simulation courses deliver hands-on entrepreneurial experience.

Innovation and entrepreneurship education should run through all stages of postgraduate training schemes. By embedding entrepreneurial cases and thinking training into professional courses, students can develop entrepreneurial awareness while mastering dance expertise. Interdisciplinary entrepreneurship curricula should be constructed to upgrade classroom teaching and consolidate teaching infrastructure and reform initiatives <sup>[7]</sup>. This research focuses on four dimensions of “cultivation”: first, establish diversified competence training systems; second, perfect screening and training mechanisms for outstanding students; third, create a favorable entrepreneurial training environment; fourth, summarize and integrate proven entrepreneurial practices <sup>[8]</sup>.

### **4.2. Practical tempering: Build diversified social practice platforms**

To address insufficient innovation in practice content and forms, a hierarchical, progressive practice system should be designed, covering curriculum observation, teaching internships, entrepreneurial incubation, competition organization, and simulated startup operations, with practice depth gradually increased. Postgraduates can deepen industrial cognition and accumulate entrepreneurial experience by participating in institutional operation and management.

Ballroom dance postgraduates face diversified career options including teachers, institutional founders, operators, project planners, and marketing specialists. Universities should design differentiated practice programs tailored to various job profiles to boost targeted entrepreneurship competence. Training should integrate on-campus and off-campus resources: internal reforms in curricula and training modes lay the groundwork, while external practice should be market-driven with targeted training based on industry job characteristics <sup>[9]</sup>.

### **4.3. Industry-education integration: Deepen collaborative talent training mechanisms**

Industry-education integration serves as a critical solution to the disconnection between university training and market demands. Universities should establish long-term cooperative ties with ballroom dance training institutions and cultural enterprises, integrating real industrial demands into talent training. Off-campus innovation and entrepreneurship practice bases can be built to provide authentic entrepreneurial experience for postgraduates <sup>[10]</sup>. Through industry-university cooperation, enterprises can supply cutting-edge industrial information, entrepreneurial resources, and employment opportunities for students.

Universities should conduct regular industry surveys to track development trends and talent demands, adjusting teaching content and methods accordingly. Since most ballroom dance graduates intend to launch training institutions independently, targeted courses on institutional operation and management should be

offered. This research adopts a dual training model combining campus and off-campus practice, closely aligned with social needs, to conduct in-depth research on training paths and consolidate theoretical and practical outcomes <sup>[11]</sup>.

#### **4.4. Platform support: Improve comprehensive guarantee systems for innovation and entrepreneurship**

Sound support systems form solid backing for postgraduate entrepreneurship training. Universities should provide multi-dimensional support covering policy, capital and tutoring: set up special entrepreneurship funds to offer startup seed money; build incubation bases with complete venues and facilities; establish mentor systems to deliver professional entrepreneurial guidance.

In terms of faculty guarantee, efforts should be intensified to build entrepreneurship teaching teams consisting of on-campus instructors and industrial mentors with practical startup experience. In evaluation mechanisms, innovation and entrepreneurship performance should be incorporated into postgraduate training quality assessment systems, with incentives and honors awarded to outstanding individuals and teams.

The research data of this project are collected from Wanfang Data, CNKI, Wuhan Sports University Library, National Library, and social surveys. Each sub-project is assigned a clear completion deadline, with regular group seminars held to resolve research obstacles and ensure high-quality delivery on schedule <sup>[12]</sup>.

### **5. Research prospects and expected practical outcomes**

Through systematic theoretical analysis and practical exploration, this project intends to define sub-research topics on postgraduate entrepreneurship training and reveal their internal logical relations, analyzing their practical value. The research is expected to deliver systematic theoretical frameworks and operable practical schemes for cultivating ballroom dance postgraduates' innovation and entrepreneurship competence.

This research carries distinct innovative value. Existing studies on innovation and entrepreneurship mostly target undergraduate and junior college students, while research at the postgraduate level remains scarce. Previous literature focuses mostly on status analysis and superficial countermeasures without forming integrated systematic frameworks or actionable practical outputs. This project comprehensively explores multi-dimensional training paths and reveals interrelations among training elements to upgrade research depth in this field <sup>[13]</sup>.

Research methods adopted include a literature review to sort national policy documents and prior studies for theoretical foundation; the Delphi method to identify core training indicators; and the Analytic Hierarchy Process to quantify weights of subtopics and expose internal logical links among all system elements.

Expected research outputs include the *Survey Report on Career Demands of Ballroom Dance Postgraduates in the New Era* and *Practical Research on Cultivating Innovation and Entrepreneurship Competence of Ballroom Dance Postgraduates in the New Era*, offering theoretical and practical references for relevant education reforms <sup>[14]</sup>.

### **6. Conclusion**

Cultivating innovation and entrepreneurship competence for ballroom dance postgraduates in the new era constitutes a systematic project requiring coordinated progress across curriculum reform, social practice

expansion, industry-education integration and comprehensive support systems. This paper systematically sorts relevant domestic and foreign literature, reviewing research from the connotation of competence, industrial talent demands, existing dilemmas, and training paths. The study identifies four major bottlenecks: imperfect entrepreneurship curricula, insufficient practical platforms, weak teaching staff, and disconnection between courses and market demands <sup>[15]</sup>.

Combined with postgraduate teaching reform practices at Wuhan Sports University, this paper proposes the four-in-one training path of “Curriculum Empowerment — Practical Tempering — Industry-Education Integration — Platform Support.” Centered on embedding entrepreneurship education into full-cycle talent training, the model takes curriculum reform as the foundation, social practice as support, industry-university-research collaboration as guarantee, and comprehensive service systems as backup to build a systematic training framework through multi-dimensional coordination.

From an innovative and entrepreneurial perspective, the ballroom dance industry will witness expanding employment space with abundant opportunities alongside challenges. Innovative competence serves as the prerequisite, while entrepreneurial capacity forms the fundamental goal. Only with solid innovative thinking can graduates gain employment advantages and seize market opportunities to realize personal growth and a promising future. Universities should seize new-era opportunities to deepen entrepreneurship education reform and cultivate high-level ballroom dance talents with innovative spirit, entrepreneurial capacity, and global vision, providing talent support for high-quality development of ballroom dance and prosperity of socialist culture <sup>[16]</sup>.

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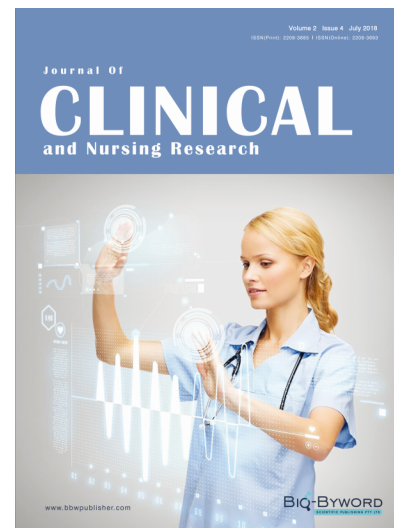
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