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An Online Survey of Science Educators' Challenges of Implementing Digital Pedagogy in Public Universities in Kogi State, Nigeria

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Abstract

This study explored an online survey of science educators' challenges of implementing digital pedagogy in public universities in Kogi State, Nigeria. The population of this study consists of 52 science educators in the four public universities in Kogi State, Nigeria. There was no sampling since the population was manageable. The study adopted a descriptive survey research design. An online google form survey questionnaire titled Challenges of Implementing Digital Pedagogy Questionnaire (CIDPQ) was the instrument used for data collection. CIDPQ was trial tested which yielded a reliability value of 0.88 using Cronbach Alpha. The CIDPQ contained 22-items. Two research questions and two null hypotheses guided the study. The research questions were answered using mean and standard deviation scores while the null hypotheses were tested at 0.05 level of significance using t-test statistics. The study revealed that there is no significant difference between the mean ratings of male and female science educators on challenges of implementing digital pedagogy ($t=1.89$, $df=50$, $P>0.05$). There was no significant difference between the mean ratings of male and female science educators on measures that could address the challenges of implementing digital pedagogy ($t=1.76$, $df=50$, $P>0.05$). Thus, there is need for universities administrators and other relevant educational stakeholders to provide sufficient and accessible ICT resources and provide continuous professional development on how to effectively implement digital pedagogy.

Keywords: science educators, digital pedagogy and public universities

1. Introduction

In the age of digital transformation, education is at a historic crossroads. The concept of digital pedagogy is no longer a mere trend but has become a fundamental necessity for modern education systems. Though, digital pedagogy doesn't supersede fundamental educational merits but rather boost and modernize them, standardizing teaching methods with the realities of the digital age and meeting the needs for "digital native" generations. Digital pedagogy completely redefines the teaching and

learning, assessment practices, integrating digital not only as an auxiliary tool, but as central elements of a new educational philosophy. In other words, digital pedagogy is an emerging philosophy of teaching which combines the carefully curated use of technology with evidence-based strategies to achieve excellence in learning and teaching. The transformation from traditional methods to digital pedagogy marks a revolution that transcends the mere use of technology, aiming at a profound transformation in the way we think about learning and skills development in the 21st century (Vaataja & Ruokamo, 2021).

Technology has influenced a lot on learning and resulted in the development of digital pedagogy, which has become a vital part of today's world. Digital pedagogy encompasses the integration and utilization of technology to improve and enrich the learning experience. It is the thoughtful integration of digital tools, environments and strategies into teaching and learning process for effective instructional delivery (Waddell & Clariza, 2018). It may be applied to online, hybrid, and face-to-face learning (Tapscott, 2009). Digital pedagogy is the study of how digital technologies can be optimally used in teaching and learning (Joint Information System Committee, 2021). It can include the educational aspects of various digital applications and tools, virtual teaching and learning assistants and digital competences of teachers. Thus, science educators are required to be more creative and innovative in preparing students to face the challenges of 21st century through quality teaching and learning. Teaching and learning quality can be improved through digital pedagogy. Digital pedagogy is crucial due to the fact that it enhances personalized learning by tailoring instruction to meet individual students' unique needs and learning styles and it is also crucial for developing students with digital competencies needed for both academic success and future employability (Ajayi, Ameh, & Negedu, 2025).

Pedagogy is a teaching method, and it is adopted by a teacher, which involves teaching styles, theory, assessment and feedback. Teaching always involves the concept of design which includes planning course content, methods and modes of teaching. Digital pedagogy is the study of how to teach using digital technologies (Howell, 2013). Digital pedagogy focuses on the use of technology tools to breakdown learning barriers and enhance students' learning experiences. There are many digital pedagogy tools that facilitate activities such as interactive lessons, digital assessments, and collaborative lessons aiming to engage students and enhance their learning experience by integrating technology. The digital pedagogy tools encompass a wide range of software, hardware, and digital resources used to improve teaching and learning through technology, including learning management systems (LMS), interactive presentation tools (such as Prezi, Mentimeter, PowerPoint, Visme, Nearpod, Google slides and Pear Deck), collaborative platforms (Slack, Padlet, Mural, Miro, google workspace), content creation software (video editing, canvas, e-books) and immersive technologies such as augmented and virtual reality (AR/VR). Thus, implementing digital pedagogy brings substantial benefits for students, transforming their educational experience in multiple dimensions such as active engagement and personalized learning.

Implementing digital pedagogy requires aligning technological tools with student-centered, socio-constructivist strategies to learning to enhance engagement and skill development. Thus, science educators are expected to integrate technology into their lessons to foster digital literacy, create interactive, personalized learning paths and meaningful learning experiences. Ajayi, Ameh, and Alabi (2025) opine that science educators can leverage technology tools (such as online simulation, mini-videos and educational software) to enhance students learning. Thus, the importance of science educators' responsibilities in implementing digital pedagogy cannot be overstated. The researchers observed that science educators in public universities in Kogi State are making efforts in implementing digital pedagogy. However, despite these efforts of science educators to equip students with the quality education necessary to navigate and address global challenges effectively. Yet, there are a number of challenges that need to be addressed in order to realize fully the anticipated benefits of these efforts. Kane and Staiger (2017) found that teachers score lowest on complex teaching abilities such as using technology means to communicate with students about subject. A study by Chen (2018) revealed that some teachers lack the necessary abilities and competences to apply technology effectively in the learning process. Ajayi and Audu (2023) opines that the abrupt emergence of COVID-19 at the end of 2019,

the performance of teachers in providing quality education has been significantly diminished due to their inability to effectively implement digital pedagogy.

A study by Delgado (2022), revealed that teachers face a multitude of challenges when integrating technology to classroom learning in grade 3 class in Thailand, which include poor technical support, poor internet access, excessive work, and inadequate technology pedagogical knowledge. A study by Mokhele (2024) concluded that teachers' inability to develop and use technology-supported instructions, and inadequate staff development training hindered the implementation of smart technology in High Schools in South Africa. However, there is scarcity of studies on science educators' challenges of implementing digital pedagogy. Gender has to do with socially constructed differences which lead to forms of inequality (Penda, 2024). Gender is one of the factors that could influence science educator's ability to implement digital pedagogy. Differences in characteristics, attitudes, and abilities by male and female science educations could influence science educator's ability to implement digital pedagogy. Thus, the study explored an online survey of science educators' challenges of implementing digital pedagogy with respect to gender in public universities in Kogi State, Nigeria.

1.1 Purpose of the Study

The purpose of this study was on an online survey of science educators' challenges of implementing digital pedagogy in public universities in Kogi State, Nigeria. Specifically, the study:

1) ascertain the science educators' challenges of implementing digital pedagogy in public universities; and
2) determine the measures that could address the challenges of implementing digital pedagogy in public universities.

1.2 Research Questions

The following research questions guided this study:

1) What are the science educators' challenges of implementing digital pedagogy in public universities?
2) What are the measures that could address the challenges of implementing digital pedagogy in public universities?

1.3 Hypotheses

The following null hypotheses were tested:

1) There is no significance difference between the mean rating of male and female science educators on challenges of implementing digital pedagogy in public universities.
2) There is no significance difference between the mean rating of male and female science educators on measures that could address the challenges of implementing digital pedagogy in public universities.

2. Methodology

The study adopted a descriptive survey design. This design was adopted because it is a design in which a group of people or items are studied by collecting and analyzing data from only a few people or items considered to be representative of the entire group. The study area was of Kogi State, Nigeria. Kogi State is a state in the North Central region of Nigeria. The target population for this study comprises all the 52 science educators in the four public universities in Kogi State, Nigeria. The public universities are Prince Abubakar Audu University Anyigba (PAAU), Confluence University of Science and Technology Osara (CUSTECH), Kogi State University Kabba (KSU) and Federal University Lokoja (FUL). In this study, Science educators are lecturers or professional teachers who teaches science education subjects such as biology, chemistry, physics, integrated science, computer science, and mathematics in public universities in Kogi State, Nigeria. There was no sample size due to the fact that the population size involved was small and easily accessible, it was feasible to collect data from every science educator especially with the use of online google form survey questionnaire, making sampling unnecessary.

An online google form survey questionnaire titled Challenges of Implementing Digital Pedagogy Questionnaire (CIDPQ) was the instrument used for data collection. CIDPQ contained two sections. Section "A" contained demographic information of the respondents, while section "B" contained a 24-item questionnaire which is intended to help lecturers express their opinions on the challenges of implementing digital pedagogy and their opinions on measures that could address the challenges of implementing digital pedagogy. Each of the items is a 4-point Likert-rating scale with 4 response options. The options are Strongly

Agree (SA), Agree (A), Disagree (D), and Strongly Disagree (SD). CIDPQ is a 4 Likert scale with number indicators as 4 (Strongly Agree), 3 (Agree), 2 (Disagree) and 1(Strongly Disagree).

The online google form survey questionnaire was face validated by two experts in Science Education/Measurement and Evaluation in the department of Science Education, Prince Abubakar Audu University Anyigba and an expert in Science Education in the department of Science Education, Federal University Lokoja. The items were scrutinized by these expects. The instrument was review based on the experts' corrections and suggestions. The online google form survey questionnaire was trial-tested to establish the reliability coefficient which yielded 0.88 using Cronbach Alpha. Thus, online google form survey questionnaire was used for data collection. The online google form survey questionnaire was administered to respondents through email addresses/WhatsApp phone nos. by the researchers. A total of 52 copies of the online google form survey questionnaire was responded to by the science educators and the data collected were analysed. Mean and Standard deviation scores were used to answer the research questions, while the null hypotheses were tested at 0.05 level of significance using independent t-test. The online google form survey questionnaire were sorted by gender, and the differences in mean rating were obtained.

3. Results

Presentations in this section are based on research question and null hypotheses.

3.1 Research Question One

What are the science educators' challenges of implementing digital pedagogy in public universities? The answer to research question one is presented on Table 1 and Figure 1 respectively.

Table 1. Mean Rating of Science Educators' Challenges of Implementing Digital Pedagogy

S/N	Item(s)	Mean $\bar{x}$	Std.dev δ	Remark
1.	Inadequate access to technology tools and reliable internet is one of the challenges of implementing digital pedagogy.	3.83	0.31	Positive
2.	Incompetency of lecturers to use ICT tools is one of the challenges of implementing digital pedagogy.	3.17	0.19	Positive
3.	Insufficient exposure to professional training on how to effectively integrate technology into classroom teaching is one of the challenges of implementing digital pedagogy.	3.74	0.27	Positive
4.	Inadequate commitment to develop and use technology-supported instructions is one of the challenges of implementing digital pedagogy.	3.46	0.23	Positive
5.	Insufficient ICT unit technical support is one of the challenges of implementing digital pedagogy.	3.22	0.20	Positive
6.	Time constraints is one of the challenges of implementing digital pedagogy.	3.56	0.25	Positive
7.	Excessive workload is one of the challenges of implementing digital pedagogy.	3.41	0.21	Positive
8.	Inadequate laboratory equipment and other resources is one of the challenges of implementing digital pedagogy.	3.66	0.27	Positive
9.	Inadequate planning time to design digital pedagogy is one of the challenges of implementing digital pedagogy.	3.64	0.23	Positive
10.	Inadequate commitment to develop and use valid digital assessment practices is one of the challenges of implementing digital pedagogy.	3.44	0.21	Positive
11.	Inadequate of motivation (incentives) and irregular payment of salaries is one of the challenges of implementing digital pedagogy.	3.86	0.27	Positive

Total	38.99	2.64	
Cluster Mean & Std. Dev.	**3.54**	**0.24**	**Positive**

Source: Online Survey, 2025.

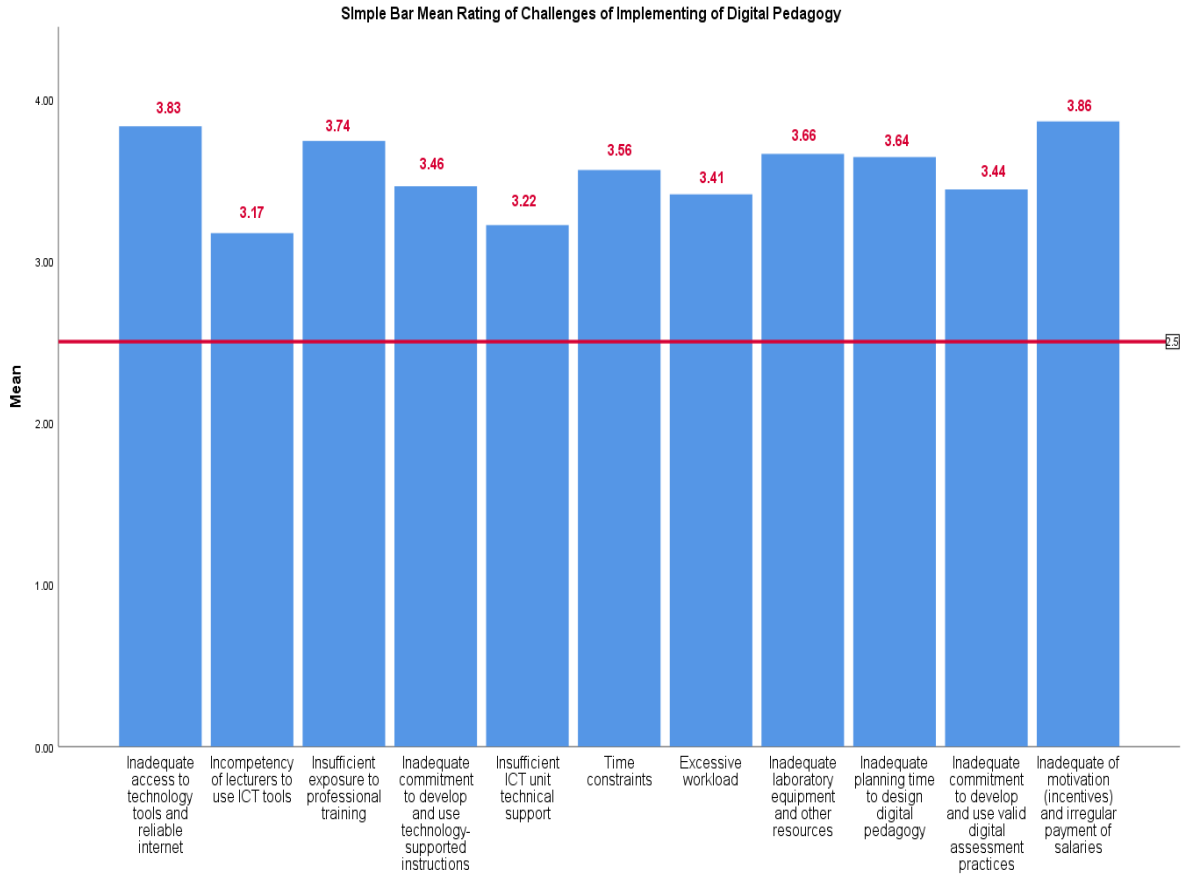

Figure 1. Bar Chart of Mean Rating of Science Educators' Challenges of Implementing Digital Pedagogy

The summary of the mean ratings of science educators' challenges of implementing digital pedagogy in public universities in Kogi State, Nigeria is represented in Figure 1. Figure shows that, the responses of science educators on all the eleven items on challenges of implementing digital pedagogy was above cut-off point of 2.50. The data in Table 1 show that, the responses of science educators on all the eleven items on challenges of implementing digital pedagogy were positive, giving a cluster mean responses of 3.54 which is positive. This implies that all the mentioned areas are the science educators' challenges of implementing digital pedagogy in public universities in Kogi State, Nigeria.

3.2 Research Question Two

What are the measures that could address the challenges of implementing digital pedagogy in public universities? The answer to research question two is presented on Table 2.

Table 2. Mean Rating of Measures that could address the Science Educators' Challenges of Implementing Digital Pedagogy

S/N	Item(s)	Mean x	Std.dev δ	Remark
1.	Adequate access to technology tools and reliable internet will address the challenges of implementing digital pedagogy	3.57	0.22	Positive

2.	High proficiency of lecturers on the use ICT tools will address the challenges of implementing digital pedagogy	3.79	0.31	Positive
3.	Continuous professional training on how to effectively integrate technology into classroom teaching will address the challenges of implementing digital pedagogy	3.81	0.34	Positive
4.	Adequate commitment to develop and use technology-supported instructions will address the challenges of implementing digital pedagogy	3.56	0.25	Positive
5.	Sufficient ICT unit technical support will address the challenges of implementing digital pedagogy	3.33	0.22	Positive
6.	Allocation of adequate lecture time will address the challenges of implementing digital pedagogy	3.45	0.29	Positive
7.	Encouraging universities administrators to adopt a maximum of 8-12 credit hours per week per semester workload as recommended by National Universities Commission (NUC) will address the challenges of implementing digital pedagogy	3.62	0.28	Positive
8.	Adequate provision of infrastructure and resources (laboratory equipment and technology tools) to support hands-on learning will address the challenges of implementing digital pedagogy	3.53	0.25	Positive
9.	Encouraging science educators to create time to design digital pedagogy will address the challenges of implementing digital pedagogy	3.41	0.23	Positive
10.	Adequate commitment to develop and use valid digital assessment practices will address the challenges of implementing digital pedagogy	3.43	0.23	Positive
11.	Provision of adequate motivation (incentives) and regular payment of salaries will address the challenges of implementing digital pedagogy	3.71	0.29	Positive
	Total	42.17	2.77	
	Cluster Mean & Std. Dev.	**3.51**	**0.23**	**Positive**

Source: Online Survey, 2025.

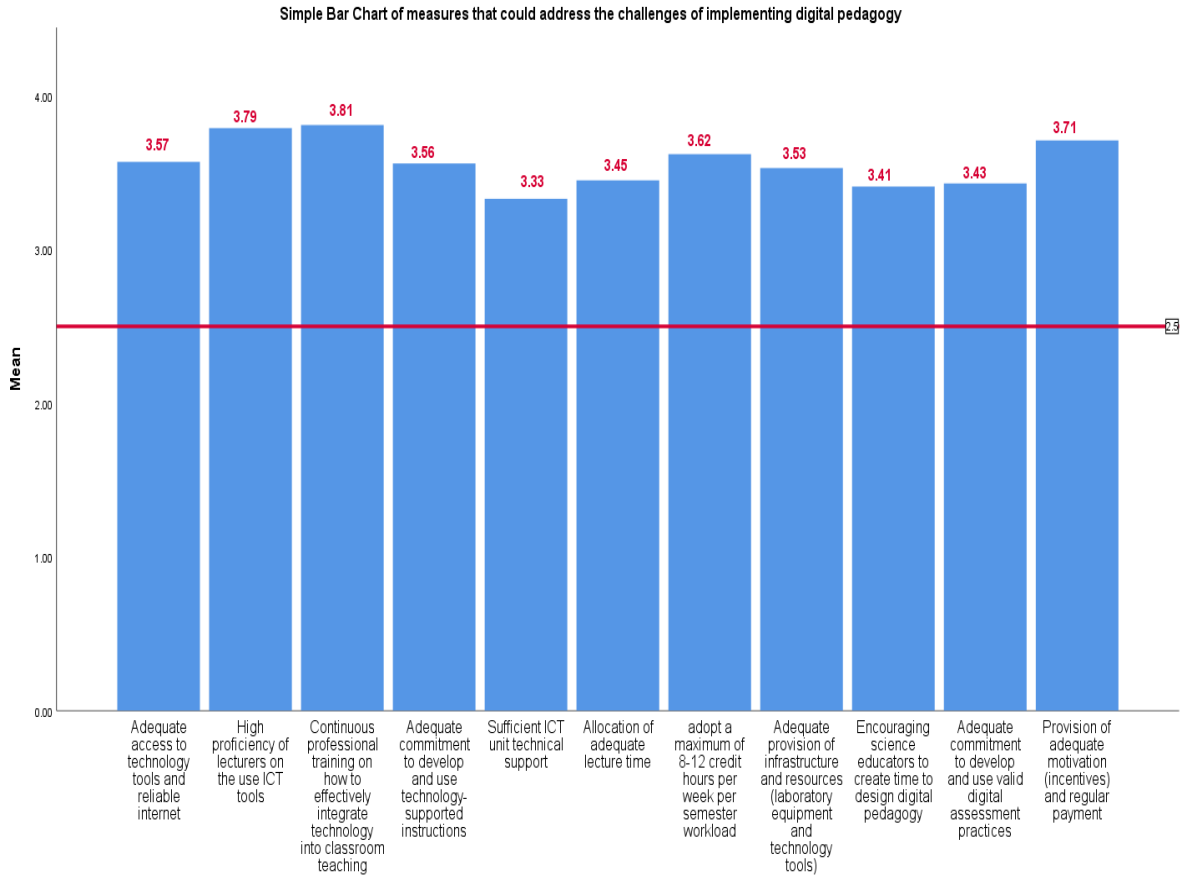

Figure 2. Bar Chart of Mean Rating of measures that could address the science educators' challenges of implementing digital pedagogy

The summary of the mean ratings of the measures that could address the science educators' challenges of implementing digital pedagogy in public universities in Kogi State, Nigeria is represented in Figure 2. Figure shows that, the responses of science educators on all the eleven items on the measures that could address the science educators' challenges of implementing digital pedagogy was above cut-off point of 2.50. The data in table 2 show that, the responses of science educators on all the eleven items on the measures that could address the science educators' challenges of implementing digital pedagogy were positive, giving a cluster mean responses of 3.54 which is positive. This implies that all the mentioned areas are measures that could address the science educators' challenges of implementing digital pedagogy in public universities in Kogi State.

Hypothesis One

There is no significance difference between the mean rating of male and female science educators on challenges of implementing digital pedagogy. The test for hypothesis one is presented on Table 3.

Table 3. t-test of Mean Rating of Male and Female Science educators on Challenges of Implementing Digital pedagogy

Sex	*N*	Mean x	Std.dev δ	*t*	*df*	*p-value*	*level of significant*	*decision*
Male	28	3.78	0.31					
				1.89	50	.223	0.05	NR
Female	24	3.71	0.29					

Source: Online Survey, 2025; NR= Not Rejected.

Table 3 presents the summary of t-test analysis of mean rating of male and female science educators on challenges of implementing digital pedagogy in public universities in Nigeria. The t-test result reveals that there is no significant difference between the mean ratings of male and female science educators on challenges of implementing digital pedagogy (t=1.89, df=50, P>0.05). The null hypothesis is therefore not rejected. This implies that there is no significance difference between the mean rating of male and female science educators on challenges of implementing digital pedagogy in public universities in Kogi State, Nigeria.

Hypothesis Two

There is no significance difference between the mean rating of male and female science educators on measures that could address the challenges of implementing digital pedagogy. The test for hypothesis two is presented on Table 4.

Table 4. t-test of Mean Rating of Male and Female Science educators on Measures that could address the Challenges of Implementing Digital pedagogy

Sex	*N*	Mean x	Std.dev δ	t	df	*p-value*	*level of significant*	*decision*
Male	28	3.82	0.30					
				1.76	50	.323	0.05	NR
Female	24	3.69	0.27					

Source: Online Survey, 2025; NR= Not Rejected.

Table 4 presents the summary of t-test analysis of mean rating of male and female science educators on measures that could address the challenges of implementing digital pedagogy in public universities in Nigeria. The t-test result reveals that there is no significant difference between the mean ratings of male and female science educators on measures that could address the challenges of implementing digital pedagogy (t=1.76, df=50, P>0.05). The null hypothesis is therefore not rejected. This implies that there is no significance difference between the mean rating of male and female science educators on measures that could address the challenges of implementing digital pedagogy in public universities in Kogi State, Nigeria.

4. Discussion of Findings

The study was on an online survey of science educators' challenges of implementing digital pedagogy in public universities in Kogi State, Nigeria. The finding revealed that, there is no significance difference between the mean rating of male and female science educators on challenges of implementing digital pedagogy. This implies that both male and female science educators' opinions on the challenges of implementing digital pedagogy are the same irrespective of gender. Thus, it was concluded that the science educators' challenges of implementing digital pedagogy are; Inadequate access to technology tools and reliable internet, Incompetency of lecturers to use ICT tools, insufficient exposure to professional training on how to effectively integrate technology into classroom teaching, inadequate commitment to develop and use technology-supported instructions, insufficient ICT unit technical support, time constraints, excessive workload, inadequate laboratory equipment and other resources, inadequate planning time to design digital pedagogy, inadequate commitment to develop and use valid digital assessment practices, and inadequate of motivation (incentives) and irregular payment of salaries. This finding agrees with Delgado (2022) who revealed that teachers face a multitude of challenges such as poor technical support, poor internet access, excessive work, and inadequate technology pedagogical knowledge when integrating technology to classroom learning in grade 3 class in Thailand. This finding also agrees with Mokhele (2024) who concluded that teachers' inability to develop and use technology-supported instructions, and inadequate staff development training hindered the implementation of smart technology in High Schools in South Africa. By implication, digital pedagogy brings in new opportunities and challenges for science educators while the traditional teaching method has been gradually losing and decreasing its lure.

The finding revealed that, there is no significance difference between the mean rating of male and

female science educators on measures that could address the challenges of implementing digital pedagogy in public universities in Kogi State, Nigeria. Thus, this implies that both male and female science educators' perceptions on the measures that could address the challenges of implementing digital pedagogy are the same irrespective of gender. Hence, it was concluded that adequate commitment to develop and use technology-supported instructions, high proficiency of lecturers on the use ICT tools, continuous professional training on how to effectively integrate technology into classroom teaching, adequate commitment to develop and use technology-supported instructions, sufficient ICT unit technical support, allocation of adequate lecture, encouraging universities administrators to adopt a maximum of 8-12 credit hours per week per semester workload as recommended by National Universities Commission (NUC), adequate provision of infrastructure and resources (laboratory equipment and technology tools) to support hands-on learning, encouraging science educators to create time to design digital pedagogy, adequate commitment to develop and use valid digital assessment practices, and provision of adequate motivation and regular payment of salaries are the measures that could address the challenges of implementing digital pedagogy in public universities in Kogi State, Nigeria.

5. Conclusion

It is evident from the findings of this study that no gender disparity exists in the perceptions of male and female science educators on the challenges of implementing digital pedagogy in public universities in Nigeria. This study has established that science educators' challenges of implementing digital pedagogy in public universities in Kogi State, Nigeria are inadequate access to technology tools and reliable internet, incompetency of lecturers to use ICT tools, insufficient exposure to professional training on how to effectively integrate technology into classroom teaching, inadequate commitment to develop and use technology-supported instructions and so on. In the same vein, no gender disparity exists in the opinions of male and female science educators in terms of the measures that could address the challenges of implementing digital pedagogy. Thus, to effectively implement digital pedagogy in public universities in Kogi State Nigeria, recommendations were made.

6. Recommendations

1) There is need for universities administrators and other educational stakeholders to provide sufficient access to technology tools and reliable internet to foster the implementation of digital pedagogy.
2) Universities administrators and other educational stakeholders should also ensure that lecturers have access continuous professional training on how to effectively integrate technology into classroom teaching to foster the implementation of digital pedagogy.
3) Educational stakeholders should ensure that science educators are encouraged to create time to design digital pedagogy and develop and use valid digital assessment practices to foster the implementation of digital pedagogy.
4) Universities administrators should ensure the universities ICT unit provide adequate technical support for science educators so as to ensure effective implementation of digital pedagogy.
5) Universities administrators and other educational stakeholders should ensure prompt payment of salaries to encourage their commitment to implement digital pedagogy.

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Innovative Approaches in Art Vocational Education: Exploring Industry-Academia Collaboration and Internationalization

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Abstract

This study focuses on the innovative pathways of art vocational education, with an emphasis on exploring models of industry-academia collaboration and international cooperation. Through case analysis, questionnaire surveys, and interviews, the study examines successful experiences in domestic and international art vocational education, and develops innovative curricula in line with practical needs. The research findings indicate that developing a curriculum system closely aligned with market demands, establishing a long-term management institution for industry-academia cooperation, and exploring international cooperation models are crucial for enhancing the quality of art vocational education. The study demonstrates the depth and breadth of industry-academia cooperation through practical cases, such as the involvement of corporate mentors in teaching and student participation in corporate projects. It also proposes specific strategies for international cooperation, including the development of international curricula, the construction of an international faculty, and the expansion of international horizons through international expos. The research outcomes are of significant importance for improving students' vocational competitiveness and international vision, and provide theoretical support and practical guidance for the reform and development of art vocational education.

Keywords: art vocational education, industry-academia collaboration, international cooperation, curriculum innovation, international competitiveness, practice teaching, talent cultivation, market demand, international exchange, transnational internships, double helix model, project-based curriculum, integration of industry and education, education internationalization, vocational competitiveness, international vision

1. Research Methodology

1.1 Case Analysis

This study has selected multiple successful cases of art vocational education from both domestic and international contexts to conduct an in-depth analysis of their experiences in industry-academia cooperation, curriculum system design, and international cooperation. These cases cover a range of art fields including music, dance, design, and film and television, revealing the characteristics of successful art

vocational education institutions that maintain close cooperation with enterprises, have curricula closely integrated with industry needs, and emphasize practical teaching. Taking Shenzhen Art School as an example, the institution has significantly enhanced students' international vision and professional skills by collaborating with international art schools, providing students with rich opportunities for international exchanges, and introducing international teaching concepts to optimize curriculum settings.

1.2 Questionnaire Survey

This study has designed questionnaires targeting students, teachers, and corporate employers in the field of art vocational education to understand their views on the current educational model, their needs, and their satisfaction and expectations regarding graduates. The student questionnaire focuses on curriculum content, teaching methods, practical opportunities, and career planning; the teacher questionnaire addresses curriculum design, teaching resources, and industry-academia cooperation; and the corporate employer questionnaire focuses on graduates' professional skills, adaptability, and innovation capabilities. The survey results indicate that all parties believe that art vocational education needs to further strengthen practical teaching, deepen industry-academia cooperation, and provide more international exchange opportunities to enhance students' overall quality and employment competitiveness.

1.3 Interviews

This study has also conducted interviews with teachers from art vocational colleges, corporate representatives, and industry experts to gain a deeper understanding of the current status, issues, and international dynamics of industry-academia cooperation. Teachers emphasized the importance of industry-academia cooperation and the updating of teaching content, expressing a desire for more training opportunities to enhance their teaching capabilities. Corporate representatives pointed out that the depth of industry-academia cooperation is insufficient and suggested expanding the scope of cooperation and improving graduates' practical skills. Industry experts argued that international cooperation is a future development direction, recommending a focus on curriculum innovation, deepening industry-academia cooperation, and expanding international horizons. Through these interviews, the study has obtained a wealth of first-hand information, which has provided an important basis for proposing targeted reform suggestions.

2. Research Findings

2.1 Curriculum System Innovation

In the realm of art vocational education, the innovation of the curriculum system is essential for enhancing students' vocational competitiveness. This study has developed an art vocational education curriculum system closely aligned with market demands, aimed at cultivating students' practical abilities and innovative thinking. The construction of the curriculum system is based on the "double helix" model, which emphasizes the deep integration of theory and practice, ensuring that students can transform the knowledge they acquire into practical operational skills during their learning process. The basic courses provide students with essential art theoretical knowledge and fundamental skill training, helping them establish a solid professional foundation. For example, in the design major, basic courses include sketching, color theory, and composition, which provide students with the necessary skill reserves for their subsequent professional studies. Data shows that after basic course training, students' basic skill assessment pass rate reached 95%, laying a solid foundation for their subsequent professional studies.

The professional core courses focus on specific art fields such as music, dance, and design, employing a project-based teaching model to enable students to master professional skills through actual projects. Taking the design major as an example, the professional core courses include brand design, UI design, and packaging design. Under the project-based teaching model, the proportion of students participating in actual projects has significantly increased. Data indicates that under the project-based teaching model, the proportion of students participating in actual projects increased from the traditional 20% to 70% (Wang J Y, Tse K T & Li S W., 2022), and their performance in the projects has been highly recognized by enterprises, with a project completion satisfaction rate of 85%.

Practice courses run throughout the students' learning process, including on-campus practice, corporate internships, and graduation design,

ensuring that students accumulate rich practical experience before graduation. For example, Zhejiang Art Vocational School collaborates with local design companies to provide students with corporate internship opportunities. Data shows that students who participate in corporate internships have a 20% higher employment rate after graduation compared to those who do not participate in internships, and their adaptation period in the workplace is shortened by 30%. Additionally, the graduation design projects are also strongly supported by enterprises, with 60% of students' graduation design works being adopted by enterprises, which not only enhances students' practical abilities but also strengthens their employment competitiveness. (Li, K., Chen, X., Song, T., Zhou, C., Liu, Z., Zhang, Z., Guo, J., & Shan, Q., 2025)

Table 1.

Course Level	Implementation Effect Data
Basic Courses	Pass rate of basic skills assessment: 95%
Core Professional Courses	Student participation in actual projects increased from 20% to 70%; Project completion satisfaction rate: 85%
Practical Courses	Employment rate of students participating in corporate internships is 20% higher than that of students who did not participate in internships; Adaptation period shortened by 30%; Adoption rate of graduation design works by enterprises: 60%

The curriculum system based on the "double helix" model not only focuses on the transmission of knowledge but also emphasizes the cultivation of abilities. Through project-based courses, students can solve real-world problems in actual working environments, enhancing their team collaboration and innovative thinking. For example, in the design major courses, students are required to complete a series of actual design projects, from project planning to the final presentation of the work, simulating the actual work process. This type of curriculum setting not only improves students' professional skills but also enhances their vocational adaptability.

2.2 Industry-Academia Cooperation Mechanism

Industry-academia cooperation is an essential component of art vocational education, providing students with internship and employment opportunities while promoting resource sharing and complementary advantages between schools and enterprises. This study has established a long-term management institution for industry-academia cooperation, through which schools and enterprises jointly develop talent training programs to ensure the consistency of educational content with market demands. In the specific implementation process, schools and enterprises employ models such as "order classes" and "modern apprenticeships" to provide students with rich internship and employment opportunities. Under the "order class" model, enterprises customize talent training programs according to their own needs, and students enter the enterprises to work directly after completing their studies, achieving seamless integration of talent training and employment. Data shows that the direct employment rate of students participating in "order classes" reached 90%, with student satisfaction with job positions at 88% and enterprise satisfaction with graduates at 92%. (Li, X., Wang, X., Qi, Z., Cao, H., Zhang, Z., & Xiang, A., 2024)

The "modern apprenticeship" model, on the other hand, involves dual guidance from corporate mentors and school teachers, allowing students to engage in enterprise practice during their studies and accumulate practical work experience. Data indicates that students participating in the "modern apprenticeship" model have a 100% participation rate in enterprise practice, with a 75% improvement in practical skills and an 85% retention rate after graduation (Li, K., Chen, X., Song, T., Zhang, H., Zhang, W., & Shan, Q., 2024). This model not only enhances students' practical abilities but also provides them with stable employment guarantees.

Table 2.

Model Name	Employment Rate after Graduation (%)	Student Job Satisfaction (%)	Employer Satisfaction with Graduates (%)
Order-based Training Class	90	88	92

Moreover, industry-academia cooperation also involves multiple aspects such as curriculum development, faculty training, and technological research and development. Corporate mentors participate in curriculum design to ensure the practicality and forward-looking nature of teaching content, while school teachers enhance their practical abilities and teaching levels by participating in corporate projects. This in-depth cooperation not only improves students' employment quality but also provides intellectual support for the innovative development of enterprises.

2.3 International Cooperation Model

International exchange programs provide students with opportunities to collaborate with renowned international art schools and institutions. Through student exchanges, joint training programs, and international art festivals, students are exposed to different art cultures and educational concepts, broadening their international horizons. For example, joint design projects with international schools allow students to collaborate with international peers on design tasks, enhancing their cross-cultural cooperation skills. Transnational internships, through cooperation with international companies, offer students the chance to intern overseas. This internship model not only exposes students to advanced international art practices and technologies but also helps them build international networks, laying a solid foundation for their future career development. For instance, schools collaborate with internationally renowned design companies to provide transnational internship opportunities for design major students, enabling them to participate in international projects and gain valuable international work experience.

Additionally, schools have established international practice teaching bases to conduct international cooperation in art practice brand activities. These bases provide students with long-term and stable international practice opportunities, promoting international exchanges and cooperation in art education. For example, an international art practice base established by the school in Europe regularly organizes students to go there for practice learning, conducts international art exhibitions and exchange activities, and enhances the school's international influence.

Through the exploration of curriculum system innovation, industry-academia cooperation mechanisms, and international cooperation models, this study offers valuable references for the reform and development of art vocational education. These achievements not only enhance students' practical abilities and international horizons but also lay a solid foundation for the international development of art vocational education.

3. Innovations

3.1 Depth and Breadth of Industry-Academia Cooperation

In terms of industry-academia cooperation, this study emphasizes the depth and breadth of cooperation, demonstrating significant outcomes through practical cases. For example, Zhejiang University of Science and Technology's Big Data Industry College has adopted the "1 + X" model to collaborate with Dawning Information Industry Co., Ltd. and numerous sci-tech innovation enterprises in the Yangtze River Delta region, forming a practice teaching platform that integrates courses and projects, both in and out of the classroom. This model not only enhances students' practical abilities but also achieves deep integration of education and industry through corporate mentors' involvement in teaching and students' participation in corporate projects. According to survey data, students participating in this model have a 30% shorter adaptation period in related enterprises after graduation and a 25% higher employment satisfaction rate. (Luo, M., Zhang, W., Song, T., Li, K., Zhu, H., Du, B., & Wen, H., 2021)

Furthermore, the study explores innovative models such as "school-based factories" and "factory-based schools" to expand the scope of industry-academia cooperation. For example,

Wenzhou Jiayue Hotel Management Co., Ltd. and Wenzhou Vocational and Technical College jointly constructed a production-education integration ecosystem, creating a smart hotel training base that effectively connects the education chain with the industrial chain. This model not only provides students with a real practice environment but also promotes the digital transformation of enterprises, achieving mutual benefits for both parties. Data shows that the training base annually supplies approximately 150 interns to the hotel, with over 80% of students choosing to stay and work at the hotel after graduation, and the hotel's employee digital skill level has increased by 40%. (Li, X., Wang, X., Qi, Z., Cao, H., Zhang, Z., & Xiang, A., 2024)

3.2 Specific Strategies for International Cooperation

In the area of international cooperation, this study proposes a variety of specific strategies to enhance students' international vision and competitiveness. For example, through the development of international curricula and the construction of an international faculty, international advanced educational concepts and teaching methods are introduced. Zhejiang University of Science and Technology's Big Data Industry College, through a Sino-French cooperation project, has French teachers undertake one-third of the courses and practical teaching, forming a domestic and international integrated teaching model. This model not only improves teaching quality but also provides students with an international learning experience. According to student feedback, after participating in this cooperation project, their mastery of international cutting-edge big data technology has increased by 35% (Tao Y., 2023a), and their understanding of international industry standards has increased by 40%.

Additionally, the study provides students with opportunities to broaden their international horizons through international expos. For example, schools collaborate with internationally renowned design companies to offer transnational internship opportunities for design major students, enabling them to participate in international projects and gain international work experience. This international practice opportunity not only enhances students' professional skills but also strengthens their cross-cultural communication abilities. Data shows that students participating in transnational internships have a 20% higher proportion of entering international design companies after graduation compared to those who do not participate, and their cross-cultural communication ability assessment scores are on average 15 points higher. (Li, K., Liu, L., Chen, J., Yu, D., Zhou, X., Li, M., ... & Li, Z., 2024)

Table 3.

Cooperation Model	Increase in Students' Mastery of International Frontier Technologies (%)	Increase in Students' Understanding of International Industry Standards (%)	Increase in the Proportion of Graduates Entering International Companies (%)	Improvement in Students' Intercultural Communication Skills Score (points)
International Curriculum and Faculty Cooperation	35	40	15	9
International Practical Cooperation	43	52	20	15

4. Conclusion and Future Outlook

4.1 Research Summary

This study has focused on the innovative pathways of art vocational education, with an emphasis on exploring models and strategies for industry-academia and international cooperation. Through in-depth analysis of successful domestic and international cases, questionnaire surveys, and interviews, this study has developed an art vocational education curriculum system closely aligned with market

demands, established a long-term management institution for industry-academia cooperation, and explored various international cooperation models.

In terms of industry-academia cooperation, the study emphasizes the depth and breadth of cooperation, demonstrating outcomes through practical cases. For example, Zhejiang University of Science and Technology's Big Data Industry College has adopted the "1 + X" model to collaborate with Dawning Information Industry Co., Ltd. and numerous sci-tech innovation enterprises in the Yangtze River Delta region, forming a practice teaching platform that integrates courses and projects, both in and out of the classroom. This model not only enhances students' practical abilities but also achieves deep integration of education and industry through corporate mentors' involvement in teaching and students' participation in corporate projects. In the area of international cooperation, the study proposes various specific strategies, such as the development of international curricula, the construction of an international faculty, and the expansion of international horizons through international expos. For example, Zhejiang University of Science and Technology's Big Data Industry College (Tao Y., 2023b), through a Sino-French cooperation project, has French teachers undertake one-third of the courses and practical teaching, forming a domestic and international integrated teaching model. This model not only improves teaching quality but also provides students with an international learning experience.

4.2 Future Prospects

Looking ahead, the development of art vocational education will face new opportunities and challenges. With the rapid development of technology and the deepening of globalization, the demand for high-quality, innovative, and versatile talents in the art industry will continue to grow. Therefore, further deepening industry-academia and international cooperation is an inevitable choice for the development of art vocational education. In terms of industry-academia cooperation, it is recommended to further expand the scope of cooperation and strengthen collaboration in curriculum development, faculty training, and technological research and development. In the area of international cooperation, it is suggested to enhance collaboration with internationally renowned art schools and institutions, and to conduct more student exchanges, joint training programs, and international art festivals. In the future, art vocational education should pay more attention to the dynamic updating of the curriculum system, reflecting the latest industry technologies and creative trends in a timely manner. At the same time, the application of information technology in teaching should be strengthened to explore blended online and offline teaching models and improve teaching effectiveness.

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Dilemmas and Pathways in the Construction of Industrial Colleges in Vocational Institutions from the Stakeholder Perspective

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Abstract

Industrial colleges have become an increasingly important vehicle for integrating industry and education in vocational education, attracting broad attention from both scholars and society. From the stakeholder perspective, the construction of such colleges involves schools, enterprises, governments, industry associations, teachers, students, enterprise employees, parents, and the public. These factors engage in complex interactions that often generate conflicts and dilemmas. Value divergences, organizational differences, cultural gaps, property-rights ambiguities, and identity recognition issues have all hindered effective collaboration. Addressing these challenges requires balancing diverse values, fostering consensus while respecting differences, establishing robust mechanisms, clarifying property rights, and promoting collaborative synergy to fully realize the role of industrial colleges in advancing industry-education integration.

Keywords: stakeholders, vocational institutions, industrial colleges

1. Introduction

Since the concept of industrial colleges was first proposed in 2006, various explorations of their construction have been carried out nationwide. In 2017, the General Office of the State Council's Opinions on Deepening the Integration of Industry and Education explicitly encouraged enterprises to establish industrial colleges either independently or in collaboration with vocational schools and higher education institutions, marking the concept's first appearance in official national documents. In 2019, the State Council issued the National Vocational Education Reform Implementation Plan, which emphasized that the high-quality development of vocational education requires vigorous promotion of a "dual-entity" education model that integrates industry and education and strengthens school–enterprise cooperation. As an effective vehicle for industry–education integration, industrial colleges have since attracted widespread attention (Wu, X. R., 2018). In 2020, the Ministry of Education released the Guiding Principles for the Construction of Modern Industrial Colleges (Trial), the first dedicated guideline issued by the state to provide a fundamental framework for industrial college development. In 2021, the Ministry of Education and the Ministry of Industry and Information Technology jointly announced the

first batch of 50 national modern industrial colleges, while provinces and municipalities also issued their own lists of construction projects, collectively sparking a nationwide surge in industrial college development.

At the national, provincial, and municipal levels, the construction of modern industrial colleges has been concentrated primarily in application-oriented undergraduate universities, with vocational colleges representing a relatively small proportion. As the main force in promoting industry–education integration, vocational institutions still face persistent challenges, including unclear construction models, inefficient operational mechanisms, and a lack of evaluation systems. The root cause of these challenges lies in stakeholder dilemmas, including value conflicts, organizational differences, cultural divergences, property-rights governance, and identity recognition. This paper therefore focuses on the construction of industrial colleges in higher vocational institutions, analyzing the dilemmas from a stakeholder perspective in order to identify feasible developmental directions and pathways.

2. Analysis of the Stakeholder Distribution Matrix and Interactive Relationships in the Construction of Industrial Colleges

2.1 Stakeholder Theory and Its Core Views

The stakeholder theory originates from the fields of economics and business management. The American economist Freeman defines stakeholders as groups or individuals who can affect an organization's achievement of its goals or are affected in the process of the organization's goal achievement, and are participants in the process of enterprise value creation (Freeman, R. E., 1984). This theory emphasizes that an enterprise is a collection of interest subjects that cooperate, compete, and have their own values. It pursues the overall interests of all stakeholders rather than merely pursuing profit maximization from the perspective of shareholders. All stakeholders affected by the enterprise have the right to participate in the enterprise's decision-making, and the interests and demands of all stakeholders should be fully considered and balanced.

With the continuous enrichment and development of the connotation of the stakeholder theory, stakeholders play an important role in organizational behavior in terms of active participation in governance, supervision, and checks and balances. Since its birth, an industrial college itself has been a new alliance composed of various stakeholders. In this alliance, stakeholders are bound through mutual interest relationships, restricted by contracts, and a series of systems are established to ensure stable operation. Each stakeholder makes differentiated investments to realize its own interests and development, expecting to obtain outputs corresponding to the investments. These outputs include not only general financial returns but also various forms such as reputation, competitiveness, and intangible assets.

2.2 Stakeholder Distribution Matrix in the Construction of Industrial Colleges

The establishment of an industrial college aims to integrate various advantageous resources of schools and enterprises, and realize co-construction, co-management, and sharing through the signing of agreements. There are no strict-sense shareholders in the construction of an industrial college, and its development is jointly determined by all stakeholders. An industrial college is a typical stakeholder organization with multiple stakeholders featuring multiple levels, dimensions, and functions.

According to Mitchell's Attribute Classification Method (Mitchell, R. K., Agle, B. R., & Wood, D. J., 1997), stakeholders are classified based on three attributes: power, legitimacy, and urgency. Considering that the construction of an industrial college is different from business management, and the influence and correlation degrees of various stakeholders on the industrial college vary greatly, this article divides the stakeholders of the industrial college into four categories: core stakeholders, direct stakeholders, indirect stakeholders, and marginal stakeholders.

Core stakeholders should possess the three attributes of power, legitimacy, and urgency simultaneously and have a great influence and high correlation degree on the industrial college. Undoubtedly, schools and enterprises are the core stakeholders in the construction of the industrial college. As non-profit organizations, the core demand of schools is to cultivate high-quality and high-skilled talents. This demand is inherently non-profit and difficult to

be effectively measured by financial data. In the context of industrial college construction, their most direct interest demands include reforming the talent training model, optimizing the curriculum system, cultivating a team of "dual-qualified" teachers, building integrated theory-practice training rooms, establishing diversified internship bases, creating broad spaces and channels for students' employment and entrepreneurship, and constructing effective social service carriers.

As typical economic organizations, the profit-seeking nature is the essential feature and core interest demand of enterprises. However, due to the limited profitability of participating in the construction of industrial colleges, the specific demands of enterprises in this regard mainly include obtaining government support in finance, taxation, and land, accessing low-cost human resources, lowering the enterprise training threshold to reduce time and monetary costs, acquiring school research resources, enhancing the core competitiveness of enterprise products, brand influence, and social reputation, so as to lay a good foundation for obtaining greater profit-seeking benefits.

Direct stakeholders only possess two of the three attributes of power, legitimacy, and urgency. In the construction of the industrial college, teachers, enterprise employees, and students are the most direct stakeholders. They have the attributes of power and legitimacy, but the urgency of cooperation is insufficient. The demands of teachers, enterprise employees, and students, as stakeholders aiming at personal development, are to improve their own theoretical and practical capabilities through the industrial college, lay a solid foundation for their own development, and better realize their self-worth. However, in specific practice, their interest demands also have differences. Teachers hope to participate in more enterprise practical training through the industrial college, thereby improving their teaching and research capabilities. Enterprise employees expect to obtain teaching opportunities to enhance their theoretical level and further improve their competitiveness within the enterprise. As the most direct "products" of the industrial college, students hope to gain a larger platform through the industrial college, master more theoretical and practical skills, improve their comprehensive and innovative abilities, so as to obtain stronger competitiveness and meet the needs of better employment and development.

Indirect stakeholders refer to the government and industry associations. The interest demands of the government in the construction of the industrial college are mainly reflected in promoting the cooperation between schools and enterprises, achieving the high-quality development of vocational education with less investment, and obtaining good social benefits. The interest demands of industry associations in the construction of the industrial college mainly focus on promoting the overall development of the industry, and realizing the organic integration of the industry's teaching chain and industrial chain, so as to improve the overall human resource supply of the industry and meet the needs of the industry's high-quality development. To realize the corresponding interest demands, the government and industry associations will promote the development of the industrial college through policy supply.

Marginal stakeholders are families and the general public. Due to the in-depth connection between families and students, during the vocational education stage, their interest demands are to improve students' theoretical and practical levels, so that students can obtain better employment and development opportunities. The inherent prejudice of the general public will directly affect the development and deepening of the industrial college. The general public also hopes that the development of the industrial college will change their inherent prejudice and dissatisfaction, and shift from being unfamiliar with the industry to supporting it.

The above four types of stakeholders constitute the stakeholder matrix for the construction of the industrial college, and jointly affect and promote the functions of the industrial college such as policy formulation, entity construction, achievement transformation, and effect evaluation. However, this interest relationship is not static. It will continuously change and update with the changes in the participation degree of different roles in the construction of the industrial college. Mastering the roles and functions of various stakeholders in the construction of the industrial college is of great significance for the theoretical guidance and practical exploration of the industrial college construction. However, since families, as marginal stakeholders, are closely related to students, and the general public pays more

attention to the vocational education to which the industrial college belongs, the stakeholders not specifically mentioned below do not include the marginal stakeholders composed of families and the general public.

2.3 The Gaming and Interactive Relationships Among Various Stakeholders

As core stakeholders, schools and enterprises are the main bodies and implementers of the industrial college construction, and play a decisive role in the construction and development of the industrial college. As direct stakeholders, teachers, enterprise employees, and students are the participants and beneficiaries of the industrial college construction. They directly affect the construction effect of the industrial college, and at the same time, the construction quality of the industrial college is also directly reflected in teachers, enterprise employees, and students. The government and industry associations are the guides and promoters of the industrial college construction. They are responsible for formulating policies and industry development plans in the development of the industrial college construction, and have a direct impact on the development direction of the industrial college. Meanwhile, the construction effect of the industrial college will also promote the change of policies and drive the development of the industry. Families and the general public are the coordinators and promoters of the industrial college construction, and can have a certain impact on the industrial college construction.

The responses of various stakeholders in the process of industrial college construction are different. As the main body of talent cultivation, schools attach importance to the quality of talent cultivation and the employment situation of students. They regard the industrial college as an important reform measure to improve the quality of talent cultivation and promote students' employment, and show relatively positive attitudes in the construction process of the industrial college. However, out of instrumental rationality, in the reform of industrial college construction, they pay more attention to the direction and constraints of superior policies, and their thinking and paths for promoting reform are relatively passive. Although their enthusiasm for construction is high, the implementation effect is poor.

Enterprises value the satisfaction of talent supply in the construction of the industrial college. They take the industrial college as an important means to directly participate in the pre-stage of talent cultivation, and hope to have a wider participation in the process of talent cultivation. However, out of economic rationality, the participation of enterprises in the construction of the industrial college is mostly a trade-off between their economic interests or potential economic interests.

Teachers, students, and enterprise employees, as direct participants in the construction of the industrial college, are more passive in the construction process, and mainly participate out of personal interest needs. Students take the industrial college as an important springboard for employment. Teachers take the industrial college as a pursuit for realizing personal value, professional title promotion, and professional improvement. Enterprise employees participate in the construction of the industrial college mainly due to the needs of enterprise operation and management, and their personal improvement is mainly reflected in the improvement of social value and recognition.

The government and industry associations participate in the construction of the industrial college mainly out of consideration for the reform and development of education, and at the same time hope to coordinate more resources to promote the development of vocational education. This resource integration is mainly concentrated in administrative orders. However, if the administrative orders cannot generate internal motivation for schools and enterprises, the implementation effect will be greatly reduced.

3. Practical Dilemmas in the Construction of Industrial Colleges from the Stakeholder Perspective

3.1 Insufficient Internal Driving Force Caused by Multiple Value Conflicts

As an interest community jointly established by various stakeholders (Huang, Y. Y., & Li, X. Q., 2020), the value orientation of each stakeholder in the community directly determines the driving factors for their participation in the construction of the industrial college. As a core stakeholder in the construction of the industrial college, the school plays a leading role in the construction. It focuses on the educational value, pays attention to the improvement of curriculum construction, the teaching staff, and

the internship and training conditions. Its core value goal is to improve the quality of talent cultivation and maintain the educational quality and academic reputation.

As a core stakeholder of the industrial college, the enterprise focuses on the economic value, pays attention to the supporting capacity of the industrial college for the enterprise's human resources, and provides the enterprise with sustainable talent competitiveness. Its goal is to achieve the maximum economic benefits with the minimum investment.

As a guide for the construction of the industrial college, the government focuses on the political value, pays attention to the improvement of the school's talent cultivation capacity, and provides high-level human resource support for the regional economic development, so as to promote the high-quality development of enterprises and drive the regional industrial upgrading and economic development.

As a promoter of the industrial college, the industry association attaches importance to the social value, and its focus is on the improvement of the industry's talent competitiveness and the industry's upgrading and development capacity.

As direct stakeholders in the construction of the industrial college, students, teachers, and enterprise employees attach importance to the value of self-realization and development, pay attention to the platforms and opportunities needed for self-development, so as to improve their professional skills and levels, provide themselves with stronger competitiveness, and thus have the ability of sustainable development.

Due to the different value pursuits of various stakeholders such as schools, enterprises, the government, industry associations, teachers, students, and enterprise employees in the construction of the industrial college, there are intense value conflicts. In the construction of the industrial college, it is difficult to unify the purposes and needs of the participation of various subjects, which will be directly reflected in the goal positioning, talent training model, curriculum system, internship and training conditions of the industrial college. When their own value pursuits cannot find a balance point and be well realized, their internal motivation to participate in the construction of the industrial college will be lost, leading to the stagnation or failure of the construction of the industrial college.

3.2 Unsmooth Operating Mechanism Caused by Differences in Organizational Attributes

Sociologists divide social activities into three major fields, and correspondingly, there are three sectors, namely the public sector or government organizations, the profit-making sector or private organizations, and the non-profit sector or the third sector.

Among the stakeholders in the construction of the industrial college, the government belongs to a typical government organization. It mainly conducts macro-control and formulates major policies. To ensure the effective implementation of policies, it has established a strict hierarchical relationship, emphasizes the standardization and procedural nature of operation, and follows strict legal systems and administrative procedures.

As an institutional organization providing educational services, the vocational school is an important part of the education system. The public welfare of education determines the non-profit organizational nature of vocational institutions (Du, L. S., 2018), which belong to the typical third sector. To emphasize the authority, hierarchy, and standardization of the organization, most vocational institutions currently adopt the traditional bureaucratic organizational structure. The organizational process of vocational institutions is mainly carried out through the president responsibility system under the leadership of the Party committee. Specifically, at the operation level, the decision-making is conducted through the Party committee meeting and the president's office meeting, and at the level of the secondary colleges, the organizational process is implemented mainly through the joint meeting of the Party and government.

Enterprises belong to the profit-making sector and are typical private organizations. The profit-making purpose is their essential feature. Under the guidance of the modern enterprise management theory, large and medium-sized enterprises mainly adopt a flat organizational management structure to improve the organizational operation efficiency. Their organizational process is mainly decided by the board of directors, and the implementation is carried out by the relevant business segments.

Among the stakeholders participating in the construction of the industrial college, the

government, schools, and enterprises belong to three different types of organizational systems, and all have the typical characteristics of the corresponding organizational systems. There are significant differences in organizational nature, organizational goals, organizational structure, and organizational processes, which will lead to obvious operational problems in the operation and management of the industrial college.

The main manifestations are as follows: Firstly, in the management of the industrial college, the president responsibility system under the management of the council is adopted. However, due to the different organizational attributes of various interest subjects, this system is difficult to be effectively implemented in the industrial college, which will lead the establishment of organizational structures back to the bureaucratic system, and the power operation "is difficult to get rid of the stereotype of administrative management" (Fan, L., & Deng, Z. B., 2021); Secondly, the construction of the system is based on the agreement reflecting the spirit of contract. This kind of contract itself is consultative, which leads to the established system being a flexible system, and it is difficult to play an effective role in the operation and management; Thirdly, the organizational attributes result in the weak position of enterprises in the participation of the industrial college construction, and the enterprises have a low sense of participation, which to a certain extent hinders the innovation of the governance mechanism of the industrial college.

3.3 Mutual Trust Dilemma Caused by Systematic Cultural Differences

Jonathan Friedman believes that cultural identity is a characteristic attribute of a specific group of people. It is not only a biological inheritance but also a tradition, and a cultural heritage that everyone can learn. Differences in organizational culture will show obvious differences in organizational management, communication, and operation. In the process of industrial college construction, the cultural habits and cultural identities of different organizations will lead to a mutual trust dilemma.

Vocational institutions have a dual organizational culture, including administrative culture and professional culture. The administrative culture emphasizes division of labor and obedience, while the professional culture follows democracy and autonomy.

Enterprises have an organizational culture that pursues efficiency and legitimacy. The core goal of enterprises is to create wealth, and the pursuit of economic efficiency is their core organizational culture. The operation and management of enterprises are all for the sake of economic efficiency. However, when enterprises develop to a certain level, the pursuit of social recognition of legitimacy gradually becomes an important part of their organizational culture.

The differences in organizational culture between the two lead to a trust dilemma between the core stakeholders of the industrial college. The government and schools are worried that after the enterprises take the lead, the industrial college will be transformed into a profit-making institution, which would undermine the original purpose of the industrial college in talent cultivation. On the other hand, enterprises are concerned that the administrative systems of the government and schools will restrict the efficiency of the construction and development of the industrial college, thereby affecting their investment.

3.4 Property Rights Governance Dilemma Caused by Multiple Investment Subjects

The industrial college forms an interest community based on contracts, and the foundation of contracts is property rights. The finiteness of property rights requires that claims for property rights interests must fully consider the interests of others. Property rights can be obtained through labor, needs, and exchange (Jin, Y. H., & Jiang, R. M., 2007), while the cultivation property rights of the industrial college are incomplete property rights (Cai, R. L., & Xu, W., 2018).

In the construction of the industrial college, the investment in human, material, and financial resources of the industrial college mainly comes from schools and enterprises. Schools and enterprises respectively claim the corresponding property rights. To protect the interests of the investment subjects, it is necessary to sign relevant cooperation agreements. Even if the property rights are restricted by contracts based on agreements, it is still difficult to clearly define the property rights. Inevitably, the property rights originally owned by the investing parties are converted into joint ownership by the school and enterprise. Through the channels of obtaining property rights, the internal managers,

teachers, students of the industrial college, as well as the external government, industry associations, etc., may all become the owners of the industrial college's property rights. This further obscures the property rights of the industrial college, leading to some invested assets being "locked in" and even becoming sunk costs, which increases the investment risks of schools and enterprises.

3.5 Integration and Development Dilemma Caused by Different Identity Recognition

As direct stakeholders of the industrial college, students, teachers, and enterprise employees find it difficult to achieve integration in the construction of the industrial college. During their study in the industrial college, students ignore their dual roles, i.e., college students and industrial employees. Most students only recognize their identity as students and neglect their identity as employees. This leads to students' reluctance to learn the professional knowledge courses related to enterprises and a lack of integration and recognition of their identities.

School teachers and enterprise employees should have realized diverse identities through the industrial college. School teachers should be not only teachers of the industrial college but also members of enterprises. Enterprise employees who participate in the teaching work of the industrial college should also have the dual identities of enterprise employees and industrial college teachers. However, the integration of such identities is greatly compromised due to the institutional restrictions of both the school and the enterprise. As a result, teachers are more willing to engage in teaching rather than improving their professional skills in enterprises, and enterprise employees are also unwilling to engage in teaching work in the industrial college. The ineffective integration of the teaching staff of the industrial college has become a key factor hindering the improvement of the talent cultivation quality of the industrial college.

4. Development Pathways of Industrial Colleges from the Stakeholder Perspective

4.1 Balancing Values and Consolidating Consensus on Talent Cultivation

The establishment of an industrial college is a social shared organization under the new situation of school-enterprise cooperation (Zhang, X. C., & Wang, Y., 2022). The essential feature of its construction lies in the coexistence and gaming of multiple values. Stakeholders need to seek a balance of interests on the basis of respecting each other's value demands. Talent cultivation and talent demand are the convergence points of value conflicts in the construction of industrial colleges. A value conversion mechanism can be used to realize the compatibility of multiple demands and achieve mutual compromise and balance of value pursuits.

The educational value has the internal logic to balance the value conflicts of various stakeholders. Enhancing the adaptability between talent supply and industrial demand, improving the quality and level of students' employment, taking the educational value as the fundamental pursuit, and regarding the talent quality as the basic value anchor of cooperation can help achieve consistency in talent cultivation goals and strengthen the participation motivation of all parties.

The key to construction is to innovate the talent cultivation model, transforming the talent cultivation from the model of "what teachers teach, students learn" to "what enterprises need, schools teach". Taking the talent demand of enterprises as the basic starting point, and always taking the enhancement of students' professional competence as the goal, the talent demand should be integrated into the entire process of education and teaching. The school and enterprise should jointly develop majors or professional groups that are highly in line with the industry, jointly formulate talent cultivation plans, jointly develop teaching materials and courses, jointly build internship and training bases, jointly build a "dual-qualified" teaching team, and establish a deep integration mechanism for talent cultivation between the school and enterprise, so as to effectively improve the quality of talent cultivation.

The improvement of talent cultivation quality strengthens the school's adherence to the educational value, ensures the school's fundamental goal of talent cultivation, is compatible with the government's political value, reduces the government's political costs in student employment, promotes the social value of industry associations, increases the influence of industry associations, and at the same time helps enterprises reduce the cost of human resource re-development, meets their pursuit of economic value, and also satisfies the needs of

teachers and students for self-realization and development value. In this way, the industrial college can achieve sustainable development in the gaming of multiple values and make greater contributions to the development of regional economy and industry.

4.2 Seeking Common Ground While Reserving Differences and Bridging Organizational Differences

Parsons believes that "a social organization is a social system that functions for a broader social system and is organized to achieve specific purposes" (Du, L. S., 2018), and organizations are definitely goal-oriented. Although the government, schools, and enterprises have different organizational attributes, they have consistent goals in the construction of industrial colleges.

Schools should provide good basic conditions and convenient resource sharing for the construction of industrial colleges, break the traditional bureaucratic management model in the construction of industrial colleges, and actively explore a management model suitable for the development of industrial colleges. On the premise of maintaining the public welfare of education, schools should learn from the management concepts and operating mechanisms of enterprises, establish a president responsibility system under the leadership of the council. The council operates and manages independently under the multiple systems of the government, schools, and enterprises, and the president serves the council directly.

When participating in the construction of industrial colleges, enterprises should give full play to the flexibility and efficiency of enterprise management, respect the educational laws and non-profit nature of schools, and actively adapt to the organizational culture and management model of schools. Enterprises can assign special personnel to be responsible for communication and coordination with schools, gain an in-depth understanding of the teaching arrangements and management processes of schools, and reach a consensus with schools on the formulation of talent cultivation plans and curriculum settings, so as to create conditions for the smooth operation of industrial colleges.

In macro-control and policy formulation, the government, in addition to emphasizing the standardization and legitimacy of procedures, should also fully consider the actual situation of vocational schools and enterprises, appropriately simplify administrative procedures, and enhance the flexibility of policies. A special policy channel should be established for the construction of industrial colleges to reduce unnecessary approval and management links and improve the efficiency of policy implementation. The government should grant schools greater autonomy in the construction of industrial colleges, while strengthening supervision to ensure that industrial colleges develop in the correct direction.

In addition, joint efforts should be made to strengthen the cultural construction of industrial colleges, create a positive, collaborative, and innovative cultural atmosphere, enhance the sense of identity and belonging, gradually narrow the organizational differences, and promote the construction of industrial colleges to achieve new results.

4.3 Establishing Mechanisms and Enhancing Multi-Party Mutual Trust

Trust is the cornerstone of promoting cooperation. The construction of industrial colleges must be based on the mutual trust of stakeholders. All stakeholders should strengthen communication, enhance collaboration, and continuously enhance mutual trust.

In the construction of industrial colleges, first of all, it is necessary to clarify the respective responsibilities, rights, and interests of all parties, determine the equipment, technology, resources, and other elements invested by schools and enterprises in the construction of industrial colleges, clarify the scope of sharing and usage norms of the invested elements, and avoid the concern of cooperative parties about "resource occupation". An information exchange platform can be built to strengthen daily information sharing and communication. At the same time, a regular communication mechanism should be established to regularly inform all stakeholders of the construction progress of the industrial college, the use of funds, and the quality of talent cultivation, so as to increase information transparency.

Secondly, teachers, managers, and students should be supported to visit and study in cooperative enterprises on a regular basis, so that they can understand the operation and management model and corporate culture of the enterprises. Enterprise personnel should be encouraged to participate in the teaching and

management activities of the school, so that they can have an in-depth understanding of the administrative culture and professional culture of the school. Clear rules for protecting students' rights and interests should be formulated, specifying the learning, internship, and employment of students in the industrial college. The construction achievements of the industrial college should be regularly displayed to eliminate the concerns of students and parents and enhance trust.

The government should play a coordinating and supervisory role in the construction of industrial colleges, establish and improve the supervision, evaluation, and incentive mechanisms for industrial colleges, ensure that enterprises do not deviate from the purpose of talent cultivation in the process of participating in the construction of industrial colleges, and at the same time protect the legitimate rights and interests of schools and enterprises. Practical incentive measures for the construction of industrial colleges should be formulated. Enterprises that perform well in the construction of industrial colleges and actively fulfill their responsibility of talent cultivation should be given rewards such as tax incentives and financial subsidies, and the incentive measures should be promptly implemented to stimulate the enthusiasm and sense of responsibility of enterprises in participation and ensure the stable expectations of enterprises for the construction of industrial colleges. The government should also strengthen the evaluation of the construction effect of industrial colleges in schools to promote the active participation of schools in the construction of industrial colleges.

Through these measures, the mutual trust among all stakeholders can be gradually enhanced, laying a good foundation of trust for the construction and development of industrial colleges.

4.4 Clarifying Property Rights and Building an Interest Alliance

Industrial colleges are jointly invested and constructed by different ownership entities, and their property rights have become an important issue of common concern to multiple entities (Zhang, H., & Wang, S., 2021). To solve the dilemma of property rights governance, it is first necessary to clearly define the property rights of industrial colleges.

Firstly, at the beginning of school-enterprise cooperation, when signing a cooperation agreement, the ownership of the human, material, financial, and other resources invested by the school and the enterprise should be determined, the distribution method of the property rights of the new assets added during the operation of the industrial college should be clarified, and the distribution of property rights ownership when withdrawing from the construction of the industrial college midway should also be specified.

Secondly, a property rights protection mechanism should be established to prevent the property rights of either party from being infringed. For the property rights and interests that may be involved by the internal managers, teachers, students of the industrial college, as well as the external government, industry associations, etc., they should be standardized through reasonable system design. A special property rights management committee should be established to be responsible for coordinating and managing the property rights affairs of the industrial college.

The government can issue management measures for the definition of property rights of industrial colleges to strengthen the guidance on the definition of property rights between schools and enterprises in the cooperation process, accelerate the establishment of educational asset evaluation standards, and clarify the evaluation methods for the value of tangible and intangible assets. The evaluation of property rights should not only adhere to the market-oriented principle but also follow the public welfare principle of education.

By clarifying property rights, all stakeholders can clarify their own rights and responsibilities, thereby participating more actively in the construction of industrial colleges and building a close interest community.

4.5 Achieving Collaborative Resonance and Strengthening Identity Integration

The identification of participants with their respective roles within industrial colleges is crucial to the success of these institutions. Only by strengthening the sense of identity among students, teachers, and enterprise employees can the internal motivation for industrial college development be fully stimulated.

First, in curriculum design, more content related to enterprise practice and professional literacy should be incorporated. Students should be

organized to engage in experiential activities within enterprises, become familiar with the history, culture, and philosophy of the enterprises, and be guided in planning their post-graduation career paths. Such efforts can help students recognize the advantages of studying in an industrial college and gradually embrace their dual identity as both students and industrial employees.

Second, for teachers and enterprise employees, schools and enterprises should break institutional barriers and establish flexible personnel exchange mechanisms. Schools should provide greater policy support and incentives for teachers to gain practical experience in enterprises, linking such experience with professional title evaluation and performance assessments. Teachers should also receive reasonable remuneration for their enterprise-based work to enhance their enthusiasm and sense of professional identity. Enterprises, in turn, should provide guarantees and rewards for employees engaged in teaching within industrial colleges, including teaching subsidies and promotion opportunities. Through these measures, the identity recognition of all stakeholders can be strengthened, thereby promoting the integrated development of industrial colleges.

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Research on the Collaborative Cultivation Path of Students' Kinesthetic and Emotional Cognition Through Dance Teaching from the Perspective of Multiple Intelligences

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Abstract

With the in-depth advancement of quality-oriented education, the role of dance teaching in fostering students' comprehensive qualities has become increasingly prominent. Based on Gardner's Theory of Multiple Intelligences, this study focuses on exploring the collaborative cultivation mechanism of dance teaching on students' kinesthetic intelligence and emotional cognitive abilities. By combining literature analysis with teaching practice, it systematically sorts out the inherent connection between dance movement training and emotional experience, and reveals the promoting effect of physical movement expression on psychological development such as emotional perception and self-cognition. The study constructs a three-dimensional teaching model including body perception training, emotion-guided teaching, and creative choreography practice, emphasizing the stimulation of students' physical expression potential through situational creation and improvisational performance. Practice shows that this teaching model can effectively improve students' physical coordination, sense of rhythm, and emotional expression ability, while also playing a positive role in cultivating students' sense of teamwork and aesthetic literacy. The research provides a theoretical basis for innovating art education methods and has practical significance for promoting the all-round development of students. In the future, further exploration can be made on differentiated cultivation strategies for students of different age groups.

Keywords: multiple intelligences, dance teaching, kinesthetic cognition, emotional cognition, collaborative cultivation

1. Introduction

As the status of art education in the talent training system continues to rise, dance, as an art form that combines physical expression and emotional transmission, has attracted widespread attention for its educational value in the new curriculum reform. In current educational practice, traditional dance teaching often focuses on movement imitation and skill training, while neglecting the collaborative development of students' kinesthetic intelligence and emotional cognitive abilities. This

fragmented teaching model is difficult to meet the needs of cultivating compound talents in the new era.

Gardner's Theory of Multiple Intelligences provides important theoretical support for the reform of dance teaching. Human intelligence is diverse and can be developed through educational intervention, among which bodily-kinesthetic intelligence has a natural connection with dance teaching (Gardner, 1983). The physical movement training in dance can not only improve students' physical coordination, but also promote the development of their self-cognition and emotional management abilities through emotional guidance (Xia & Mo, 2023). However, existing studies mostly focus on the cultivation of a single ability, and there is a lack of systematic discussion on the collaborative mechanism of kinesthetic and emotional cognition.

Against this background, this study aims to explore the collaborative cultivation path of kinesthetic intelligence and emotional cognition in dance teaching. By analyzing the connection between the Theory of Multiple Intelligences and dance education, it reveals the inherent relationship between physical movement training and emotional experience, and further constructs a scientific and effective teaching model. The study focuses on three core issues: first, how dance movements affect the development of kinesthetic intelligence through body perception training; second, how emotion-guided teaching improves students' emotional expression ability; third, how creative choreography practice realizes the organic unity of physical expression and emotional cognition. The solution to these problems will provide a theoretical basis for innovating art education methods and have practical significance for realizing the all-round development of students.

2. Theoretical Basis of Multiple Intelligences Theory and Dance Teaching

2.1 Core Connotation and Educational Value of Multiple Intelligences Theory

The theory of multiple intelligences was proposed by American psychologist Howard Gardner in 1983. Its core idea breaks away from the single-cognitive perspective of traditional intelligence theories, arguing that human intelligence is a complex system composed of multiple relatively independent and interacting types of intelligence. Gardner initially put forward seven types of intelligence, which were later expanded to nine, including linguistic intelligence, logical-mathematical intelligence, spatial intelligence, musical intelligence, bodily-kinesthetic intelligence, interpersonal intelligence, intrapersonal intelligence, naturalistic intelligence, and existential intelligence (Gardner, 1983). Intelligence forms a dynamically developing network through the interaction between individuals and the environment, among which the linkage mechanism between bodily-kinesthetic intelligence and intrapersonal intelligence provides a key theoretical fulcrum for dance teaching.

The diversity of intelligence is reflected in three aspects: first, the variety of intelligence types, each with a unique cognitive symbol system; second, the difference in intelligence development, as individuals show significant differences in the development level of different intelligence fields; third, the uniqueness of intelligence combination, as the intelligence structure formed by each person is as irreproducible as a cognitive fingerprint. This multi-dimensional perspective subverts the intelligence evaluation system centered on language and mathematical abilities, and provides a more comprehensive evaluation framework for educational practice. The Theory of Multiple Intelligences establishes a coordinated relationship between teaching activities and students' development (Xu, 2024), enabling educators to activate students' potential through differentiated teaching strategies.

In terms of educational value, the Theory of Multiple Intelligences has promoted three fundamental transformations. Firstly, the transformation of teaching objectives, from single knowledge imparting to multi-ability cultivation. Especially in art education, dance teaching is no longer limited to movement skill training, but synchronously develops students' emotional cognition and social skills through physical expression. Dance teaching can "strengthen students' sense of rhythm and physical coordination" while promoting the "collaborative improvement of interpersonal interaction and self-awareness abilities" (Huang, 2024). Second, the transformation of teaching methods. Teachers need to design multi-modal teaching activities including physical experience, music perception, and spatial

exploration. For example, improvisational dance is used to develop students' bodily-kinesthetic intelligence and musical intelligence, and duet choreography is adopted to cultivate interpersonal intelligence. Third, the transformation of the evaluation system, which adopts dynamic evaluation to pay attention to students' development trajectory in different intelligence fields, rather than conducting standardized horizontal comparisons.

In the context of dance education, the value of the Theory of Multiple Intelligences is concentrated in the interaction between bodily-kinesthetic intelligence and emotional cognitive intelligence. Gardner believes that bodily-kinesthetic intelligence not only involves the ability to perform movements, but also includes the meta-ability to express emotions through the body, which is highly consistent with the emotional transmission function of dance (Gardner, 1983). When students express joy or sadness through dance movements, they not only exercise their physical intelligence in muscle control and spatial positioning, but also deepen their ability to perceive and regulate emotions, forming a "movement-emotion" two-way strengthened learning loop. This collaborative effect makes dance teaching an effective carrier for the implementation of quality-oriented education.

2.2 Unique Role of Dance Teaching in Cultivating Kinesthetic and Emotional Cognition

As an important form of art education, dance teaching has an irreplaceable integrated function in cultivating students' kinesthetic intelligence and emotional cognitive abilities. This dual attribute makes dance a natural bridge connecting physical training and psychological development, and its unique role is mainly reflected in three dimensions.

From the perspective of physiological mechanism, dance movement training strengthens kinesthetic intelligence through the coordinated operation of the neuromuscular system. When students perform movements such as spinning and jumping, they need to accurately perceive the spatial position and movement trajectory of various parts of the body. This continuous proprioceptive stimulation can significantly improve physical coordination and movement accuracy. Different from simple physical training, dance movements are always combined with music rhythm and emotional expression. For example, when expressing heroic emotions through the shoulder-shaking movements of Mongolian dance, students not only exercise the explosive power and control of the shoulder muscles, but also synchronously activate the cognitive experience of emotional tension. This synchronous physical and mental training model can simultaneously promote the "spiral development of physical intelligence and introspective intelligence" (Xiao, 2004).

At the psychological development level, dance teaching establishes a metaphorical connection between movements and cognition through emotional guidance. When teachers ask students to express "joy" or "anger" with their bodies, students need to transform abstract emotions into specific movement elements such as spatial trajectory and strength changes. This process is essentially the externalization of emotional cognition. Improvisational dance training particularly highlights this feature. For example, in the thematic improvisation "Spring Awakening", students express the emotional experience of life germination through physical rhythm, which not only develops spatial intelligence and musical intelligence, but also deepens the emotional resonance with the vitality of nature. Improvisational training can cultivate students' "ability to accurately convey emotional connotations through dance movements" (Xu, 2024), forming a two-way strengthening mechanism between physical expression and emotional experience.

From the social and cultural perspective, the collective creation characteristic of dance teaching provides a practical field for the collaborative development of intelligence. Group dance choreography requires students to not only accurately control their own movements, but also maintain emotional synchronization with others through non-verbal signals such as eye contact and gestures. This interpersonal interaction process simultaneously exercises bodily-kinesthetic intelligence and interpersonal intelligence. For example, in the teaching of Guozhuang dance, students maintain a circular formation and unified rhythm together, which not only improves physical coordination, but also cultivates team tacit understanding and collective sense of belonging. This comprehensive training can "break the limitations of professional teaching" and realize the "synchronous improvement of

emotional cognitive level and professional skills" (Han, 2023).

In current educational practice, the unique value of dance teaching has been further extended through digital means. The widely used virtual reality technology in recent years allows students to observe their own dance trajectory and emotional expression effects in real time through motion capture systems. This real-time feedback mechanism further strengthens the connection efficiency between kinesthetic training and emotional cognition. For example, in the basic training of ballet, students can intuitively see the relationship between spine extension and emotional tension in the arabesque movement through 3D projection, so as to more effectively adjust their body posture and emotional investment.

The "unity of body and mind" characteristic of dance teaching makes it an effective carrier for the implementation of quality-oriented education. Different from traditional physical education courses that focus on skill teaching and aesthetic education courses that emphasize theoretical explanation, dance teaching constructs a practical platform for the collaborative development of multiple intelligences for students through the organic unity of physical movements and emotional expression. This integrative feature is the core of dance education maintaining its unique vitality in the contemporary education reform.

3. Influence Mechanism of Dance Teaching on Students' Kinesthetic and Emotional Cognition

3.1 Stimulation Path of Kinesthetic Intelligence in Dance Teaching

In the practice of dance teaching, the stimulation of kinesthetic intelligence relies on the establishment of systematic body perception training and movement expression mechanisms. In dance, this intelligence is specifically manifested in the accurate grasp of body posture, movement trajectory, and strength control (Xu, 2024). Current teaching practice shows that the progressive training path can effectively activate students' kinesthetic potential and promote the collaborative development of their emotional cognitive abilities.

Movement decomposition training in the basic stage is the primary link to stimulate kinesthetic intelligence. By decomposing complex dance movements into local movement units such as head and neck, trunk, and limbs, teachers guide students to establish a clear awareness of body parts. For example, in the teaching of the classical dance movement "Yun Shou", students need to independently complete decomposed movements such as wrist rotation and arm circling first, and then gradually integrate them into a complete movement chain. This training strengthens students' fine perception of muscle contraction degree and joint movement range, laying a physiological foundation for the expression of complex movements in the future. Step-by-step training can help students shift from mechanical imitation to conscious movement control (Xu, 2024), realizing the initial development of physical intelligence.

The spatial trajectory training in the advanced stage focuses on cultivating the dynamic characteristics of kinesthetic intelligence. By designing movement combinations in different directions (such as linear movement and curved movement) and multi-level spatial movements (such as ground rolling and standing jumping), teachers help students establish a dynamic connection between the body and the three-dimensional space. The "fall and recovery" exercise in modern dance training typically embodies this process: students need to quickly adjust the position of their limbs to maintain balance in a state of weightlessness. This training not only improves spatial positioning ability, but also strengthens the body's instinctive response to physical properties such as inertia and gravity. Continuous spatial training can significantly enhance students' "ability to transform abstract spatial concepts into embodied movements" (Piao, 2014).

The improvisational creation link is a key path for the high-level development of kinesthetic intelligence. Through forms such as music improvisation and thematic improvisation, teachers require students to transform their internal emotions into impromptu movements. For example, in the thematic improvisation "Storm", students need to use rapid foot stamping to represent thunder and spinning movements to simulate whirlwinds. This process forces the brain to quickly integrate physical memory and emotional experience, forming a unique movement vocabulary. Improvisational training "breaks the constraints of standard movements" and enables students to achieve the "synchronous improvement of

physical control and expressive ability" in creative expression (Han, 2023).

Group dance collaboration improves the cultivation of kinesthetic intelligence from the dimension of social interaction. In group dance choreography, students need to maintain the accuracy of their own movements while achieving coordination with others in terms of speed, strength, and direction. For example, in the group dance training of Dai peacock dance, students need to complete the formation flow around the core shape of "peacock spreading its tail". They perceive the movement rhythm of their partners through non-verbal signals and adjust their own movements in real time, which not only strengthens the accurate control of body movements, but also exercises interpersonal coordination ability, reflecting the cross-activation characteristics of multiple intelligences.

Current teaching practice also focuses on integrating traditional cultural elements into kinesthetic training. For example, Zeng Huanxing integrates the breath regulation of Tai Chi and the stretching movements of dance in modern basic training. In practice, students can not only understand the physical control principle of "guiding Qi with will", but also feel the aesthetic conception of "combining hardness and softness". This training model goes beyond simple skill teaching, and integrates the development of kinesthetic intelligence with cultural cognition and emotional experience, providing an innovative paradigm for dance teaching under the goal of quality-oriented education.

3.2 Cultivation Model of Emotional Cognition in Dance Teaching

The cultivation of emotional cognition in dance teaching lies in establishing an organic connection between emotional experience and physical expression. The intrapersonal intelligence and interpersonal intelligence in Gardner's Theory of Multiple Intelligences provide theoretical support for this process. Through models such as situational creation, emotional guidance, and collaborative practice, dance teaching promotes the collaborative development of students' emotional perception and expression abilities.

Situational creation is the basic link to stimulate emotional cognition. By constructing a specific emotional atmosphere with elements such as music, lighting, and props, teachers guide students to transform abstract emotions into embodied movement expressions. For example, in the thematic teaching of "joy", combined with lively music and a bright color environment, students naturally express positive emotions through open movements such as jumping and spinning. This training not only strengthens the physical expression ability, but also cultivates students' keen awareness of emotional states. Han Yang pointed out that situational teaching can help students establish a metaphorical connection between emotions and movements (Han, 2023), realizing the transformation from physiological response to psychological experience.

Emotion-guided teaching adopts a progressive strategy to deepen cognition. In the primary stage, imitation training is used to establish a basic emotional vocabulary. For example, slow downward-swinging arms are used to express "sadness", and rapid arm movements are used to express "excitement". In the intermediate stage, complex emotional expression is introduced. For example, in the folk dance combination "Farewell", students need to express contradictory psychology through both the attachment in their eyes and the determination in their steps. The advanced stage focuses on emotional transformation training. For example, the modern dance exercise "Emotional Flow" requires students to complete the emotional transition from anger to calmness in continuous movements. This structured training can significantly improve students' "delicacy and coherence of emotional expression" (Zou, 2022). In this process, teachers need to closely observe students' emotional feedback, adjust the guidance method in a timely manner, and avoid the distortion of emotional expression caused by mechanical imitation.

Collaborative learning improves the development of emotional cognition from the dimension of social interaction. In duet or group dance choreography, students need to achieve emotional synchronization through non-verbal means such as physical contact and eye contact. For example, in the "trust" exercise, students take turns to fall backward with their eyes closed, relying on the physical support of their partners to establish an emotional connection. This training not only cultivates empathy, but also strengthens the social skill of interpreting

others' emotions through body language. In this process, teachers need to design clear collaboration rules, such as taking turns to act as the facilitator and setting up physical signals for emotional transmission, to ensure the orderliness and effectiveness of the interaction process.

The reflection and evaluation link is the quality guarantee for the cultivation of emotional cognition. After class, students are guided to analyze the effect of emotional expression in their own movements through methods such as video review and dance diaries. Teachers adopt a three-stage feedback method of "description-analysis-suggestion": first, objectively record the movement characteristics, then interpret the accuracy of emotional transmission, and finally put forward targeted improvement plans. This reflection process urges students to transform unconscious emotional expression into conscious cognitive strategies, realizing the leap from perceptual experience to rational cognition.

Current teaching practice also focuses on the infiltration of traditional cultural emotions. For example, students can experience the implicit emotional expression through the "twisting and grinding" movements of Jiaozhou Yangko, or feel the bold and passionate national character through the shoulder-shaking movements of Mongolian dance. This training makes the cultivation of emotional cognition go beyond the individual level and integrate with cultural inheritance and social value education, reflecting the comprehensive value of dance teaching in quality-oriented education.

3.3 Collaborative Mechanism of Kinesthetic and Emotional Cognition

The collaborative effect of kinesthetic and emotional cognition in dance teaching is essentially a dynamic process in which physical expression and psychological experience reinforce each other. This collaborative mechanism is realized through three core links: physiological activation triggering emotional resonance, movement coding deepening emotional understanding, and physical-mental feedback forming a cognitive closed loop. Together, they constitute a "body-emotion" two-way interactive teaching ecosystem, and improvisational creation is the core practical carrier that runs through it and realizes the in-depth collaboration between the two.

From the perspective of practice form, improvisational creation promotes the hierarchical collaboration of kinesthetic and emotional cognition through multi-thematic design. In thematic improvisation, teachers set specific or abstract themes (such as "Storm", "Trapped Bird", "Expectation") and require students to quickly transform the thematic emotions into physical language: when expressing "Storm", students need to use rapid foot stamping (strengthening lower limb strength control) to correspond to the intense emotion of thunder, and use rapid arm spinning (training spatial trajectory perception) to simulate the chaos of whirlwinds. In movement design, they simultaneously complete kinesthetic training such as muscle control and spatial positioning, as well as the cognitive expression of emotional intensity and levels; when expressing "Trapped Bird", they convey a sense of depression through body curling (core muscle contraction) and reflect the contradictory psychology of longing to break free through tentative finger stretching (fine movement control), realizing the in-depth integration of complex emotions and precise kinesthesia. In musical improvisation, students need to adjust the physical texture in accordance with the changes in the music style (such as transitioning from a soothing piano piece to an intense symphony) — for slow-paced music, they use smooth body waves (to train the continuity of movements) to express calmness; for fast-paced music, they use jerky joint vibrations (to enhance the explosive power of movements) to convey excitement, so as to create an immediate linkage between the sensory response and emotional perception, breaking the constraints of pre-set movements and achieving "the simultaneous improvement of body control and emotional expressiveness" (Han, 2023).

From the perspective of action mechanism, improvisational creation activates the spontaneous response of physical-mental collaboration through "no preset movement pressure". On the one hand, in the process of improvisation, students need to quickly integrate physical memory (such as movement vocabulary from previous training) and emotional experience (such as life perception of the theme), forcing the brain to quickly establish a mapping relationship between "movement elements and emotional symbols". For example, the degree of spine flexion and extension

corresponds to the ups and downs of emotions, and the weight of footsteps reflects the intensity of emotions. This mapping process upgrades kinesthetic intelligence from "mechanical execution" to an "emotional coding tool", and transforms emotional cognition from "conceptual understanding" to "embodied experience" (Xia & Mo, 2023); on the other hand, the personalized expression in improvisational creation encourages students to explore non-standard movement vocabulary, such as using finger trembling to express tension and body tilting to convey unease. These unique movement designs not only enrich the diversity of kinesthetic expression, but also deepen the cognition of subtle emotional differences, forming a virtuous cycle of "movement innovation — emotional deepening".

From the perspective of collaborative effect, the reflection and optimization link of improvisational creation further consolidates the achievements of physical-mental collaboration. Teachers guide students to analyze the matching degree between movements and emotions through video review, clarify the optimization path of kinesthetic adjustment for emotional expression, and transform unconscious collaboration into explicit cognition. This reflection process turns unconscious collaborative behavior into explicit cognition, enabling students to actively use kinesthetic control strategies to improve the effect of emotional expression, and finally achieve the collaborative goal of "accurate movement execution — in-depth emotional understanding — organic unity of the two", laying a foundation for the physical-mental integration in subsequent structured training and work choreography.

The physiological collaboration starts with the linkage between proprioception and emotional arousal. When students perform dance movements, the proprioceptive signals generated by muscle contraction and joint movement are transmitted to the brain, which not only activates the motor cortex to regulate movement accuracy, but also stimulates the limbic system to trigger corresponding emotional responses. For example, the sense of weightlessness generated by the body when completing large-scale jumping will naturally trigger excitement, while slow contraction movements tend to induce a state of calm or sadness. This physiological connection between "movement and emotion" is the material basis of the collaborative effect, and systematic training can enhance students' perception of the connection between physical signals and emotional changes (Huang, 2024).

The cognitive collaboration is manifested as the metaphorical mapping between movement symbols and emotional concepts. By embodying abstract emotions into movement elements (such as using rapid tapping to express anger and smooth curves to express joy), dance teaching helps students establish a movement representation system for emotional cognition. This mapping relationship is not a one-way transmission, but a two-way construction process: on the one hand, students master basic emotional vocabulary by imitating standardized emotional movements (such as using "covering the face" in classical dance to express sadness); on the other hand, they independently explore personalized expression methods (such as using finger trembling to express tension) in improvisational creation, thereby enriching the diversity of emotional cognition. This training can "open up the symbolic channel between physical experience and psychological experience", and develop emotional cognition from conceptual understanding to embodied cognition (Xia & Mo, 2023). The "Emotion-Movement Comparison Table" used in current teaching further systematizes this mapping relationship. The table not only sorts out the typical physical indicators corresponding to basic emotions (such as joy, sadness, anger) (for example, "joy" corresponds to raised corners of the mouth and increased body stretch), but also refines the movement combination logic for complex emotions (such as grievance, expectation) (for example, "grievance" needs to combine slightly lowered head and inward-shrinking shoulders), providing direct reference for students to establish a clear "emotion-movement" connection cognition. For example, "pride" is decomposed into operable physical control points such as upright spine, slightly raised chin, and expanded step range.

In the dimension of social interaction, the collaborative effect is strengthened through the synchronization of group movements. In group dance rehearsal, students need to adjust their own movement rhythm to be consistent with the group. This non-verbal coordination process is essentially the externalization of emotional

resonance. For example, in the circular formation of group dance, participants adjust the range and speed of arm swings to adapt to each other, which not only achieves visual uniformity, but also forms an emotional connection at the subconscious level. Collective creation can "surpass the limitations of individual intelligence" and catalyze the collaborative evolution of group emotional cognition through physical co-presence (Dong, 2021).

The improvement of the collaborative effect depends on the establishment of an "experience-reflection" cycle mechanism. After each dance training session, teachers guide students to conduct three-dimensional reflection: physical feelings (such as which muscle groups are tense), emotional changes (such as how emotions flow during the movement process), and cognitive gains (such as new understanding of the emotional theme). This structured reflection transforms the unconscious collaborative process into explicit knowledge. For example, students may realize that "when the arms are stretched, the chest opens, which brings about a sense of open-mindedness". In modern teaching practice, video review is used to mark key frames and match them with physiological data curves, making the reflection more accurate and efficient.

The final effect of the collaborative effect is reflected in the improvement of students' comprehensive expressive ability. After systematic training, students can: accurately perform technical movements at the physical level, understand the connotation of works at the emotional level, and realize the organic unity of the two at the expression level. This integration ability marks that the collaborative development of kinesthetic intelligence and emotional cognition has reached a new height, providing an operable practical path for dance teaching to achieve the goal of quality-oriented education.

4. Practical Path Design of Dance Teaching from the Perspective of Multiple Intelligences

4.1 Design of Dance Teaching Objectives Based on Multiple Intelligences

The Theory of Multiple Intelligences provides a systematic framework for the design of dance teaching objectives, emphasizing the collaborative development of intelligences such as bodily-kinesthetic, musical, and spatial intelligences to achieve the comprehensive improvement of students' comprehensive qualities. Based on this theory, dance teaching objectives should focus on three core dimensions: basic ability cultivation, emotional cognition development, and creative expression, forming a hierarchical and mutually supportive objective system.

In the dimension of basic abilities, the teaching objectives first focus on the development of bodily-kinesthetic intelligence. Through systematic body perception training, students are helped to establish accurate physical control abilities, including specific objectives such as muscle strength regulation, joint movement range, and movement trajectory grasp. For example, in basic ballet training, observable behavioral objectives such as "accurately completing the position change of fifth position feet" are set to ensure that students master the standard movement paradigm. At the same time, spatial intelligence cultivation objectives are integrated, such as "maintaining the perception of distance from the surrounding environment during movement", which can be achieved through spatial composition exercises in modern dance. The musical intelligence objective is reflected in the cultivation of a sense of rhythm, requiring students to "adjust movement speed according to music beats", which is particularly crucial in the combination training of folk dances. The setting of these basic objectives should follow the progressive principle, from local movements to complete combinations, and from single elements to multi-element collaboration, forming a stepped ability development path.

The teaching objectives in the dimension of emotional cognition emphasize the synchronous improvement of intrapersonal intelligence and interpersonal intelligence. Teachers need to design operable emotional experience objectives, such as "expressing three basic emotional states through physical movements", to guide students to establish a metaphorical connection between emotions and movements. In collective creation, interactive objectives such as "realizing emotional transmission through non-verbal signals" are set to cultivate empathy and social skills.

The objectives in the dimension of creative expression focus on the cultivation of high-level thinking abilities. Through improvisational

creation tasks, objectives such as "developing personalized movement vocabulary under a limited theme" are set to stimulate students' innovative potential. In work choreography, cross-art integration objectives such as "transforming literary images into dance scenes" are integrated to promote the cross-application of multiple intelligences. The design of objectives in this dimension should retain an appropriate degree of openness, such as "exploring non-traditional expression methods using props", to avoid restricting students' creativity. Current teaching particularly emphasizes cultural inheritance objectives, such as "analyzing regional cultural characteristics through folk dance movements", so that creative expression has both artistic value and educational significance.

The differentiation of objective design is the key to practice. For vocational college students, the focus is on vocational ability objectives, such as "mastering the essentials of teaching demonstration movements"; for ordinary college students, the aesthetic literacy objectives are strengthened, such as "analyzing the emotional expression methods of dance works". For groups with weak foundations, minimum objectives such as "completing basic movement combinations" can be set; for students with outstanding abilities, challenging objectives such as "creating micro dance sketches" are proposed. This hierarchical design can ensure that each student makes progress on their original basis.

The implementation of objectives relies on a scientific evaluation mechanism. A combination of process evaluation and result evaluation is adopted, focusing not only on skill indicators such as "movement completion degree", but also on expressive elements such as "accuracy of emotional transmission". The evaluation criteria should be open and transparent, so that students clearly know the direction of their efforts.

This objective system has the characteristic of dynamic adjustment. Teachers need to regularly collect students' feedback, such as understanding the appropriateness of objective difficulty through dance diaries, and optimize the design in a timely manner. Under the trend of interdisciplinary integration, innovative objectives such as "optimizing movement efficiency by combining physical principles" can be added to maintain the timeliness of teaching content. The final objective network runs through the entire process of dance teaching with the development of multiple intelligences, providing a clear direction for the construction of subsequent teaching models.

4.2 Teaching Strategies and Methods for the Collaborative Cultivation of Kinesthetic and Emotional Cognition

The collaborative cultivation of kinesthetic and emotional cognition requires systematic teaching strategies, whose core is to establish an organic connection between physical movements and emotional experience. Based on the Theory of Multiple Intelligences, teachers can adopt a progressive teaching method, guiding students to achieve the development goal of the unity of body and mind from basic perception training to high-level integrated expression.

Structured training adopts a "decomposition-integration" model to achieve ability progression. In the primary stage, complex movements are decomposed into single elements. For example, "joyful jumping" is decomposed into three components: "smiling expression", "arms raising", and "feet leaving the ground". Students practice each component separately and then gradually integrate them. In the intermediate stage, emotional transformation exercises are introduced, such as transitioning from "heavy walking" to "light running" to experience the emotional changes corresponding to different movement textures. The advanced stage focuses on improvisational creation, giving emotional themes (such as "Expectation") and allowing students to independently develop movement combinations. This training model conforms to the law of cognitive development, enabling students to flexibly apply the basic skills they have mastered to emotional expression. The "Emotion-Movement Comparison Table" used in current teaching systematically sorts out the physical indicators corresponding to common emotions (such as "anger" corresponding to fist-clenching, foot-stamping, etc.), providing a scientific reference for structured training: the table not only marks the quantifiable physical indicators corresponding to "anger", such as fist-clenching strength and foot-stamping frequency, to help students accurately control the movement intensity; but also clarifies the movement transformation logic between different emotions (such as gradually increasing muscle tension and accelerating movement

rhythm when transitioning from "calm" to "anger"), guiding students to achieve the coherent collaboration of emotions and kinesthesia in dynamic training and avoiding the problem of "movements in place but emotions disconnected".

The interactive feedback mechanism is a key link to improve the collaborative effect. Teachers adopt a "three-step feedback method": first, record students' performance through a motion capture system; second, jointly analyze the matching degree between movements and emotional expression with students; finally, formulate personalized improvement plans. For example, for the thematic improvisation of "Fear", teachers may point out that "the shoulder tension is sufficient but the eyes lack a dodging look" and suggest adding a slight head tilt movement. Peer evaluation is also an important method, adopting a "2+1" model (proposing two advantages and one improvement point) to cultivate students' observation and evaluation abilities.

Interdisciplinary integrated teaching expands the path of collaborative cultivation. By combining dance with art forms such as literature and fine arts, for example, choreographing movements according to poetic images (using spinning to express "high spirits in spring") or designing dance trajectories by imitating painting lines. This training encourages students to transform abstract emotions into multi-sensory experiences, strengthening the cross-activation of kinesthetic intelligence and emotional cognition. In folk dance teaching, students can be guided to analyze the relationship between costume colors and emotional expression, and enhance the cultural emotional resonance through practicing in traditional costumes. Teachers need to carefully select integrated materials to ensure that they are highly consistent with the teaching objectives, avoiding formalization for the sake of integration.

Differentiated teaching strategies meet the development needs of different students. For students with advantages in kinesthesia, the focus is on the training of the delicacy of emotional expression, such as conveying complex emotions through micro-movements (finger trembling, eye changes); for students with weak emotional perception, clear emotional prompt cards are used, marking specific guidelines such as "lowering the body center of gravity when feeling sad". When grouping students, attention should be paid to the complementarity of intelligence types, such as pairing students with a strong sense of space with emotionally rich students to promote mutual complementarity of advantages.

Reflective practice is a necessary means to consolidate the collaborative achievements. After class, students record their physical feelings and emotional changes through dance diaries, such as "feeling excited when making large-scale jumps, but the unstable landing affects the coherence of emotions". Teachers regularly organize sharing sessions to guide students to mark the emotional response areas of different movements with a "body map". In modern teaching practice, video review functions are combined, and slow playback is used to observe the expressions and physical coordination at key frames, making the reflection more objective and specific. This practice helps students transform the unconscious collaborative process into explicit knowledge, forming a sustainable improvement learning cycle.

The cultural infiltration strategy endows collaborative cultivation with deeper significance. In the teaching of folk dance, by analyzing the cultural connotations such as "the connection between the hand shape of Dai peacock dance and the modest character", physical training carries the functions of emotional education and value transmission. Current teaching particularly emphasizes the combination of traditional culture and modern life. For example, integrating traditional festival themes into improvisational creation. When students express "Jingzhe" (the Awakening of Insects), they need to not only imitate the physical movements of insects waking up, but also convey the emotional experience of the germination of life. This training goes beyond the level of skill teaching, making the collaborative development of kinesthetic and emotional cognition a vivid carrier of cultural inheritance.

The implementation of the above strategies requires teachers to have keen observation and flexible control abilities. In teaching practice, it is recommended to adopt a "dual-line recording method": focusing not only on visible skill indicators such as "movement completion degree", but also on tracking emotional experience changes through interviews and

questionnaires. Regular interdisciplinary teaching and research activities should be organized, such as jointly designing "emotion-movement" correlation experiments with psychology teachers, to continuously optimize the scientificity and effectiveness of collaborative cultivation. The final teaching strategy system transforms the Theory of Multiple Intelligences into an operable practical plan, providing strong support for the quality cultivation goal of dance education.

5. Conclusions

Based on Gardner's Theory of Multiple Intelligences, this study systematically explores the collaborative cultivation mechanism and practical path of dance teaching on students' kinesthetic intelligence and emotional cognitive abilities. The main conclusions show that dance teaching can effectively promote the development of students' comprehensive qualities through the organic integration of physical movements and emotional experience. Specifically, the cultivation of kinesthetic intelligence not only improves students' physical coordination and movement expressive ability, but also provides an embodied carrier for emotional cognition; while the development of emotional cognition endows movement expression with in-depth connotations, and the two form a virtuous cycle of mutual reinforcement. Practical verification shows that the three-dimensional teaching model including body perception training, emotion-guided teaching, and creative choreography practice, combined with teaching methods such as situational creation and improvisational performance, can significantly improve students' artistic expressive ability and sense of teamwork.

There are still several aspects of the current research that need to be further deepened: first, the differentiated cultivation strategies for students of different age groups need to be refined, especially the differences in physical development and emotional maturity between child and adult learners have not been fully explored; second, cross-cultural comparative research is relatively insufficient.

Looking forward to the future, the development of this research field can focus on three directions: first, constructing a dynamic evaluation system and developing a multi-dimensional evaluation tool that takes into account both movement skills and emotional expression to realize the scientific quantification of teaching effects; second, expanding the interdisciplinary research perspective and strengthening cooperation with fields such as psychology and neuroscience to deeply reveal the physiological and psychological mechanisms of the collaborative effect of kinesthetic and emotional cognition; third, promoting educational equity practice and exploring dance teaching models suitable for special education groups (such as hearing-impaired students) to give full play to the inclusive value of art education. With the continuous deepening of quality-oriented education reform, dance teaching, as an important carrier of aesthetic education, will be more widely recognized and applied for its function of developing multiple intelligences.

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Occupational Stress and Coping Strategies Used by Secondary School Teachers in Kisumu County, Kenya

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Abstract

Although, teaching is a noble occupation, it comes with a lot of commitment and responsibilities that are highly demanding and which requires resilience to cope with stress. Teachers are predisposed to stress from lesson planning, heavy workload, strained relationships from the school administrators and colleagues as well as financial constraints, mental health issues and family work balance. Thus, the necessity to prioritize better coping strategies to help teachers manage occupational stress. This study assessed Occupational stress and coping strategies used by secondary school teachers in Kisumu County, Kenya. A mixed method research design was used in the study. Secondary school teachers in Kisumu County were the targeted population. Simple random sampling technique was used to select 100 teachers from secondary schools in Kisumu County. The data collection instruments were questionnaires and focused group discussions. Analysis of data was done through descriptive statistics and thematic analysis for the focus group discussions. Findings of the study indicate that teachers in Kisumu County are highly stressed. Results also point out that teachers use coping strategies ranging from mindfulness, religious activities, counseling, exercise, social support network, suicidal tendencies, reading, professional development, alcohol and substance abuse; some of which are unhealthy. The study recommends a counseling unit for teaching staff both at the school and county level. Teachers should also prioritize self-care for their own mental wellness. Moreover, the teacher's welfare should be put at the heart of educational institutions through open communication channels, active and empathic listening for enhanced performance and teachers' mental wellness.

Keywords: occupational, stress, coping, strategies

1. Introduction

1.1 Causes of Occupational Stress Among Teachers

Occupational stress refers to persistent stress that is related to the work environment. The stress may be caused by work responsibilities or by hostile work conditions (Ahmed, 2019). Other studies define occupational stress as the physical and emotional reaction that takes place when an individual employee perceives an imbalance between their work demands and their ability or resources to meet the work demands and expectations (Punia & Balda, 2016; Gao, 2020). However, if the work pressures are not well

managed, occupational stress may not only be harmful to the physical and emotional wellbeing of an individual but also impact on their productivity (Gebrekirstos, 2015; Fadhel, 2020). Worldwide, research studies reveal that teachers play a key role as educational planners, learning facilitators, students' mentors, resource persons, content deliverers, curriculum developers and implementers and this increases the burden of occupational stress due to the heavy workload (Kang, Park & Park, 2020). The huge responsibilities and the need to create a balance further intensifies the level of stress among teachers. (Mills, 2002; Siswanto, 2015; Atieno, Ogalo, Odera & Ogogo, 2020; Chinthana et al, 2022). Several factors predispose teachers to have occupational stress. A research study by Kaupa (2020) among 100 high school teachers in the Khomas Region in Namibia reveals that teacher's heavy workload, understaffing in schools, inadequate resources, poor remuneration and unconducive work environment has led to chronic absenteeism. This has resulted in frequent teacher transfers, anger and suicidal ideation among teachers which impacts negatively on teacher performance.

Similarly, several studies indicate that job stress among teachers is aggravated by the heavy workload. The heavy burden of work includes number of lessons taught by a teacher weekly, setting and marking of class assessments, administrative roles and the discipline of learners. The studies indicate that the pressure of work is demanding due to understaffing in most schools hence work stress, exhaustion and burn out among teachers. (Kongcharoen et al, 2020; Freire et al, 2020; Fathi, Greenier & Derakhshan, 2021). Additionally, these studies indicate that student's needs, societal expectations and school evaluation and assessment create excessive tasks for teachers which can be overwhelming.

Comparatively, Nyambogi's (2013) study on the causes of Stress among teachers in public secondary schools in Starehe District, Kenya, reiterates that work overload, students' indiscipline, inadequate remuneration, strained relationships with colleagues and the school administration escalates the level of teacher stress which is not only harmful to their general wellbeing but also their performance. Moreover, research studies postulate that the cause of stress among teachers is work overload, unconducive work environment, teacher-student interaction, staff communication, poor motivation, which leads to dismal performance (Prasad et al, 2016; Weiguo et al, 2022). On the other hand, research findings by Zhao, Liao, Li, Jiang and Ding (2022) on the relationship between job stress and burnout among Chinese primary and secondary school teachers argues that the imbalance between work and family contributes to stress and burnout among teachers. Moreover, chronic job stress heighten work–family tension, and this contribute to job burnout. Similarly, studies by Gao (2020) and Kang, Park and Park (2020) assert that when the emotional wellbeing of spouse and children are not seriously taken into consideration, family tension is bound to increase, hence affecting the performance of individual teachers.

1.2 Teachers Coping Strategies

Research studies indicate that secondary school teachers used planning, active problem solving, positive reframing as strategies to cope with occupational stress (Freire, Ferrada's, Rodriquez, Valle, & Nunez, 2020; Amponsah, Adasi et al, 2020). Other studies by Johnson, Cooper et al, (2005) and Cinthatana, Ashok et al. (2022) report that secondary school teachers used withdrawal, intense hostility and substance use as coping strategies. On the other hand, studies (Al Tell, Mansor, 2019; Fadhel & Adawi,2020) highlight the use of exercise, support seeking, religion and meditation as healthy coping strategies. Further research by Gowrie, Ramdass, Birbal, Dass, Singh and Rocke (2015) indicate that teachers should be engaged in fun activities that they enjoy; listening to music, gardening, exercising and art as such activities give teachers an outlet and takes their minds off the work pressures. Findings show that other coping strategies that teachers employ include seeking professional counseling, meditation and Yoga (Gebrekirstos, 2015).

2. Research Methodology

The study used a mixed method research design exploring both quantitative and qualitative methods. Secondary school teachers in Kisumu Central Sub County, Kisumu County were the targeted population. Simple random sampling technique was used in the study. The sample population was 100 teachers from secondary schools in Kisumu Central Sub County, Kisumu County. The data collection instruments were

questionnaires and focused group discussions. The questionnaires were used to seek information on the causes of stress among the teachers and the coping strategies that they use. The focus group discussions were used to harvest data on the coping strategies that teachers use to manage stress. The focus group discussion helped the researcher to have close interaction with the participants, and this helped in putting the teachers stress and coping strategies they use in perspective. Analysis of data was done through descriptive statistics and thematic analysis for the focus group discussions. To ascertain the degree to which test items measure the characteristics for which they are designed to measure, reliability and validity of the instruments was done.

3. Results and Discussion

3.1 Participants Response on Signs of Occupational Stress

The findings in Table 1 present the teachers' opinion on the signs of occupational stress that they experience as a result of their work engagements.

Table 1. Participants Response on Signs of Occupational Stress

No	Signs of Occupational Stress	No of Teachers	Percentages
1	Back aches	9	11%
2	Chronic headaches	14	48%
3	Sleeplessness/Insomnia	16	30%
4	Severe illness	8	38%
5	Depression	11	26%
6	Lack of motivation	23	42%
7	Substance abuse/alcohol	15	36%
8	Forgetfulness	5	20%
9	Restlessness/Anxiety	9	54%
10	Anger	10	34%
11	Absenteeism	4	8%
		Total= 100	

Moreover, as presented in Table 2, a four-point rating scale, ranging from strongly agree (4) to strongly disagree (1), was used to record responses of the teacher's opinion on causes of occupational stress.

Table 2. Secondary School Teachers View on Causes of Stress

No	Causes of Stress among teachers	Strongly Agree 4	Agree 3	Disagree 2	Strongly Disagree 1	Mean	Standard deviation
1	I am stressed because of my workload as a teacher	53%	37%	6%	4%	3.15	1.123
2	Family-work imbalance is a burden	33%	39%	15%	13%	2.72	0.998
3	I feel stressed due to poor remuneration	45%	38%	10%	7%	2.93	0.973
4	Threats, intimidation, forced transfers and interdiction by the school Administrator is a stressor to me	46%	50%	2%	2%	2.91	0.984

5	Students Indiscipline among students is stressful to teachers	24%	31%	34%	11%	2.01	0.785
6	Unhealthy Interaction with colleagues makes me stressed	33%	48%	11%	8%	2.12	0.798

The results in Table 2 show the causes of stress among the teachers. The findings on this table indicate that one of the causes of stress among the teachers is heavy workload which stands at 53% with a mean score of 3.15 and standard deviation of 1.123. Table 2 implies that teachers face stress due to high pressure in their workplace. Additionally, the findings from the focus group discussions revealed that most teachers were stressed due to heavy workload which stretched past the official working hours. Teachers face stress due to long working hours, high expectations from school management to produce good results as well as pressure from school administrators. From the focus group discussion, teachers were of the opinion that there should be flexibility on time required to administer any extra program beyond the official working hours.

We go through a lot of stress due to work overload which stretches as late as 10.00 pm and as early as 4.00 am. Teachers need to rest and rejuvenate after the day's activities in order to prepare for lessons the next morning. As teachers we have families to take care of, some of us with young children under our care. Therefore, family time should also be given priority.

Moreover, 39% of the respondents opine that work family imbalance is a stressor in their lives. Similarly, findings from the focus group discussion show that there is no work family balance as the teachers spend most of their time in school past the official working hours. Teachers are unable to balance work and family as more time is spent at work. Furthermore, the respondents felt that the late working hours is breaking families and creating conflicts between teachers and their spouses hence no peace at home.

"Due to late working hours, some of us go through constant disagreements and conflicts with our spouses hence no peace at home."

Nearly half of the teachers (45%) strongly agreed that they are stressed due to poor remuneration. The findings show that teachers face financial challenges. On the same note, results from the focus group discussion reveal that teachers are struggling financially due to low pay which forces them to survive on loans thus fueling unresolved domestic issues. The respondents felt that the issue of poor salaries should be addressed by the employer. The findings also show that a majority of the teachers (50%) with a mean of 2.91 agree that threats, intimidation, forced transfers and interdiction by the school Administrators contribute to stress. Results from the focus group discussion further indicate that a major source of stress at the workplace is caused by threats and intimidation by the administration. The teachers reported that they are scared about withdrawal of lessons allocated to them, show cause or disciplinary letters, interdiction and abrupt transfer to other schools. The respondents as well reported that they feel stressed because the administration has little regards and respect for teachers, always ordering and communicating with them using disrespectful language. Teachers felt that they are being harassed and as such, communication channels should be improved, and teachers' opinion should also count.

We live in constant fear due to threats and intimidation by the school administrators, withdrawal of lessons allocated to us, show cause or disciplinary letters, interdiction and abrupt transfers to other schools, the teachers reiterated.

Another key challenge that predisposes teachers to stress is student indiscipline, which stands at 31% with a mean score of 2.01. Additionally, 48% of teachers were of the opinion that unhealthy interaction with colleagues makes them stressed. Moreover, the focus group discussion revealed that the respondents felt that there was little support among teacher colleagues due to mistrust, gossip and rumour mongering. Consequently, teachers are afraid of being reported negatively to the administration, so everyone keeps to themselves.

Table 3 shows how often the respondents used coping strategies to manage occupational stress A four-point rating scale, ranging from; most often (4) to less often (1), was used to record responses of the teachers on coping strategies used to manage occupational stress.

Table 3. Teachers view on Coping Strategies they use to manage stress

No	Coping Strategies	Most often 4	More often 3	Often 2	Less often 1
1	Mindfulness	10%	15%	25%	50%
2	Religious activities	18%	32%	29%	21%
3	Counseling	16%	14%	25%	45%
4	Time management	48.5%	32.5%	15%	4%
5	Exercise/ outdoor activities	23.2%	28.8%	33%	15%
6	social support network	35.7%	13%	31%	21%
7	Suicidal tendencies	28%	16%	5%	51%
6	Hobbies/reading	25.7%	29%	36%	30%
9	professional development	12.5%	38.5%	40%	5%
10	Alcohol and Substance abuse	44%	26%	10%	20%

The findings on Table 3 show that most teachers cope with stress by using diverse coping strategies: mindfulness, religion, counseling, time management, social support networks, exercises, suicidal tendencies, reading, professional development and alcohol and substance abuse. The table above indicates that 50% of the respondents less often use meditation while 18% and 16% use religious activities and counseling respectively. Moreover, 48.5% use time management whereas 33% often engage in exercise and other outdoor activities. The results clearly point out that although 35.7% of the teachers seek social support, 28% of the teachers most often explore suicidal tendencies. From Table 3, it is indicated that 44% of teachers often use alcohol and other addictive substances when they are stressed. The results also indicate that 29% of the respondents more often use reading and other hobbies to cope with stress.

However, 38.5 % get involved in professional development when stressed. Generally, the results in Table 3 reveal that some teachers use coping mechanisms which are healthy and problem solving oriented such as mindfulness, religion, counseling, time management, social support networks and exercises. On the contrary, the findings presented in Table 3 also indicate that teachers use unhealthy coping strategies (suicidal tendencies, alcohol and substance abuse) some of which are detrimental to their health, performance and wellbeing. The results of the current study were consistent with previous research (Freire, Ferrada's, Rodriquez, Valle, & Nunez, 2020; Amponsah, Adasi et al, 2020), which reported that religion, meditation, fun activities, planning and positive reframing were more effective than use of withdrawal and substance use (Cinthatana, Ashok et al, 2022).

4. Conclusion

In conclusion, the teachers in Kisumu County are stressed due to unconducive work environment, the teachers' heavy work load with some programs running past the official working hours. Moreover, it is not easy achieving work family balance, and this degenerates family conflicts. The teachers are also stressed because of too much pressure imposed on them by the school administration, poor pay and indiscipline among students. Therefore, the school administration should create a conducive work environment as this is not only significant for effective academic performance but also plays a key role in the general well-being of the teachers. Teachers also use diverse coping strategies ranging from mindfulness, religious activities, counseling, exercise, social support network, suicidal tendencies, reading, professional development, alcohol and substance abuse.

5. Recommendation

Based on these results, the study recommends that the school administrators and the Ministry of Education should introduce occupational stress management programs and a counseling unit for teaching staff both at the school and county level. Teachers should also prioritize self-care for their own mental wellness. Moreover, school administrators should create a friendly conducive environment to enhance performance and general wellbeing of the teachers. The teacher's welfare should be put at the heart of educational institutions through

open communication channels, active and empathic listening. The Ministry of Education in collaboration with the school administrators should effectively implement teacher mentorship programs to offer support, counseling, guidance and team building to teachers in need.

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Design and Development of Kindergarten C-STEAM Curriculum from the Perspective of Five-Education Integration

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Abstract

Based on China's localized educational policy of "Five-education Integration" and the practical needs of STEAM education in kindergartens, this study proposes the "C-STEAM" curriculum concept (Cultural-STEAM, i.e., STEAM education with cultural infiltration). It explores the integrated path for fostering the all-round development of children in morality, intelligence, physical education, aesthetics, and labor (the "Five Educations") and the cultivation of interdisciplinary inquiry abilities at the kindergarten stage. By employing methods such as literature analysis, action research, and case development, a "three-dimensional and four-level" curriculum framework is constructed, a library of thematic activity cases is developed, and implementation strategies are put forward. The research shows that the C-STEAM curriculum can effectively promote the development of children's multiple abilities and provide a practical model for kindergartens to implement the Five-education Integration.

Keywords: five-education integration, kindergarten education, c-steam curriculum, children's development

1. Introduction

The "Overall Plan for Deepening the Reform of Educational Evaluation in the New Era" emphasizes the "Five-education Integration" and requires education to return to its essence of nurturing people (Yuan, L., 2022). The "Guidelines for the Learning and Development of Children Aged 3-6" advocates "integrated education", providing policy support for the localization of STEAM education (Ministry of Education of the People's Republic of China, 2012). Currently, the STEAM curriculum in kindergartens has problems such as "emphasizing skills over literacy" (Banks, J. A., 2008), "superficial interdisciplinary integration", and "insufficient cultural infiltration". Therefore, it is necessary to reconstruct the curriculum logic under the guidance of the Five-education Integration. This study combines the excellent traditional Chinese culture with STEAM education to construct a "C-STEAM" curriculum model, providing a new path for kindergartens to implement the fundamental task of fostering virtue through education (Zhan, Z. H., Li, K. D., Lin, Z. H., Zhong, B. C., Mai, Z. Y., & Li, W. X., 2020).

The Five-education Integration refers to the organic integration of moral education, intellectual education, physical education, aesthetic education, and labor education to form an educational system for all-round development. The implementation of the Five-education Integration in kindergarten curricula aims to cultivate children's comprehensive quality and all-round development capabilities (Lamb, R., Akmal, S., et al., 2015). Domestic research mainly focuses on policy interpretation and practice in primary and secondary schools, while research at the kindergarten stage mostly focuses on the infiltration of a single field, lacking systematic curriculum design (Wan, H. W. F., Mohamad, M. F., et al., 2016).

STEAM education refers to the integration of five disciplines — Science, Technology, Engineering, Art, and Mathematics — to promote the comprehensive improvement of students' comprehensive abilities (Welling, J., Wright, J., et al., 2018). David Anderson, a foreign scholar, believes that STEAM courses, with their interdisciplinary characteristics, stimulate students' innovative thinking and problem-solving abilities, and cultivate their practical skills and teamwork abilities. Foreign research on STEAM education emphasizes interdisciplinary integration and problem-solving abilities. However, the practice of STEAM education in domestic kindergartens mostly draws on Western models, resulting in insufficient cultural adaptability.

C-STEAM education is a new model of STEAM education oriented towards excellent traditional culture. It combines excellent traditional Chinese culture with the educational concept of STEAM (Science, Technology, Engineering, Art, Mathematics). It aims to inherit and promote traditional culture through interdisciplinary approaches, emphasizing the integration of disciplinary knowledge and skills in real scenarios for problem inquiry and solving, thereby cultivating students' cultural inheritance literacy and interdisciplinary innovation literacy. Scholars such as Zhan Zehui have proposed interdisciplinary integrated education (C-STEAM) for cultural inheritance, analyzed the cultivation approaches of C-STEAM education, constructed the ETIC framework from two dimensions—training methods ("process-oriented vs. result-oriented") and ability development ("low-level vs. high-level")—and further distinguished four typical C-STEAM project models: experience-perception type, skill-training type, inquiry-learning type, and innovation-creation type (Yakman, G., & Lee, H., 2012).

In recent years, the emerging "culture + STEAM" model (such as the "STEAM + local culture" model in the United States) has provided references for the development of localized curricula, but a mature practical framework for kindergartens has not yet been formed (Aschbacher, P. R., Ing, M., et al., 2014).

2. Design Principles and Objectives of Kindergarten C-STEAM Curriculum from the Perspective of Five-education Integration

2.1 Curriculum Design Principles

1) **Child-centered Principle**: Respect children's interests and cognitive characteristics, and ensure that the difficulty level of activities is in line with their zone of proximal development.
2) **Five-education Integration Principle**: Each activity should contain at least two elements of the "Five Educations". For example, the "traditional paper art" activity integrates aesthetic education (aesthetic appreciation), labor education (hands-on practice), and moral education (cooperation).
3) **Cultural Infiltration Principle**: Take traditional cultural themes (such as solar terms, intangible cultural heritage, and folk customs) as carriers to infiltrate STEAM elements.
4) **Gamification Principle**: Stimulate the interest in inquiry through game forms such as situational creation, role-playing, and hands-on operations.

2.2 Curriculum Objective System

Dimension	Objective Content
Overall Objective	Cultivate "little citizens" with the spirit of inquiry, cultural confidence, and all-round development in morality, intelligence, physical education, aesthetics, and labor

Moral Education	Cultivate the awareness of cooperation, sharing, and responsibility, and understand traditional virtues (such as "filial piety to parents" and "diligence and frugality")
Intellectual Education	Develop the abilities of observation, thinking, and problem-solving, and master simple scientific inquiry methods (such as classification and measurement)
Physical Education	Develop motor coordination skills through physical operations (such as building and weaving), and cultivate healthy living habits
Aesthetic Education	Experience the beauty of colors, shapes, and rhythms in traditional culture, and express creativity in various forms
Labor Education	Participate in the use of simple tools and material processing, and experience the process of labor and the value of labor achievements

3. Construction of the Content System of Kindergarten C-STEAM Curriculum

3.1 Curriculum Content Framework: The Three-Dimensional and Four-Level Model

3.1.1 Horizontal Three-Dimensional Dimensions

- **Cultural Theme Dimension**: Traditional festivals (e.g., the Spring Festival, the Dragon Boat Festival), folk crafts (e.g., paper-cutting, pottery), natural solar terms (e.g., the Spring Equinox, the Winter Solstice), and traditional science and technology (e.g., the compass, the abacus).
- **STEAM Element Dimension**: Scientific inquiry (observation, experiment), technology application (tool use), engineering practice (design and construction), artistic expression (creation and aesthetic appreciation), and mathematical cognition (quantity, shape).
- **Five-education Objective Dimension**: Decompose activity objectives according to moral education, intellectual education, physical education, aesthetic education, and labor education.

3.1.2 Vertical Four-Level Dimensions

- **Junior Class**: Focus on sensory experience, such as "understanding traditional toys (diabolo, kite)".
- **Middle Class**: Focus on simple operations, such as "making sachets (sewing, cutting, and color matching)".
- **Senior Class**: Focus on problem-solving, such as "designing traditional bridges (structural construction, material selection)".

3.2 Development of Excellent Cases of Thematic Activity Cases

From the perspective of "Five-education Integration", this study further interprets STEAM education, believing that the "Five Educations" are an integral educational goal rather than several independent educational processes. Moreover, on the basis of the existing research by scholars, it strongly challenges the educational status quo where the "Five Educations" are fragmented like "five separate pieces of leather". Based on the interpenetrating relationship of the "Five Educations" where "each contains the other", this study further enriches and improves the relationship between the "Five-education Integration" and STEAM education.

Secondly, this study grasps the design and development of the STEAM curriculum in combination with the characteristics of education in Henan Province, especially the C-STEAM curriculum, which should be integrated with the educational characteristics of Henan Province. STEAM education based on excellent traditional culture is a brand-new educational paradigm and also one of the important ways to cultivate and develop students' core literacy.

From the perspective of the Five-education Integration, this study conducts action research on the kindergarten C-STEAM curriculum. Experimental kindergartens are selected based on their representativeness, willingness to participate in the research, and conditions for implementing the C-STEAM curriculum, taking into account factors such as their geographical location, teaching staff, and educational resources. Within the experimental kindergartens, several classes in the junior, middle, and senior grades are randomly selected as sample classes to ensure the

representativeness and comprehensiveness of the samples. The following are excellent cases from the development and implementation of thematic activities.

Case 1: "Dragon Boat Designer" for Middle Class (Integration of Five-education and STEAM)

Activity Stage	Corresponding STEAM Field	Key Points of Five-education Integration	Specific Implementation Content
Cultural Introduction	Science (S)	Moral Education: Cultivate initial teamwork awareness through group discussions; Intellectual Education: Stimulate the interest in exploring buoyancy and hull structure	1. Watch videos of dragon boat races to experience the culture of traditional festivals; 2. Conduct group discussions on "why dragon boats can float on water" and record initial ideas
Design Stage	Mathematics (M), Engineering (E)	Moral Education: Clarify division of labor in groups to strengthen the awareness of cooperation; Intellectual Education: Learn to measure the length of dragon boats with tools and understand symmetry; Labor Education: Get in touch with material selection methods initially	1. Work in groups to draw dragon boat sketches and mark the length and symmetrical structure; 2. Measure the size of building blocks/cartons with a ruler and select suitable building materials (building blocks, cartons, ropes)
Construction and Decoration	Technology (T), Art (A)	Intellectual Education: Practice the principle of hull structure stability; Aesthetic Education: Design traditional dragon patterns and use color matching; Labor Education: Use tape to fix and assemble models to exercise hands-on ability	1. Build the hull frame with building blocks and fix the joints with tape; 2. Draw traditional patterns such as dragon patterns and auspicious clouds on cardboard/cartons with colored pens to decorate the hull
Sharing and Improvement	Engineering (E), Science (S)	Moral Education: Conduct group presentations and sharing, and learn to listen to and respect others' opinions; Intellectual Education: Analyze model problems and explore optimization methods	1. Each group presents their dragon boat models and introduces the design ideas; 2. Conduct collective discussions on "how to make the dragon boat more stable" (e.g., adding bottom supports, adjusting the center of gravity) and record the improvement plans

In terms of activity objectives, moral education cultivates teamwork awareness through group cooperation; intellectual education encourages children to understand the structural characteristics of dragon boats, such as length and symmetry; engineering and technology involve building dragon boat models with building blocks and cardboard; and art involves designing dragon boat patterns, such as colors and patterns.

The overall activity process starts with cultural introduction: watching videos of dragon boat races and discussing "why dragon boats can float on water". Then, in the design stage, groups draw dragon boat sketches and select materials. Next, the construction and decoration stage begins: fixing the hull with tape and drawing dragon patterns with colored pens.

Finally, the sharing and improvement stage takes place: presenting the models and discussing "how to make the dragon boat more stable".

It can be seen from the case that the specific path of the Five-education Integration in this case study is reflected in the following aspects: moral education is carried out through group division of labor in construction; intellectual education is implemented through scientific inquiry, including discussions on buoyancy and structural stability; aesthetic education is reflected in artistic expression, such as the creation of traditional patterns; and labor education is conducted by developing hands-on ability, specifically through tool use and model assembly.

Case 2: "Erecting Eggs on the Spring Equinox" in Traditional Solar Terms for Senior Class (Science + Culture + Mathematics)

Activity Stage	Corresponding STEAM Field	Key Points of Five-education Integration	Specific Implementation Content
Solar Term Culture Introduction	Science (S), Humanities (Cultural Extension)	Moral Education: Learn to listen to others' opinions in group discussions; Intellectual Education: Perceive the characteristics of the Spring Equinox and the connection with the custom of "erecting eggs"	1. Watch animations about the Spring Equinox to understand the characteristics of the Spring Equinox (equal day and night, revival of all things); 2. Share the legend of "erecting eggs on the Spring Equinox" (e.g., "the tilt angle of the Earth's axis is suitable for erecting eggs on the Spring Equinox") and conduct group discussions on "why it is easier to erect eggs on the Spring Equinox"
Egg-erecting Inquiry Practice	Science (S, balance principle), Mathematics (M, angle/number of attempts statistics)	Intellectual Education: Explore the balance conditions of eggs (center of gravity, contact surface); Labor Education: Exercise fine motor skills and patience; Moral Education: Conduct mutual assistance in groups to try different methods	1. Work in groups to receive eggs, shallow plates, and salt grains (auxiliary materials), and try different methods such as erecting eggs without assistance and erecting eggs with salt sprinkled; 2. Use a simple protractor to measure the tilt angle of eggs initially, record the "success/failure" status, and observe the difference in placement between the egg tip and the egg tail
Data Recording and Analysis	Mathematics (M, statistics/comparison), Technology (T, tool use)	Intellectual Education: Learn to use tables for data statistics and analyze the key factors for "successful egg erection"; Moral Education: Respect different inquiry conclusions in collective sharing	1. Use pre-drawn statistical tables to record the "number of attempts and successful attempts of different methods" within the group (e.g., "10 attempts without salt, 2 successes; 10 attempts with salt, 6 successes"); 2. Conduct collective comparison of data from each group and discuss "why sprinkling salt can improve the success rate" (salt grains increase friction and help fix the center of

			gravity)
Solar Term Extension and Application	Art (A), Mathematics (M, symmetrical design)	Aesthetic Education: Decorate eggs with elements related to the Spring Equinox; Intellectual Education: Design patterns using the principle of symmetry; Labor Education: Use colored pens and stickers safely for decoration	1. Draw symmetrical patterns related to the Spring Equinox (e.g., willow leaves, peach blossoms, kites) on eggs with colored pens; 2. Place the decorated "successfully erected eggs" in the class solar term corner for display and discuss "how to keep the displayed eggs balanced" (e.g., matching with a base, adjusting the placement position)

The core objective of Case 2 is to explore the scientific principle of "egg standing" (center of gravity and friction) and understand the custom of the Spring Equinox. Through scientific observation of the curvature of the egg surface, different placement methods are tried; mathematically, the number of successfully standing eggs is recorded, and the success rates of "placing the big end down" and "placing the small end down" are compared; culturally, the legend of "erecting eggs" on the Spring Equinox is told, and solar term picture books are made, so as to achieve the STEAM curriculum design under the Five-education Integration.

4. Curriculum Implementation Paths and Strategies

4.1 Environment Creation: Building a "C-STEAM Cultural Inquiry Area"

Environment creation is an important part of kindergarten education. According to the practice of this study, building a "C-STEAM Cultural Inquiry Area" is an effective method. In terms of class areas, set up a "traditional craft corner" with pottery and tie-dye tools, a "science laboratory" with magnifying glasses and balances, and an "engineering construction area" with building blocks and waste materials. In addition, in the kindergarten environment, arrange a "solar term corridor" and an "intangible cultural heritage wall" to display children's works such as paper-cutting and facial masks.

4.2 Teacher Role Transformation

Teachers play an important role in the design and development of the C-STEAM curriculum. Therefore, the transformation of teachers' roles is also a necessary step, which specifically includes three aspects. Firstly, teachers should be cultural communicators, master knowledge of traditional festivals and folk customs, and infiltrate culture through stories, children's songs, and other forms. Secondly, they should be inquiry guides, stimulating children's thinking through questions such as "why glutinous rice is wrapped in zongzi leaves". Finally, they should be resource integrators, connecting with community resources such as inheritors of intangible cultural heritage and science and technology museums to carry out practical activities.

4.3 Home-Kindergarten Co-Education Strategies

The design and development of the kindergarten C-STEAM curriculum from the perspective of the Five-education Integration requires not only the efforts of the kindergarten but also the implementation of home-kindergarten co-education strategies. In terms of parent-child tasks, assign "family solar term inquiry" tasks, such as making mooncakes with parents and observing the phases of the moon during the Mid-Autumn Festival. In addition, set up parent open days to display children's C-STEAM achievements, such as the "traditional bridge model exhibition", and invite parents to participate in the evaluation.

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The Dialogue Between Art and Technology: An Exploration of the Effectiveness of AISOMA and Its Application in Intangible Cultural Heritage Traditional Dance

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Abstract

This paper aims to explore the effectiveness and potential of the Artificial Intelligence (AI) choreography tool AISOMA in the inheritance and innovation of Intangible Cultural Heritage (ICH) traditional dance. Faced with the challenges of globalization and modernization, the protection and inheritance of ICH traditional dance are of great significance. By adopting multi-dimensional research methods including literature analysis, case study, and assessment based on the APEC (Aesthetic, Practical, Emotional, & Cognitive) model, this study conducts an in-depth analysis of the technical characteristics of AISOMA and its application effects in ICH traditional dance. The research findings indicate that through deep learning mechanisms, style transfer technology, and real-time feedback mechanisms, AISOMA has effectively achieved the digital preservation of ICH traditional dance and promoted the innovative development of dance art. Moreover, AISOMA has not only enhanced the interactivity of dance education but also strengthened the emotional expression and cultural experience of dance works. Although AISOMA faces challenges in terms of technological dependence, cultural adaptability, and ethical aspects, it has demonstrated tremendous potential in the protection, inheritance, and innovation of ICH traditional dance. The conclusion of this study points out that as an AI choreography tool, AISOMA provides a new direction for the future development of ICH traditional dance and is expected to play a more significant role in protecting and promoting human intangible cultural heritage.

Keywords: AI choreography tool, intangible cultural heritage traditional dance, AISOMA, digital preservation

1. Introduction

1.1 Research Background

1.1.1 The Importance of Intangible Cultural Heritage Traditional Dance

The significance of traditional dance, as an integral part of Intangible Cultural Heritage (ICH), cannot be overstated. According to the definition of the United Nations Educational, Scientific and Cultural Organization (UNESCO,

2003), intangible cultural heritage encompasses social practices, forms of expression, knowledge, skills, as well as the associated tools, objects, handicrafts, and cultural venues. Article 2 of Chapter 1 of the "Law of the People's Republic of China on Intangible Cultural Heritage" stipulates that "intangible cultural heritage refers to various traditional cultural expressions passed down from generation to generation by people of all ethnic groups and regarded as an integral part of their cultural heritage, as well as the physical objects and venues related to these traditional cultural expressions". As a core component of intangible cultural heritage, ICH traditional dance is not only a major driving force for cultural diversity but also a cornerstone of sustainable development. These dance forms have been passed down through generations and continuously recreated in the process of communities and groups adapting to their surrounding environment and interacting with nature and history. They provide these communities and groups with a strong sense of identity and continuity, thereby deepening the respect for cultural diversity and human creativity.

Against the backdrop of globalization and modernization, traditional dance is confronted with unprecedented challenges, such as the trend of cultural homogenization, the gradual disappearance of traditional dance practices, and the alienation of the younger generation from traditional culture. These challenges pose a threat to the protection, inheritance, and development of traditional dance. Meanwhile, the involvement of modern technological means has offered new possibilities and necessities for the protection and inheritance of traditional dance.

The application of AI technology In the inheritance and innovation of ICH traditional dance has gradually attracted attention. With its unique advantages, AI technology provides a new approach for the protection, inheritance, and development of ICH traditional dance. The application of AI technology in the field of ICH traditional dance can not only promote the digital protection of ICH traditional dance but also enhance its communication power and influence through innovative methods, injecting new vitality into the inheritance and development of ICH traditional dance. Therefore, this study aims to explore the application of AI technology in the inheritance and innovation of intangible cultural heritage traditional dances. With choreography as the core, it analyzes how AI technology can assist in the protection, inheritance and development of intangible cultural heritage traditional dances, as well as its potential for development and challenges in the future.

1.1.2 The Potential of AI Technology in the Inheritance and Innovation of Intangible Cultural Heritage Traditional Dance

In the protection and inheritance of intangible cultural heritage, Artificial Intelligence (AI) technology has demonstrated enormous potential and innovative prospects. The advancement of AI technology has provided unprecedented opportunities for the preservation, dissemination, and innovation of traditional dance. Through deep learning and machine learning algorithms, AI can analyze and learn a large amount of dance movement data, thereby generating new dance movements and sequences. This not only facilitates the digital archiving of traditional dance but also opens up new possibilities for dance creation.

The application of AI technology c"n en'ance the communication power and influence of traditional dance, enabling it to radiate new vitality in modern society. By means of Virtual Reality (VR) and Augmented Reality (AR) technologies, audiences can experience and participate in ICH traditional dance in a more intuitive manner. This immersive experience helps to increase the public's awareness and interest in ICH culture. In addition, AI technology can assist in dance education and training by analyzing the patterns and styles of dance movements, making the learning process more efficient and personalized.

An analysis of the "2023 Annual Development Report on Art and Technology" (China National Institute of Art and Technology, 2024) reveals that the potential of AI technology in the inheritance and innovation of ICH traditional dance is reflected in the following aspects:

Firstly, in terms of digital protection, applications such as "Henan ICH Map" integrate Henan's ICH resources through knowledge graph technology, achieving an intuitive and visualized presentation of relevant content including the intergenerational inheritance of ICH and the geographical distribution scope. This provides technical support for the preservation and research of

dance movements.

Secondly, in innovative creation, by analyzing and learning dance data, AI technology can assist choreographers in creating new dance works, promoting the innovative development of dance art. For example, the holographic recording method used for the ICH "Chashan Haozi" (Tea Mountain Chant) records the performances of ICH inheritors through holographic technology and constructs virtual 3D scenes, achieving a stage effect that combines virtual and real elements.

Thirdly, in cultural communication, AI technology, through technologies such as Virtual Reality (VR) and Augmented Reality (AR), has enhanced the communication power of ICH traditional dance, making it more accessible and appreciated by the public. In the case of the integrated production of Kunqu opera digital humans, the traditional Kunqu art form is combined with modern art forms through digital human technology, presenting vivid and three-dimensional Kunqu character images.

Fourthly, in education and training, AI technology can assist in dance education and training, providing personalized learning programs and improving learning efficiency. The European Cultural Heritage Crowdsourcing Platform (https://crowdheritage.eu) integrates data on both tangible and intangible cultural heritage through crowdsourcing, thereby fostering the shared and appropriate management of cultural heritage.

Fifthly, in policy support, policy support at the national level has created a favorable development environment for the application of AI technology in the field of ICH traditional dance. The immersive exhibition case of Castello di Casanova demonstrates how to link intangible cultural heritage with material cultural heritage and achieve an immersive exhibition of the ancient castle across time through VR technology.

Through the comprehensive application of these aspects, AI technology is expected to play a key role in the inheritance and innovation of ICH traditional dance, contributing to the protection and promotion of human intangible cultural heritage. Zhang Yimou's "Dialogue Fable 2047" is another example of the combination of AI technology and traditional art. By integrating high-tech means with traditional art forms, it demonstrates the new vitality of traditional art in modern society.

1.2 Research Questions

This study aims to conduct an in-depth exploration of the application of Artificial Intelligence (AI) technology in the inheritance and innovation of Intangible Cultural Heritage (ICH) traditional dance, with a particular focus on the core role of AI choreography tools.

Firstly, this study will explore the significance of AI choreography tools in the inheritance and innovation of ICH traditional dance. It will analyze how these tools promote the protection and inheritance of ICH traditional dance, evaluate their effectiveness in enhancing the communication power and influence of ICH traditional dance, and explore their potential in inspiring innovation and artistic expression. The expected goal is to clarify the value and application prospects of AI choreography tools in the field of ICH traditional dance, providing theoretical support and practical guidance for the future development of ICH dance.

Secondly, the study will analyze the working principles of AI choreography tools, including the machine learning algorithms and deep learning models they adopt, as well as how they process and analyze dance data to generate new dance movement sequences. In addition, it will also explore the ability of AI choreography tools to understand and learn the relationship between music and dance. The expected goal is to gain an in-depth understanding of the technical mechanisms of AI choreography tools, providing a scientific basis for the optimization and improvement of these tools.

Finally, this study will evaluate the application effects and potential value of AI choreography tools in the creation of ICH traditional dance. It will use the APEC model to assess their application effects in actual dance creation and analyze their feasibility and limitations in the inheritance and innovation of ICH traditional dance. At the same time, it will explore the applicability of AI choreography tools in different cultures and regions. The expected goal is to provide a new perspective and method for the protection and inheritance of ICH traditional dance, while offering empirical research and theoretical support for the application of AI technology in the field of dance.

Through these specific research questions, this study expects to provide a new perspective and

method for the protection and inheritance of ICH traditional dance, while offering empirical research and theoretical support for the application of AI technology in the field of dance, thereby promoting the innovative development of intangible cultural heritage traditional dance.

2. Literature Review

2.1 Current Development Status of AI Choreography Tools

The application of Artificial Intelligence (AI) technology in the field of dance is multifaceted, among which the development of AI choreography tools is particularly eye-catching. By analyzing dance data and using machine learning algorithms to generate new dance movement sequences, these tools provide choreographers with innovative inspiration (Dou & Jia, 2022). AI choreography tools such as AI Choreographer, AISOMA, and EDGE utilize advanced deep learning models and large-scale datasets, demonstrating advantages in the quality and diversity of movement generation (Liu & Sra, 2024). These tools can also understand and learn the complex relationship between music and dance, providing users with an intuitive interface and real-time feedback, and enhancing the interactivity of creation.

2.2 Application of the APEC Model in the Evaluation of AI Choreography Tools

The APEC model, whose full name is the Aesthetic, Practical, Emotional, & Cognitive framework, was proposed by Dhaval Vyas and Gerrit C. van der Veer in 2005 (Vyas & Veer, 2005). This model is a framework for designing user experience, which conveys the expected meaning based on the behaviors and feedback of the interaction between users and the environment. It includes four main dimensions: Aesthetics, Practicality, Emotion, and Cognition (Vyas & Veer, 2005).

The four components of the APEC model are as follows: the Aesthetics dimension focuses on the sensory information and immediate responses of a product or system; the Practicality dimension is related to the actual functions of the system used by users and the degree of satisfaction; the Emotion dimension involves the emotional responses triggered by interactive products; and the Cognition dimension relates to the cognitive process by which users understand the narrative structure of the product, the possibilities of actions, and the expected results (Vyas & Veer, 2005). The APEC model fully takes into account the dynamics of the interaction between users and the system to adapt to the differences between different interactive systems (Gong et al., 2020), which indicates the flexibility of the application of this model.

When applying the APEC model to the evaluation of AI choreography tools, its feasibility is reflected in its ability to comprehensively evaluate the user interface design, technical performance, emotional expression ability, and user interactivity of the tools. The Aesthetics dimension can be used to evaluate the visual presentation of dance movements; the Practicality dimension evaluates the efficiency and accuracy of movement generation; the Emotion dimension explores the emotional expression ability of works; and the Cognition dimension assesses the ease of use of the tools and their support for choreographic creativity. Therefore, the APEC model provides a comprehensive evaluation framework for AI choreography tools, which helps to gain an in-depth understanding of the performance and user experience of the tools, thereby guiding the optimization and improvement of the tools.

2.3 Protection and Inheritance of Intangible Cultural Heritage Traditional Dance

The protection and inheritance of intangible cultural heritage is a focus of global cultural policies. The Chinese government attaches great importance to the protection of intangible cultural heritage and has issued a series of policies and plans to improve the level of systematic protection of intangible cultural heritage (Ministry of Culture and Tourism, 2021). At the international level, the United Nations Educational, Scientific and Cultural Organization (UNESCO) emphasizes the importance of the protection of intangible cultural heritage and the promotion of its inheritance through the "Convention for the Safeguarding of the Intangible Cultural Heritage" (UNESCO, 2003). As an important part of intangible cultural heritage, the protection, inheritance, and development of ICH traditional dance are not only a manifestation of cultural diversity but also the inheritance of the common cultural heritage of mankind (Jiang, 2018).

2.4 Relevant Ethical Discussions

With the in-depth application of AI technology in the field of dance, ethical issues have

gradually attracted attention. AI choreography tools may have an impact on the creative work of dance artists. How to protect the intellectual property rights of dance artists and ensure the purity of cultural inheritance has become a key issue (Tong & Hu, 2024). In addition, the role of AI choreography tools in the protection of cultural diversity has also been discussed. How to use AI technology while maintaining the uniqueness and regional characteristics of dance culture and avoiding cultural homogenization is a problem that needs to be solved in future research and practice (Wang & Jiang, 2023).

3. Research Methods and Design

3.1 Research Methods

This study adopts multi-dimensional research methods, comprehensively using literature analysis, case analysis, and APEC model analysis to conduct an in-depth exploration of the effectiveness of AI choreography tools and their application potential in ICH traditional dance. Firstly, by extensively collecting and reviewing relevant literature, including academic journals, conference papers, and technical reports, the theoretical foundation of the research is constructed, and the current development status, technical characteristics of AI choreography tools, and their application in the field of dance are understood. Secondly, representative AI choreography tools are selected for case analysis to conduct an in-depth exploration of their technical architecture, choreographic mechanisms, user feedback, and application effects in actual dance creation. Finally, the APEC model is applied to conduct a multi-dimensional evaluation of the selected AI choreography tools, so as to comprehensively evaluate the performance and user experience of the tools.

3.2 Research Design

In the early stage of the research, a preliminary screening was conducted on 13 representative domestic and foreign AI choreography tools. Through a comparative analysis of the technical maturity, user evaluations, application cases, and open-source availability of these tools, AISOMA was finally determined as the research object. There are two reasons for choosing AISOMA: firstly, AISOMA is not only an AI choreography tool but also can interact with real dancers to jointly complete dance works. This characteristic of combining AI technology with human creativity endows AISOMA with unique application value in dance creation. Secondly, the movement system of AISOMA is unified and is all derived from the movement collection of the famous choreographer Wayne McGregor. This unity ensures that AISOMA can maintain consistency and coherence of style in the choreographic process. Through the above research design, this study aims to provide in-depth insights and suggestions for the practical application and future development of AI choreography tools, while offering a new perspective and method for the protection and inheritance of ICH traditional dance.

4. Evaluation and Analysis of the AISOMA Tool

4.1 Rationality of the APEC Model

The rationality of the APEC model lies in its comprehensive consideration of four key dimensions: aesthetics, practicality, emotion, and cognition. These dimensions collectively form the evaluation framework for the effectiveness of AI choreography tools, providing a comprehensive and precise standard for defining the value of these tools. This model not only focuses on the aesthetic quality of dance movements but also includes the execution efficiency of movements, emotional expression, and the interactive experience between users and the tool. In the Aesthetics dimension, the APEC model evaluates the visual appeal and artistry of the dance movements generated by the tool, which is crucial for dance art. In the practicality dimension, the technical performance of the tool is examined, such as the speed, accuracy of movement generation, and synchronization with music, which is essential for the professionalism and appreciation of dance performances. In the Emotion dimension, an analysis is conducted on whether the tool can stimulate the emotional resonance of users, which is of great significance for the appeal and influence of dance works. In the Cognition dimension, the ease of use and user interactivity of the tool are evaluated, which is critical for the popularization and application of the tool. The APEC model provides a comprehensive evaluation framework for AI choreography tools, which helps to gain an in-depth understanding of the performance and user experience of the tools, thereby guiding the optimization and improvement of the tools. Through this multi-dimensional evaluation, the APEC model ensures that the evaluation of AI choreography tools is both comprehensive and

targeted, enabling them to play a key role in the inheritance and innovation of ICH traditional dance.

4.2 Introduction to AISOMA

At the intersection of dance art and technological innovation, AISOMA (also known as SOMA) emerged. It is a revolutionary artificial intelligence dance creation tool jointly developed by the world-renowned choreographer Wayne McGregor and the Google Arts and Culture Lab (McGregor's Studio, 2024). AISOMA is a symbol of the in-depth integration of dance art and artificial intelligence, marking the beginning of a new era, specifically a new era of human-machine collaboration in the field of dance creation. Through deep learning mechanisms, AISOMA can analyze and absorb the essence of Wayne McGregor's 25 years of dance creation, learn and reproduce the unique styles of those dancers, capture their creative identities, and convert them into computable data. This process not only injects new vitality into dance creation but also opens up unlimited possibilities for the future development of dance art.

4.3 Choreographic Methods of AISOMA

The choreographic method of AISOMA is its core charm. By combining an advanced movement analysis engine and a creative generation engine, it encodes and generates dance movement data, and then models the relationship between dance movements and creativity through a cross-modal processing unit. This model architecture not only enhances the quality and diversity of dance movement generation but also enables AISOMA to extract features from a large number of dance movements through deep learning mechanisms and generate new dance movements, thereby providing choreographers with innovative inspiration.

The workflow of AISOMA starts with inputting a dance video and a short seed movement, and then generates a long-time sequence of original dance movement sequences through its complex algorithms. This process is difficult to achieve in traditional choreography because it involves an in-depth understanding of dance movements and innovative reorganization. The key designs of AISOMA include deep learning mechanisms, style transfer, real-time feedback, and the use of datasets. The deep learning mechanism enables AISOMA to extract features from historical dance works, providing possibilities for the digitization and pattern recognition of ICH traditional dance. The style transfer technology allows AISOMA to understand and imitate the unique styles of specific dancers, which is crucial for the inheritance and protection of the unique styles in ICH traditional dance. The real-time feedback mechanism enables choreographers to adjust and optimize dance movements in real time. This interactivity provides a new platform for the innovation of ICH traditional dance.

The choreographic method of AISOMA generates continuous movements in an autoregressive manner, which integrates the application of deep learning mechanisms, style transfer, and real-time feedback, making the choreographic process both scientific and artistic. This choreographic method not only promotes the innovative development of ICH traditional dance but also provides a new approach for the digital protection and inheritance of ICH traditional dance.

Another innovative aspect of AISOMA lies in its real-time feedback mechanism. During the process of dance movement generation, AISOMA can receive feedback from dancers in real time and adjust the generated movements accordingly. This interactivity provides a new platform for the innovation of intangible cultural heritage traditional dance, enabling traditional dance to more flexibly adapt to modern aesthetics and performance needs. This real-time interactivity of AISOMA not only provides a new dimension for dance creation but also opens up new possibilities for the future development of dance art.

To sum up, the technical details and working principles of AISOMA demonstrate the enormous potential of AI technology in dance creation. The combination of its deep learning mechanisms, style transfer technology, and real-time feedback mechanisms not only promotes the innovative development of ICH traditional dance but also provides a new approach for the digital protection and inheritance of ICH traditional dance. Through the application of these technologies, AISOMA has demonstrated significant effectiveness in the creation of ICH traditional dance, providing strong technical support for the protection, inheritance, and innovation of ICH traditional dance. AISOMA is not only a tool but also a bridge between dance art and technology

integration, and a new chapter in future dance creation.

4.4 APEC Analysis of AISOMA

The APEC analysis of AISOMA reveals its multi-dimensional advantages among AI choreography tools and demonstrates its application potential in the inheritance and innovation of ICH traditional dance. In terms of Aesthetics, the dance movements generated by AISOMA not only possess a high level of artistry and professionalism visually but also demonstrate a high level of aesthetic value according to expert evaluations and audience feedback, meeting the aesthetic needs of ICH traditional dance creation.

In terms of practicality, AISOMA performs excellently in matching dance movements with music rhythms. It can generate corresponding dance movements based on the rhythm and emotion of the music, enhancing the expressiveness and appreciation of the dance. The Emotion analysis shows that as a choreography tool, AISOMA provides an innovative platform that allows choreographers and dancers to generate dance movements based on personal creativity and musical inspiration, greatly enhancing the users' emotional engagement and creative pleasure.

In the Cognition evaluation, the design of AISOMA's user interface and operation process takes user convenience into account, enabling even non-professional users to quickly get started and generate dance movements, which indicates its high ease of use. At the same time, AISOMA supports user input and provides real-time feedback on the generated results. This real-time interactivity allows users to adjust and optimize dance movements in real time, improving the flexibility and interactivity of creation.

To sum up, the APEC analysis of AISOMA has demonstrated its effectiveness as an AI choreography tool in the creation of ICH traditional dances. It not only promotes the digital protection and inheritance of ICH traditional dances, but also drives their innovative development, opening up new paths for the future of ICH traditional dances. Through this comprehensive analysis, the application prospects of AISOMA in the field of ICH traditional dances are optimistic. It not only promotes the innovative development of ICH traditional dances but also provides new approaches and methods for the education, protection, and international exchange of ICH traditional dances. With the continuous development of technology, it is expected that AISOMA will play a greater role in protecting and promoting intangible cultural heritage.

5. Application of AI Choreography Tools in Intangible Cultural Heritage Traditional Dance

5.1 Technical Characteristics and Innovations

The technical characteristics and innovations of AISOMA lie in its in-depth integration of artificial intelligence technology, and it has demonstrated significant application potential especially in the digital preservation, educational popularization, integration of innovation and tradition, and protection of cultural diversity of ICH traditional dance. Its core advantages are reflected in the following aspects:

Firstly, the deep learning mechanism of AISOMA enables it to conduct accurate digital preservation of ICH traditional dance movements, which is of great significance for preventing cultural loss and promoting cultural inheritance. This technical characteristic not only contributes to the preservation of endangered dance forms but also provides valuable resources for dance research and education. Secondly, as an educational tool, AISOMA, through its intuitive interface and interactivity, makes the process of learning and understanding the creation of ICH traditional dance easier and more interesting, thereby enhancing the interactivity and interest of education.

In addition, the style transfer and real-time feedback mechanisms of AISOMA enable traditional dance to integrate with modern aesthetics and performance needs, providing technical support for the innovative development of ICH traditional dance. This not only allows traditional dance to adapt more flexibly to the modern stage but also provides choreographers with an innovative platform to explore new artistic expression methods. Finally, the application of AISOMA is conducive to maintaining the uniqueness and regional characteristics of dance culture, avoiding cultural homogenization, and promoting the protection of cultural diversity.

To sum up, the technical characteristics and innovations of AISOMA not only promote the innovative development of ICH traditional

dance but also provide a new approach for the digital protection and inheritance of ICH traditional dance. With the continuous development of technology, it is expected that AISOMA will play a more significant role in protecting and promoting human intangible cultural heritage.

5.2 Contributions to the Inheritance of Intangible Cultural Heritage Traditional Dance

AISOMA plays a multi-dimensional role in the inheritance of ICH traditional dance and has made significant contributions at multiple levels. Firstly, in terms of digital preservation, AISOMA uses its deep learning mechanism to conduct digital preservation of ICH traditional dance movements, which is of great significance for preventing cultural loss and promoting cultural inheritance (Dou & Jia, 2022). Secondly, as an educational tool, AISOMA can help students and enthusiasts gain a deeper understanding of and learn the creation process of ICH traditional dance, thereby enhancing the interactivity and interest of education (Tong & Hu, 2024). In addition, through style transfer and real-time feedback mechanisms, AISOMA enables traditional dance to integrate with modern aesthetics and performance needs, providing technical support for the innovative development of ICH traditional dance (Wang & Jiang, 2023). Finally, the application of AISOMA is conducive to maintaining the uniqueness and regional characteristics of dance culture, avoiding cultural homogenization, and promoting the protection of cultural diversity (Jin, 2017).

However, AISOMA also faces challenges and limitations in practical applications. Technological dependence may lead to the neglect of the humanistic value of dance art and the personal expression of dancers. Especially in terms of cultural adaptability, AISOMA requires more localized data and algorithm adjustments to better handle dances of different cultures and styles. How to maintain the traditional essence of ICH traditional dance while pursuing innovation is a problem that needs continuous exploration and solution. In addition, whether the application of AISOMA can promote the sustainable development of ICH traditional dance rather than just serving as a technical demonstration is also a key point that needs attention in future research and practice. Through further localized adjustments and cross-cultural verification, it is expected that AISOMA will play a more significant role in protecting and promoting human intangible cultural heritage.

5.3 Discussion on the Feasibility of Creation

When discussing the feasibility of AISOMA in the creation of ICH traditional dance, based on the analysis results of the APEC model, the application prospect of AI choreography tools in this field is demonstrated. Firstly, in the Aesthetics dimension, the dance movements generated by AISOMA meet the aesthetic needs of ICH traditional dance creation with their visual appeal and artistry. This benefits not only from its deep learning algorithm but also from its in-depth understanding of dance art. Secondly, in the Practicality dimension, the technical performance of AISOMA, including the speed, accuracy of movement generation, and synchronization with music, provides reliable technical support for the performance of ICH traditional dance, ensuring the professionalism and appreciation of dance performances.

In the Emotion dimension, AISOMA provides a rich user experience, enhancing the users' emotional engagement and creative pleasure, which is crucial for the emotional communication and cultural experience of ICH traditional dance. Finally, in the Cognition dimension, the ease of use and interactivity of AISOMA enable non-professional users to quickly get started and generate dance movements, which lowers the technical threshold for the creation of ICH traditional dance and increases the level of participation. Through the comprehensive consideration of these dimensions, AISOMA can not only promote the digital protection and inheritance of ICH traditional dance but also drive the innovative development of ICH traditional dance, opening up a new path for the future development of ICH traditional dance.

To sum up, the technical characteristics of AISOMA and the analysis results of the APEC model indicate that AI choreography tools have high feasibility in the creation of ICH traditional dance. They can not only promote the digital protection and inheritance of ICH traditional dance but also drive the innovative development of ICH traditional dance, opening up a new path for the future development of ICH traditional dance. With the continuous development of technology, it is expected that AISOMA will play

a more significant role in protecting and promoting human intangible cultural heritage.

6. Conclusions

The technical characteristics of AISOMA, especially the application of its deep learning and machine learning algorithms, provide an innovative solution for the creation of ICH traditional dance. For an ICH traditional dance with a unified style and clear movement scope, AISOMA can realize the digital preservation of dance movements through its high-precision motion capture technology and establish a comprehensive movement database, which is of great significance for preventing cultural loss and promoting cultural inheritance. In addition, the style transfer technology of AISOMA can maintain the originality and authenticity of the dance during the innovation process, while its real-time feedback mechanism allows choreographers to adjust movements in real time, enabling traditional dance to flexibly adapt to modern aesthetics. Through the cross-modal processing unit of AISOMA, ICH traditional dance can also be integrated with other art forms to create richer artistic effects.

The educational and popularization functions of AISOMA should not be ignored either. It can help students and enthusiasts better understand and learn the creation process of ICH traditional dance, improving the interactivity and interest of education. At the same time, AISOMA plays a significant role in the protection of cultural diversity. It respects and reflects the original style and cultural connotation of ICH traditional dance, ensuring the purity of cultural inheritance. To sum up, the technical characteristics and innovations of AISOMA provide strong technical support for the protection, inheritance, and innovation of ICH traditional dance, opening up a new development path.

The application prospects of AI choreography tools, especially AISOMA, in the creation of ICH traditional dance are promising. Through technological innovation, these tools provide new approaches and methods for the protection, inheritance, and innovation of ICH traditional dance. Firstly, the technological innovation of AI choreography tools means that they will become more intelligent with the advancement of AI technology, capable of providing more abundant and accurate support for dance creation. This can not only improve the efficiency of dance creation but also expand the forms of expression and creative space of dance art. Secondly, AI choreography tools can be used as educational tools to help more people understand and learn ICH traditional dance, thereby increasing the popularity and influence of ICH traditional dance. Through intuitive interfaces and interactivity, these tools make learning and creating ICH traditional dance easier and more interesting. In addition, AI choreography tools will play a more significant role in the digital protection of ICH traditional dance. Through high-precision motion capture and 3D reconstruction technologies, AI choreography tools can provide strong technical support for the preservation and research of ICH traditional dance, ensuring the inheritance of these precious cultural heritages. At the same time, these tools also contribute to the international communication of ICH traditional dance. Through natural language processing and machine translation technologies, language barriers are overcome, promoting communication and understanding between different cultures.

To sum up, the application prospects of AI choreography tools in the creation of ICH traditional dance are optimistic. They can not only promote the innovative development of ICH traditional dance but also provide new approaches and methods for the education, protection, and international communication of ICH traditional dance. With the continuous development of technology, it is expected that AI choreography tools will play a more significant role in protecting and promoting human intangible cultural heritage, while also making contributions to the protection and promotion of global cultural diversity.

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Reform Practice and Effect Analysis of Blended Teaching in the Public Psychology Course for Normal Students

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Abstract

Aligned with Outcome-Based Education (OBE) reforms in teacher-education institutions, this study implemented an online–offline blended model in a General Psychology course and empirically examined student satisfaction. Two intact classes of 2024-cohort normal teachers served as an experimental group (blended instruction) and a control group (conventional in-person lectures). Post-instruction comparisons were conducted on course satisfaction, self-reported learning outcomes, and the final theoretical exam. Results indicated high overall satisfaction; relative to the control group, blended instruction yielded significantly higher learning-outcome ratings and exam scores. These findings support blended delivery as a viable approach to advancing OBE-aligned competencies in teacher education.

Keywords: blended teaching, psychology course, practice and effect

1. Introduction

Amid nationwide accreditation of teacher-education programs and the growing adoption of Outcome-Based Education (OBE), curricula are shifting from knowledge transmission to competency development. As a compulsory foundation course, Public Psychology must satisfy dual aims—general education and professional formation—while contending with reduced contact hours, heterogeneous student backgrounds, and fragmented learning data (Qu Dongxu, 2016; CAI Wenbo & Liu Junli, 2022). Building on OBE, this study integrates online and offline modalities to design, implement, and evaluate a course that is backward-designed from clearly specified outcomes.

2. Current Challenges in Teaching Public Psychology

2.1 The Current Situation Problems of Students in Class

The teaching content is complex. The public psychology course is highly theoretical, with abstract terms, numerous and scattered knowledge points, and great learning difficulties. Students often resist because they can't understand or apply it. Teachers mainly focus on lectures, emphasizing theory over practice, and the course falls into the

embarrassing situation of being unpopular (Liu Jing, 2016; Xie Teng & Yang Yun, 2021).

The learning purpose of students is not clear. Normal university students need to master psychological theories and apply them to practice. However, there are students from liberal arts, science, and vocational courses. Some science and vocational course students find the theory boring and difficult to remember, resulting in a fear of difficulties (Peng Mingfang, 2009). Therefore, it is necessary to help students clarify their learning purposes and enhance their learning initiative.

The assessment system is imperfect. The traditional closed-book examination leads teachers to focus on theoretical explanations and students to focus on last-minute cramming for the final exam, which is not conducive to the mastery of basic knowledge, the improvement of practical abilities, and the development of innovative thinking.

2.2 Problems Existing in Current Offline and Online Teaching

The teaching mode is single and outdated, emphasizing theory over practice. Classroom teaching mainly focuses on teachers' lectures, with a straightforward form and a lack of diversified methods such as experiments and discussions, resulting in the disconnection between theory and practice. Students often feel that "learning is difficult to be applied" (Zhang Xue & Yin Zhixiao, 2019). At the same time, the practice of simply reducing theoretical class hours to increase practice in teaching reform has not effectively improved students' abilities, but instead weakened the theoretical depth (Yang Shuo, 2016). This situation ultimately dampens students' learning initiative and enthusiasm.

Modern teaching methods and traditional teaching methods have not been effectively combined. The application of multimedia has brought a series of teaching reforms to this public course, which is obvious to all. However, to a certain extent, it has led to the ineffective combination of modern teaching methods and traditional teaching methods. Some students take notes in class by copying the courseware or taking pictures with their mobile phones, which easily results in little effect on students' mastery and internalization of knowledge, and the phenomenon that their learning and thinking about theory remain on the surface.

The effect of pure online teaching is not ideal, and the recognition from teachers and students is not high. Due to problems such as the inability to replicate the real class situation due to network transmission issues, imperfect interactive functions, and low self-awareness of students in online teaching, research shows that nearly 50% of teachers and students still believe that offline teaching has a better learning effect, and no more than 10% think that online learning has a good effect (Shen Zigang, 2022).

3. Method

3.1 Participants and Design

Participants were four intact classes of normal education students taught by the same instructor at a university. Two classes formed the experimental group (n = 126) receiving OBE-aligned blended instruction; two classes formed the control group (n = 139) receiving conventional in-person instruction. Online tools in the control condition were limited to materials distribution and assignment submission.

3.2 Instructional Procedures

3.2.1 Blended (Experimental) Condition

3.2.1.1 Select the Appropriate Teaching Platform

Based on the actual situation of the open course and the actual situation of school resources, this teaching activity will be implemented through the combination of Chaoxing Learning Platform and Tencent Meeting live streaming. Chaoxing Learning Online provides students with a wealth of teaching resources, including teaching syllabuses, teaching calendars, teaching courseware, teaching videos and other teaching documents; Modules that guide students to learn independently, such as learning introduction, self-test, and knowledge expansion; Interactive areas such as topic discussions and in-class exercises. In addition, technologies such as Chaoxing Learning Platform and Tencent Meeting can also record complete teaching activities (Luo Xian, 2019; Zhang Haixia, 2021).

3.2.1.2 Design Teaching Content

Unitize the teaching content. In strict accordance with the curriculum standards, analyze the psychology teaching content and the background of online teaching and students' online learning, and determine the teaching content for each class based on students' acceptance ability as a teaching unit. Clarify the teaching objectives of each unit, and then

determine the teaching approach and key and difficult points. Use this as chapter points to build a course knowledge graph system on the Chaoxing Learning Platform.

The teaching of knowledge points is refined. Based on the analysis of the previous questions, in order to solve the problem of fragmented knowledge points that students have responded to frequently, and in combination with the actual needs of the teacher qualification examination and professional certification, the psychology knowledge points are refined into specific task points in the teaching design, and tasks are distributed to students on the Chaoxing Learning Platform at different time points according to the course progress.

Modularize the learning path teaching. On the Learning Platform, modules such as learning introduction, learning objectives, learning content (with teaching materials, electronic lesson plans, videos, courseware), in-class practice tests, and knowledge expansion (after class) are provided.

3.2.1.3 Offline Teaching Tasks and Enriched Teaching Methods

Offline teaching task-driven. Before the project began, the research team designed eight practical investigation tasks in advance based on the requirements of practical ability, covering common hot issues in students' psychological development. With the help of Learning Pass, students were randomly divided into 8 groups, each choosing one survey task, and after completing the corresponding learning content, they conducted the survey and formed a report. Teachers ask questions and provide feedback on the spot, promptly correcting the problems and the psychological knowledge behind them.

Offline classes enrich teaching methods: In addition to using traditional multimedia technology, they also combine the Learning Pass platform to conduct real-time topic discussions and viewpoint sharing. Moreover, they leverage the online platform's technology to share classroom game activities, making learning enjoyable. They guide the teaching with intuitive and vivid methods, making it easier for students to understand and stimulating their thirst for knowledge and innovative thinking.

3.2.1.4 Diversified Assessment Methods

Homework and tests are not the purpose of teaching in themselves, but a means to achieve teaching (Xu Yun et al., 2016). Blended teaching courses focus on learning outcomes as well as formative assessment. Both classroom participation assessment and group cooperative learning assessment, along with a weighted combination of online tests, can serve as evidence of students' participation in learning and also reflect their academic progress (Han et al., 2020). At the same time, timely feedback on the evaluation results can also give students a clearer understanding of their own learning outcomes.

3.2.2 Control Group Teaching Method

The control classes received face-to-face lectures and standard practice assignments without structured online self-study. Before the course begins, teachers systematically teach theoretical and practical content in the traditional way, without arranging online self-study sessions. The instructors, class hours, teaching content and focus of the theoretical and practical classes were consistent with those of the experimental group. After the relevant teaching was completed, practical homework was assigned after class. Students are required to complete the homework in the traditional presentation form. After the teacher grades the homework, it records common and individual problems, explains the problems in the homework, responds to students' questions on the spot, and asks questions and interacts appropriately. Instructor, contact hours, and content coverage matched the experimental group.

3.3 Measures

Course satisfaction. A researcher-developed scale assessed four dimensions—teaching resources (4 items), course planning (3), content (4), and methods (3)—on a 5-point Likert scale (1 = strongly disagree to 5 = strongly agree); higher scores indicate higher satisfaction.

Learning outcomes. A researcher-developed scale measured knowledge acquisition (4 items), skills/ability gains (4), and professional identity (3) on the same Likert format.

Theoretical exam. Measured by the unified closed-book "theory score" (out of 100) at the end of the course.

3.4 Statistical Analysis

Analyses were performed in SPSS 27.0. Descriptive statistics summarized outcomes. Between-group differences were examined with independent-samples t-tests (α = .05). Where

appropriate, we report t(df), p.

4. Results

4.1 Descriptive Statistics

A total of 265 valid cases were retained (experimental n = 126; control n = 139; 96 male, 169 female). Means suggested advantages for the experimental group on learning outcomes, satisfaction, and exam scores (see Table 1).

Table 1. Group Means (M) and Standard Deviations (SD)

Group	Experimental		Control	
	M	SD	M	SD
Learning outcomes	34.81	4.576	30.15	6.281
Satisfaction	71.29	9.324	67.32	11.836
Grades	82.78	7.519	78.00	9.249

4.2 Group Comparisons

Independent-samples t-tests indicated significant between-group differences favoring blended instruction for learning outcomes and exam performance, the results showed (see Table 2) that there were significant differences in self-assessment scores of learning outcomes and theoretical grades between the experimental group and the control group. This indicates that the blended teaching model, while ensuring that students' mastery of theoretical knowledge is equivalent to traditional teaching, also enhances students' self-perceived learning gains and value perception.

In terms of teaching satisfaction, the overall satisfaction score of the experimental group was significantly higher than that of the control group, as shown in Table 2, which indicates that the blended teaching reform has a promoting effect on improving students' course satisfaction and online learning experience.

Table 2. Comparison of each indicator between the two groups

	t	df	*p*
Learning outcomes	7.158	265	<0.001
Satisfaction	4.830	265	<0.001
Grades	3.167	265	<0.005

5. Discussion

Blended instruction aligned with OBE likely improved outcomes via several mechanisms. First, backward-designed objectives clarified performance expectations and decomposed complex concepts into actionable tasks, which can scaffold self-regulation and generate mastery experiences. Second, diversified learning activities increased time-on-task and supported multiple pathways to understanding. Third, formative assessment with timely feedback may have strengthened motivation and engagement (Xu Yingli, & Fang Hua, 2022; Wang Chuang & Chen Chen, 2025); Finally, collaborative inquiry fostered both cognitive elaboration and social integration, which are positively associated with learning in higher education.

Limitations include the need for further construct validation of satisfaction and outcome scales, lack of process data analytics, and single-institution sampling.

6. Conclusion

An OBE-aligned blended model in Public Psychology for normal students yielded higher satisfaction and improved self-reported learning outcomes and exam performance compared with conventional lectures. Future work should integrate learning analytics and multi-institution samples to optimize design features and validate effects at scale.

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Artificial Intelligence in Music Education: A Scoping Review of Practices, Strategies, and Challenges

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Abstract

This review uses the PRISMA framework for a scoping review, including 27 empirical studies on artificial intelligence (AI) in music education from 2015 to 2025, establishing current research trends, challenges in AI-assisted teaching, and implementation. The research shows that AI is primarily used to improve the effectiveness of performance assessment, optimize music theory teaching, and facilitate scaffolded self-learning. The study focuses on Asia, particularly China, and is mainly student-centered, with lower emphasis on teacher dimensions and long-term learning outcomes. The findings also highlight three main ways in which AI contributes to educational innovation: personalized feedback, standardized assessment, and immersive engagement. With these technologies embedded in the classroom, the role of teachers is also transforming, shifting from direct teaching to promoting learning and interpreting technical feedback. Despite the significant potential of AI in improving teaching efficiency and student engagement, challenges remain in terms of technology, equity issues, and teaching ethics. Overall, this review comprehensively summarizes the current research and emphasizes the need to view AI as a partner in music education rather than a substitute for human professional knowledge.

Keywords: artificial intelligence, music education, PRISMA framework, scoping review, educational innovation

1. Introduction

In recent years, the application of artificial intelligence (AI) in the field of music education has shown a trend of rapid expansion, accompanied by significant diversity. From the perspective of technical tools, existing studies have covered various types, including AI vocal teaching systems based on speech recognition (Bai, 2022), virtual reality (VR)-based immersive teaching platforms (Chen, 2022), evaluation models driven by Convolutional Neural Networks (CNN) and Recurrent Neural Networks (LSTM) (Cui & Chen, 2024; Han, 2025), Music Information Retrieval (MIR) systems (Kayis et al, 2021), digital audio workstations (for example, Soundtrap) (Knapp et al, 2023), and generative AI tools (for example, IBM Watson BEAT, DeepBach) (Liu & Liao, 2025; Yuan, 2024). In terms of application scenarios, it covers multiple dimensions such as vocal training, piano instruction, classical music

education, inheritance of traditional folk music, and music aesthetic cultivation. From the perspective of research types, it includes not only studies on technical function verification (for example, Li, (2022)'s test on the accuracy of the Q-Learning algorithm in piano instruction) but also studies on teaching effectiveness evaluation (for example, Liu & Guo (2025)'s comparative experiment on AI tools enhancing vocal skills), as well as survey studies on students' cognition and motivation (for example, Wang and Li, (2024)'s analysis of the correlation between AI readiness and academic performance). However, current studies are scattered across different technical directions and teaching scenarios. There has not yet been a systematic review of the overall landscape, core pathways, and common issues of AI application in music education. This leads to a lack of clear understanding of the overall landscape in the field, making it urgent to integrate existing findings through a scoping review.

Although existing studies have initially verified the application value of AI in music education, there are still obvious research gaps. First, the tracking of long-term learning effects is insufficient. Most studies focus on short-term interventions (for example, 12-week vocal instruction, duration 4 months piano training) (Liu & Guo, 2025; Wang, 2025), and there is a lack of studies on how AI tools affect the formation of students' long-term musical literacy and creativity transfer ability. Second, targeted research on students with special educational needs is scarce. Existing samples are mostly regular groups such as college students and primary and secondary school students (for example, sixth-grade students (최미설, 2023), and there has been no exploration of adaptation strategies of AI tools for students with special needs (for example, Students with hearing impairments or learning disabilities). Third, the impact of differences in socioeconomic backgrounds on AI applications has not received sufficient attention. Only a few studies have mentioned issues related to technology accessibility (for example, "unequal access to technology" (Chen, 2025), but no comparative studies have been conducted on schools with different resource levels (for instance, Urban VS. Rural schools, schools with varying inputs of funding). Fourth, the effectiveness of teacher professional development models lacks systematic evaluation. Some studies mention that teachers need to receive training on AI tools (for example, Wang, 2025). Still, they do not clarify which training model can effectively improve teachers' AI application capabilities, nor have corresponding evaluation frameworks been established. Based on this, this study focuses on the following three core research questions:

RQ1: What is the scope and characteristics of existing literature on the application of AI in music education?

RQ2: What AI-assisted practices or strategies have been conducted by music teachers?

RQ3: What are the challenges of incorporating AI in music education?

The findings of this scoping review hold multi-dimensional practical and research value. For music teachers, this review will systematically organize the functional positioning of existing AI tools (for example, Real-time feedback tools like Vocal AI Analyzer, personalized practice platforms like Smart Vocal Coach) (Liu & Guo 2025), and their supporting teaching strategies (for example, Group teaching, contextualized virtual scenario design). It provides practical references for teachers to select suitable tools and optimize teaching processes. For school administrators, the barriers to technology application revealed in this review (for example, Outdated equipment, insufficient digital skills of teachers) (Wei, 2021; Wang, 2025) suggest that it is necessary to attach importance to the investment in AI teaching resources and specialized training for teachers, to promote schools to build a teaching environment that supports AI integration. For the development of evaluation systems, this review will summarize the development experience of existing AI evaluation tools (for example, 1D-CNN pronunciation scoring engine, BiLSTM piano performance evaluation model) (Shen & Zhao, 2024; Xiang & Sun, 2024), and point out the necessity of standardization and improved objectivity of evaluation tools. For future research, the gaps identified in this review—such as those in long-term effects, adaptability to special education, and resource equity—will point out directions for subsequent studies and promote the field to develop in a more comprehensive and balanced direction.

2. Method

This study adopts a scoping review approach to

map the existing research landscape in 'Artificial Intelligence in Music Education,' identify key concepts, types of evidence, and research gaps, and delineate the scope and nature of this field. Given that AI-assisted technologies are still emerging, I set the time span to the most recent decade (2015–2025) to systematically present the latest progress and trends in this field.

The review follows the PRISMA scoping review process (Figure 1), and Microsoft Excel spreadsheets were used for duplicate removal, filtering, and data display. To cover high-quality journals in music education and educational psychology, I limited the search to scientific articles published in international journals. I selected three research-focused electronic databases as the primary information sources: ERIC, EBSCOhost, and Web of Science. These three databases can comprehensively include music-education journals and educational research literature, meeting the scoping review's need for broad coverage and multiple sources. To retrieve as many relevant studies as possible, the search terms were mainly built from two keywords, 'music education' and 'artificial intelligence.' Based on my research objectives, these keywords were supplemented with alternative terms, such as the abbreviation 'AI'. I also provided specific alternative expressions that are widely used in article titles. According to the characteristics of different database search systems, the part of speech of the search terms was modified to accommodate database-specific features. First, I retrieved 62, 97, and 79 records from ERIC, EBSCO, and Web of Science, respectively. After removing duplicates, 129 records entered the title and abstract screening stage. The first set of screening criteria (Criteria 1) included: ① Peer-reviewed journal article; ② language: English; ③ K–12 school education context. A total of 83 eligible articles were retrieved from the initial screening. Subsequently, the author applied Criteria 2: ① closely related to music education; ② Empirical studies rather than literature reviews or conceptual studies, and obtained 27 articles. Finally, after excluding some retracted articles, 27 empirical studies constituted the database for this paper (Table 1).

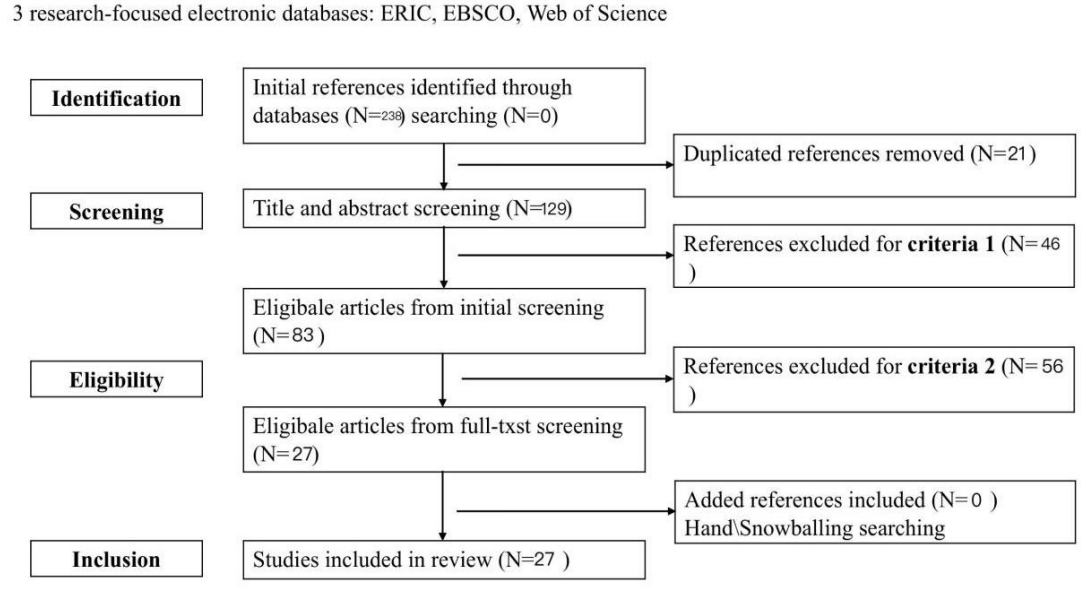

Figure 1. PRISMA Flow diagram of the study selection process

Table 1. Included studies

Number	Articles	Number	Articles
1	Bai (2022).	15	Peng (2025).
2	Chen (2025).	16	Shen & Zhao (2024).
3	Chen (2022).	17	Wang (2023).
4	Cui & Chen (2024).	18	Wang (2025).

5	Han (2025).	19	Wang (2025).
6	Kayis et al (2021).	20	Wang & Li (2024).
7	Knapp et al (2023).	21	Wei (2021).
8	Li (2022).	22	Wesolowski (2019).
9	Li et al (2023)	23	Xiang & Sun (2024).
10	Liu & Liao (2025).	24	Yuan (2024).
11	Liu et al (2025).	25	Yang (2018).
12	Liu & Guo (2025).	26	Zhang & Liu (2021).
13	Lu & Guo (2025).	27	Zhang (2024).
14	Miseol Choi (2023).		

3. Findings

3.1 Overview of Geographical and Methodological Distributions

3.1.1 Geographic Distribution

We analyzed the included studies in terms of research method, geographic distribution, and target population. The regional concentration of the sample is striking: it is overwhelmingly focused on Asia (92.6%, n=25), within which China alone contributes 85.2%(n=27); the remaining Asian share comes from South Korea (7.4% of the full sample, n=1). North America is the only non-Asian region represented (7.4%, n=2), while Europe and Oceania have no included empirical studies (0%). This structural imbalance indicates that, globally, empirical research and publication on the integration of AI into music education are not evenly distributed (see Figure 2).

Possible reasons include China's strong policy support for AI in education, substantial research investment, and a significant domestic demand in music-education markets. From the standpoint of international generalizability, regions such as Europe (with its deep classical-music traditions) and Oceania (with the needs of Indigenous music transmission) have distinctive cultural and educational contexts. The lack of studies from these settings may limit how well existing AI music-education tools, models, and findings transfer to their needs and may hinder cross-cultural knowledge exchange. Future work should strengthen cross-regional collaboration to address these gaps.

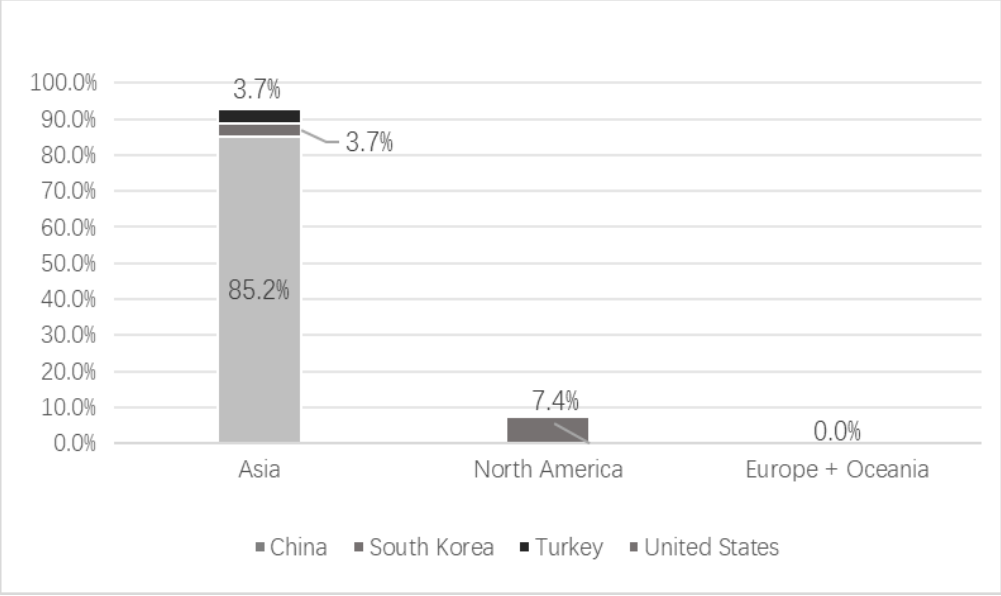

Figure 2. Geographic distribution by continent

3.1.2 Methodological Distributions

The analysis reveals a clear pattern in research

methods: quantitative studies predominate (81.5%), while mixed-methods studies account for a smaller share (18.5%). Within the quantitative corpus, intervention-based experimental designs constitute the majority (59.1%); at the same time, studies focused on operational work, system improvement, and technical validation also represent a substantial proportion (40.9%), typically targeting algorithm performance evaluation, platform/application optimization, and instructional process refinement (see Figure 3).

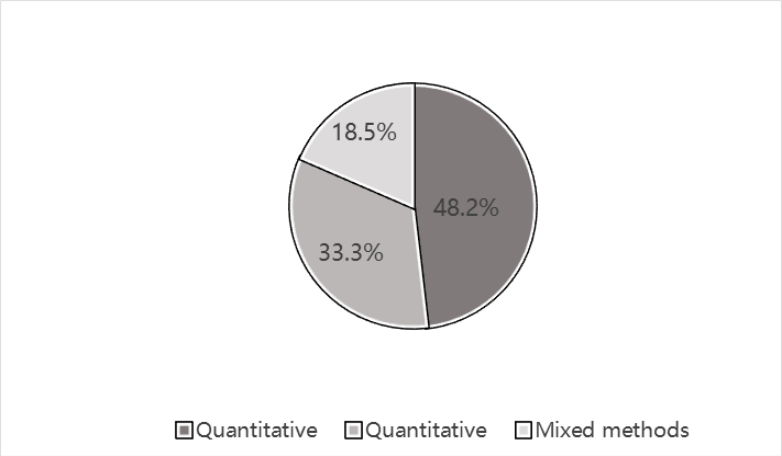

Figure 3. Overall Composition of Research Methods

3.1.3 Target Population

Studies focus on students (40.7%, the highest share among all categories, n=11), followed by studies with unspecified participants (25.9%, n=7). Studies involving students and teachers account for 14.8%(n=4), and no-human-participant studies (mostly system or audio tests) likewise account for 14.8%(n=4). Platform-level anonymized users make up 3.7%(n=1). Notably, there are no studies that treat teachers alone as the sole target population; teachers appear only as part of the "students + teachers" category.

These patterns indicate that current research is centered on the student learning experience, typically emphasizing analyses of student learning outcomes, engagement, and interaction with AI tools. Studies with both students and teachers commonly examine the two-way alignment between teaching and learning. In contrast, no-human-participant studies focus on the technical validation of tools themselves, providing technological underpinnings for student learning and instructional practice. Overall, the field remains student-centered, prioritizing the assessment of learning achievements, participation, and student–AI interactions (see Figure 4).

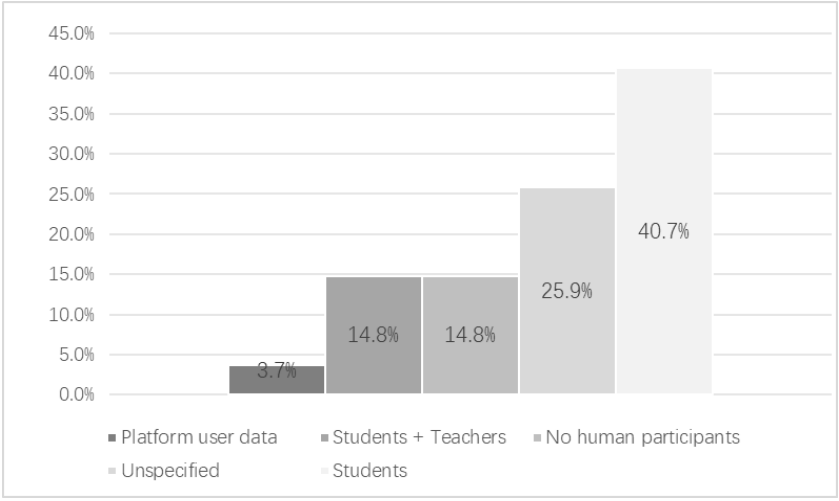

Figure 4. Target population of included studies

3.2 AI-Assisted Practices and Strategies in Music Education

This section focuses on the practical applications and strategic designs of AI in music education, covering four dimensions: AI-assisted tools and their teaching roles, core teaching objectives and learning activity designs, transformations of teacher roles and corresponding strategies, as well as the learning outcomes and impacts of AI tools on students. It aims to systematically present how AI reshapes music teaching practices and promotes educational innovation. This section examines the practical applications and pedagogical strategies associated with AI in music education. The analysis addresses four interrelated dimensions: (1) AI-assisted tools and their instructional roles, (2) core teaching objectives and corresponding learning activity designs, (3) transformations in teachers' roles and instructional strategies, and (4) the learning outcomes and educational impacts of AI integration. Collectively, these dimensions illustrate how AI technologies are reshaping music pedagogy and fostering educational innovation.

3.2.1 AI-Assisted Tools and Their Role in Music Teaching

Subsection says what each tool adds, how it fits into class, and the kind of leverage it offers. For voice, intelligent assessment works well as formative support: it turns pitch, resonance, and diction into clear cues for tiered correction and short practice loops (Bai, 2022). For performance and expression, a VR setup gives an observable space for modeling gestures and facial work, making rehearsal concrete and repeatable (Chen, 2022).

In piano, a piano assessment engine acts as an objective rater plus an individualized practice guide. It provides levels and key points so large classes share a stable standard while teachers focus on keystone movements and practice routes (Xiang & Sun, 2024). In creative work, IBM Watson BEAT serves as starting material for composing; classes move through generate, peer listening, critique, and revision (Liu & Liao, 2025). For polyphony, DeepBach offers editable examples that students rewrite in class, so style rules are learned by doing (Yuan, 2024).

For listening and style recognition, an MIR system supports makam classification and ear-based comparisons; students upload pieces, check the feedback, and build auditory memory and literacy (Kayis et al, 2021). When collaboration matters, a web-based DAW like Soundtrap keeps making and submitting in one place, which proved helpful outside traditional classrooms (Knapp et al., 2023). For process checks, DTW helps align audio and locate drifts in timing or rhythm (Wang, 2023). In theory work, Chord IQ ties explanation, a brief check, and immediate feedback together in a blended format so progress is visible (Liu et al., 2025). For short drills, Yousician combines notation, instant feedback, progress tracking, and teacher prompts (Wang, 2025).

3.2.2 Core Teaching Objectives and Learning Activity Design

Enhancing Music Performance Skills

These skills start from concrete cues and let practice grow from them, before closing with a brief check of what changed. For voice, intelligent assessment provides formative hints on pitch, resonance, and diction that teachers can turn into concrete corrections (Bai, 2022). A pronunciation-scoring model (1D-CNN) converts vocal features into objective signals that guide demonstration and self-adjustment (Shen & Zhao, 2024). For piano, a piano assessment engine acts as an objective rater plus an individualized practice guide, keeping class standards consistent while pointing to next-step work (Xiang & Sun, 2024). For process diagnosis, DTW alignment helps locate where timing or rhythm drifts and by how much, informing targeted drills (Wang, 2023).

Developing Understanding of Music Theory

Penetration of AI technology in the field of education, music theory teaching is gradually breaking through the limitations of traditional models. Chord IQ provides feedback and progress tracking so misunderstandings surface and are fixed in time (Liu et al., 2025). In counterpoint and harmony, use DeepBach as editable classroom material so students learn rules by rewriting and comparing versions (Yuan, 2024). When the class needs ready-to-use content and examples, AIVA can serve as the primary source to support concept grasp and model analysis (Lu & Guo, 2025).

Fostering Art History Awareness, Musical Expression, and Stylistic Listening

Art history, expression, and stylistic listening, understanding grows through focused listening and hands-on examples. For Classical Turkish

music, an MIR system supports makam classification with upload, feedback, and ear-based comparisons, strengthening memory and basic stylistic literacy (Kayis et al, 2021). For expressive delivery, a VR setup offers an observable space for gesture and facial work with teacher modeling and repeated practice (Chen, 2022). A multimodal learning system can personalize materials and paths, linking background information, repertoire, and listening tasks more tightly (Peng, 2025).

Strengthening Motivation and Self-Efficacy

Yousician, learners get instant feedback tied to notation, progress records, and teacher recommendations, which supports steady, self-directed practice (Wang, 2025). In composition, IBM Watson BEAT provides a clean entry point for a simple in-class cycle of generate, listen, critique, and revise (Liu & Liao, 2025). In online or hybrid settings, a web-based DAW like Soundtrap keeps making and submitting in one place (Knapp et al., 2023). When classroom energy needs a boost, the gamified design in Vocal AI Analyzer can be used for motivation and milestone prompts (Liu & Guo, 2025).

3.2.3 Teacher Roles and Their Teaching Strategies

Steer learning when digital tools are present, how lessons are designed, and how technical outputs are turned into actions students can actually take.

Teachers as Guides

Teachers keep the room on task, model key movements, and convert diagnostic observations into short, specific tasks that students can try immediately. Coaching also includes shaping students' perceptions of tool use and managing cognitive load so feedback is usable rather than distracting (Chen, 2025). Evidence from individual and group lessons shows that teachers still anchor technique through targeted correction and close monitoring of progress even when digital systems are embedded in the course (Wang, 2025).

Teachers as Learning Experience Designers

Attention turns to how a lesson is put together. Teachers decide when a tool should enter a task, what job it does, and when to step back so the activity holds together. Process studies in popular-music courses report that adjusting task flow with instructional data improves the match between materials and learner level; combining technology with clear pedagogy matters more than adding features (Li et al, 2023). Integration research similarly links gains to deliberate sequencing and alignment of objectives, assessments, and tool placement rather than to the number of tools used (Li, 2022).

Teachers as Interpreters of AI Feedback

Lesson plan is set; teachers act as interpreters of AI feedback: they read the system output with the student, restate one priority in plain musical terms, and turn it into one or two short drills plus a listening checkpoint tied to the piece at hand (Yang, 2018). They explain why the change matters, trim overly granular indicators to a cue the learner can use, and check the result in a quick re-take before setting the next small goal so improvement shows up in playing or singing, not just in a score. It tells students what to change, where to change it, and how to listen for the result, so the fix shows up in the performance, not just in a score (Yang, 2018; Wang, 2025).

3.2.4 Outcomes and Impact of AI-Assisted Tools on Students' Music Learning

The reviewed studies collectively suggest that AI-assisted tools exert a multifaceted influence on students' music learning. These impacts can be categorized into five major domains: performance proficiency, music theory and aural cognition, motivation and self-efficacy, assessment reliability and fairness, and learning engagement and accessibility.

Performance Proficiency (Vocal and Piano)

Lesson-embedded, feedback-rich practice makes technical work concrete and trackable. In voice, objective scoring pinpoints pitch, resonance, and diction issues in plain terms, so a vague practice becomes two or three focused drills the student can actually attempt (Shen & Zhao, 2024). For piano, engine reports provide clear levels and key points; teachers use them to keep grading consistent across the class while routing learners toward the next sensible exercise rather than a one-size-fits-all routine (Xiang & Sun, 2024). Everyday practice also benefits from a companion platform that joins notation, instant hints, and progress records; the steady rhythm of short, guided work tends to lift control and confidence over time (Wang, 2025). In creation classes, using a generative tool as a starting material invites minor revisions that quietly strengthen timing, phrasing, and continuity

while students focus on making the piece their own (Liu & Liao, 2025).

Music theory and aural cognition

A quick check and immediate feedback sit side by side. Chord IQ makes this loop visible, surfacing misunderstandings early and letting teacher and student address them before they harden into habit (Liu et al, 2025). For counterpoint and harmony, editable fragments shift rules from the page to the hands: students rewrite and compare versions until the constraints of the style start to feel natural rather than memorized (Yuan, 2024). When the goal is modal or stylistic literacy, an MIR system supports upload–verify–listen routines; learners test their ears against makam feedback and build a bank of heard examples they can return to in later pieces (Kayis et al, 2021).

Motivation, self-efficacy, and learning strategies

Motivation grows when the work has a clear entry point and each revision shows audible progress. In composition, IBM Watson BEAT supplies that first foothold; short cycles of generate, listen, and revise help students take ownership and see their ideas tighten from one version to the next (Liu & Liao, 2025). In polyphony, editable exemplars make knowing the rule feel like being able to use it, which steadies confidence and encourages deliberate practice rather than guesswork (Yuan, 2024). During day-to-day skills work, a companion app that pairs feedback with visible progress tends to support self-monitoring; students can tell what changed and what to try next without waiting for a whole lesson to pass (Wang, 2025).

Assessment reliability and fairness to support learning

Objective evaluators reduce concerns about subjective judgment and keep the conversation on what to fix and how. In vocal study, machine scoring that aligns with expert judgment provides trustworthy cues for targeted drills instead of broad advice (Shen & Zhao, 2024). Piano engines standardize levels and highlight priorities, which helps large groups share a stable standard while still leaving room for individual routes through the material (Xiang & Sun, 2024). For timing and phrasing work, sequence-alignment diagnostics show where performance drifts, giving the teacher and student a precise spot to slow down, separate hands, or rebuild the pulse before returning to the whole passage (Wang, 2023).

Learning engagement and access

VR turns gestures and facial work into something students can see, try, and refine, making it easier to model choices and rehearse them without fear of the room (Chen, 2022). In connected settings, a web-based DAW keeps making and submitting in one place, so participation feels continuous rather than stop-and-start between tools; this simple continuity often sustains attention and practice across weeks (Knapp et al, 2023).

3.3 Challenges and Implications of Incorporating AI into Music Education

Especially in Asia, the assessment of musical performance and engagement in music learning has had a significant impact. However, there are still challenges in terms of fairness, ethics, and teaching design.

Across the studies, the same obstacles keep surfacing, even if they are named in different ways. At the practical end, audio and voice are sensitive to noise, feature extraction needs repeated tuning, and small datasets make models wobbly; in immersive settings, cameras, lighting, and room setup raise the bar, while the "closed" habits of a traditional class blunt the value of objective feedback (Bai, 2022; Chen, 2022). Implementation also lives or dies on data quality and engineering details, which affect whether front-line teachers feel these tools are usable in real lessons (Li et al., 2023). Genre and culture add another wrinkle: systems trained on one style can stumble on others, as seen in makam work where annotation and interpretation are not always uniform (Kayis et al, 2021). In short, two steady paths help more than grand promises: widen and tidy the training data, especially under small-sample constraints, and keep polishing the collection and interaction links inside actual classrooms.

The pedagogical side is just as important. If a class hands creation or practice over to canned examples, students drift toward imitation and their pieces start sounding the same; motivation and critical listening fade with it (Yuan, 2024). Timing matters as well; bring a tool in when the task needs it, step back when the point is made, and frame each output as material to be discussed, critiqued, and rewritten rather than a final answer (Liu & Liao, 2025). Classroom reports also caution that poorly timed automation can raise pressure and disrupt the social rhythm of a group; teachers need to set

expectations, slow things down when the feedback gets noisy, and keep the musical aim in view (Chen, 2025). In practice, it helps to treat AI as a medium and a sparring partner: valuable for prompts, checks, and options, but never the driver of the lesson.

Taken together, the implications are straightforward. Keep classroom leadership with the teacher, sequence tools to fit the objective, and build fairness and access into the plan from the start so "who can use it" and "for how long" are clear, not afterthoughts (Li et al, 2023). Use assessment engines to stabilize standards while leaving space for individual routes, and tune content and models to local styles and practices so feedback makes sense to the music at hand (Xiang & Sun, 2024; Kayis et al, 2021). A staged approach works best: begin with supportive embedding in existing courses, then expand as routines settle and capacity grows, making sure technology serves musical work rather than replacing it (Wang, 2025).

4. Discussion

This scope review systematically synthesizes 27 empirical studies on the application of AI in music education from 2015 to 2025. Several key themes emerging from it clarify the potential and limitations of current research in this rapidly evolving field.

4.1 Geographical and Methodological Concentration

The research significantly focuses on East Asia, particularly China (accounting for over 85%), which to some extent echoes the policy promotion and infrastructure investment (Han, 2025; Liu & Liao, 2025). However, this also brings the issue of insufficient cross-cultural representation: regions with rich musical traditions, such as Europe, Latin America, and Africa, are rarely included in the sample, limiting the generalizability of the conclusions and ignoring how cultural differences affect the acceptance of AI and music education.

Methodologically, the field still primarily focuses on quantitative design (81.5%), with research primarily concentrated on short-term interventions, performance indicators, or experimental comparisons (such as Wang, 2025; Xiang & Sun, 2024). The evidence produced mainly reflects current quantifiable improvements. Still, it falls short in answering whether these can be sustained over the long term, whether they can be transferred to real performances or compositions, and whether they still hold under different classroom cultures and teaching styles. In contrast, longitudinal, mixed-methods, and qualitative ethnography are notably lacking, making it difficult to depict the profound changes in creativity, musical identity, peer interaction, and the teaching process over time.

4.2 The Pedagogical Role of AI: Enhancing Rather than Replacing

Excel data confirms that AI's role in the classroom is primarily supportive rather than substitutive, with standard practices involving embedding tools into specific stages: for warm-up and rhythm calibration, immediate prompts for segmented practice, such as: Yousician supports daily practice and progress visualization (Wang, 2025), Vocal AI Analyzer converts issues like pitch, resonance, and articulation into clear reminders (Shen & Zhao, 2024), IBM Watson BEAT provides modifiable segments for revision after peer listening (Liu & Liao, 2025). These uses serve the explicit goal of enhancing playing control, inspiring composition, and deepening understanding of theory and aural perception, rather than allowing tools to take over the classroom.

However, the pedagogical logic behind tool integration is often implicit or undertheorized. Only a few studies adopt structured teaching frameworks (such as the blended learning proposed by Liu et al., 2025; the blended learning proposed by Cui & Chen, 2024). Notably, teachers are being reshaped as designers of the learning experience (such as the VR scene creation proposed by Chen, 2022) and interpreters of AI feedback. Overall, this aligns with constructivist and Vygotsky's emphasis on mediated learning, with AI more like a scaffold rather than a substitute.

4.3 Challenge: Technology, Fairness, Teaching, and Ethics

Despite promising outcomes, several recurring challenges continue to constrain the broader and more equitable adoption of AI in music education. These challenges can be grouped into four interrelated categories: technological instability, inequity in access and fairness, educational risks, and ethical ambiguity.

Technological instability—audio AI systems are susceptible to noise and small samples, requiring repeated parameter adjustments. Additionally, immersive scenarios are limited by camera position, lighting, and the venue (Bai,

2022; Han, 2025).

The fairness issue—inequality in the use of smart devices, the gap in digital literacy, and cost-related limitations have not been adequately addressed, particularly evident in rural or resource-poor schools, which can lead to devices that can be used but are challenging to use sustainably (Wei, 2021; Chen, 2025).

Educational risks—inappropriate timing of intervention or excessive automation ratios can easily delegate learning tasks to tools, leading to over-reliance on AI (Miseol Choi, 2023; Lu & Guo, 2025). Data also shows that group discussions and peer evaluations are being compressed, classroom communication is decreasing, and work is becoming more similar.

Ethical ambiguity—Generative tools involve the boundaries of authorship, rewriting, and originality, as well as the transparency and explicability of evaluation, and the current norms are still insufficient (Liu & Liao, 2025).

4.4 Future Research Directions

Data shows that the current study still has several obvious gaps: Firstly, the study relies too heavily on short-term gains and lacks longitudinal tracking of students' musical development; secondly, there is insufficient inclusive attention, with almost no specialized design and testing for learners with disabilities or neurodiversity; then, teacher professional development often stops at the ability to use tools, with a lack of systematic evaluation of classroom processes and effectiveness; finally, the interaction between students and AI has not yet been refined and explained as a unique teaching relationship. These gaps collectively weaken the evidence base for large-scale promotion and also indicate that the pace of technological innovation is faster than the in-depth research on teaching. Based on these insights, the next phase of research should focus on sustained effects, context adaptation, and target populations: on one hand, expand the cross-cultural sample and conduct longitudinal tracking on a semester basis, retaining key process records; on the other hand, explore design methods involving teachers, students, and developers together, combining teachers' teaching experience, students' usage needs, and developers' technical capabilities to create truly fitting AI tools for teaching scenarios with educational significance. At the same time, study the role of AI in creativity, identity, and collaboration, with a focus on its specific performance and impact in areas beyond classical and technical performances (such as daily art creation, community cultural practices, interdisciplinary collaboration projects, etc.), and develop inclusive AI tools for different learner groups, ensuring that the tools can adapt to diverse learning needs through practical scenario testing.

In the end, the application of AI in music education should not be seen as a solution, but rather as a partner in the co-evolution of teaching innovation. In creating a music learning experience rich in emotional resonance, deep in cultural roots, and ethically responsible, teachers still play a core role.

5. Conclusion

This scope review covers empirical research on the application of AI in music education from 2015 to 2025. The reviewed studies indicate that AI is playing an increasingly important role in various teaching environments, including performance training, theoretical teaching, and music composition.

Based on the research included, three key insights emerged: Firstly, AI-assisted tools can enhance music learning outcomes through personalized feedback, standardized assessment, and immersive engagement, such as in college piano classes, where the BiLSTM assessment is divided into five levels, and individual process prompts are provided, allowing teachers to implement tiered guidance accordingly (Xiang & Sun, 2024). Secondly, the role of the teacher shifts from one-way teaching to a combination of guidance, learning experience design, and AI feedback explanation: translating system prompts into actionable classroom tasks, arranging the sequence and difficulty gradient of exercises, and avoiding students' mechanical dependence on scores; the practice of blended music theory courses shows that this approach can enhance motivation and self-efficacy (Liu & Gu, 2025). Thirdly, to truly implement and sustainably develop, it is necessary to systematically address the shortcomings in the implementation process, such as differences in equipment and bandwidth, privacy and attribution definition, and inconsistent classroom methods; some studies have reduced the threshold in aesthetic education courses through lightweight and open-source deployment, and have brought

privacy and attribution boundaries to the forefront as classroom consensus, balancing participation and compliance at the same time (Peng, 2025).

Despite encouraging progress, there is still a significant gap. Research on geographic distribution is biased towards a few regions, especially Asia; long-term tracking is limited, and special education and cross-cultural comparisons are relatively scarce. Many interventions are short-term and lack repetition validation, and the absence of a theoretical framework also limits a deeper understanding of learner development and teaching transformation. Subsequent work should shift to more context-aware tool design and teacher-centered interventions, accompanied by long-term effectiveness evaluation, and incorporate ethical norms, accessibility frameworks, and culturally responsive teaching methods into the curriculum. Ultimately, AI should be an auxiliary tool, serving to support and amplify the humanistic essence and depth of musical education, rather than replace it.

6. Implications

This review aims to provide a practical technical landscape: it does not simply list tools, but explains when, how, and to what extent they are used in music classes, and organically integrates existing practices and results.

For music teachers, focus each lesson on a key point: first, point out a specific passage, then provide practice methods within two steps, and the desired changes to be heard. Verify on the spot before moving forward. Tools are introduced only when needed, and when they are used, they are removed, keeping the focus on the work and the sound itself. This ensures class consistency while maintaining individual progress and paths. After a few lessons, students will clearly see their progress (Wang, 2025).

For course designers, curriculum development should be centered around learning objectives: First, construct a compact, closed-loop structure: explaining key points—immediate practical application—rapidly verifying results—and then making targeted adjustments. This ensures that each teaching session aligns with the objectives. Based on this, appropriate tools (such as demonstration tools and interactive practice tools) and teaching materials (such as sheet music and audio clips) should be selected accordingly, avoiding the passive pitfall of first acquiring the tools and then assembling the content. Furthermore, tailoring the teaching needs of students at different age levels and other musical styles requires the preparation of differentiated examples (such as children's song excerpts for younger students and excerpts from classic works for older students) and instructions for using the tools. Ideally, these should be fully integrated into the course package in advance to reduce the time teachers spend searching for and assembling materials during class (Li, 2022; Yuan, 2024).

For students, when using AI, they can position it as a dedicated practice partner rather than a machine that directly gives standard answers. For example, use AI to generate accompaniment of different speeds to assist in practice, or call up audio of various versions of works to expand ideas, rather than letting AI directly generate a complete performance plan. During use, pay special attention to the boundaries between quoting, rewriting, and originality: when drawing on materials provided by AI, it is necessary to mark the source, and when adjusting the performance based on AI suggestions, incorporate personal understanding. While using technology to quickly solve fundamental problems, such as pitch and rhythm, to improve practice efficiency, we must also be wary of the mental inertia caused by over-reliance on AI, and avoid losing the ability to analyze works and explore expression styles independently (Liu & Liao, 2025).

For schools and ICT coordinators, promoting the use of technology in music instruction requires clarifying key responsibilities and regulations from the outset. From the outset of a project, it's crucial to define equipment procurement or leasing channels clearly, the responsible parties for routine maintenance, the time periods and durations during which teachers and students can use the equipment, and the management standards and privacy requirements for teaching data. A small-scale pilot strategy is recommended for implementation: First, select one or two grades or specific classes for a trial run to observe the compatibility of the technology tools with classroom instruction. Once teachers have mastered the operational procedures and the classroom interaction model is operational, the scope of application can be gradually expanded to mitigate the risks of large-scale rollout. Subsequent resource

investment should be carefully considered to ensure that the tools truly contribute to improving teaching quality (Li et al, 2023).

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The Influence of Peer Support on Student Well-Being: Insights from the PISA 2018 Study

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Abstract

This study, based on data from PISA 2018, investigates the mechanism through which peer support influences student well-being, specifically examining the mediating role of resilience and the moderating role of perceived family support in this relationship. The research sample comprised approximately 10,000 15-year-old students from four provinces/municipalities in China (Beijing, Shanghai, Jiangsu, Zhejiang). The results indicated that peer support significantly and positively predicted student well-being, and resilience played a partial mediating role in this relationship. Furthermore, perceived family support significantly moderated the effects of peer support on resilience and of resilience on student well-being. Specifically, the influences of peer support on resilience and of resilience on well-being were more pronounced among students with high levels of perceived family support. This study extends social support theory, validates the proposed mediation and moderation models, and provides concrete references for educational practice. It emphasizes the importance of fostering both peer support and perceived family support in educational settings to enhance student resilience and well-being.

Keywords: PISA 2018, peer support, student well-being, resilience, perceived family support, mediation model, moderating effect

1. Introduction

Peer support refers to the emotional and practical assistance that individuals receive from peers—such as classmates and friends—who share a similar status or life circumstances. Within student populations, peer support is highly prevalent, as students form close-knit social networks through shared learning environments and life experiences. Frequent daily interactions and communication among them make peers a primary source of mutual support. Peer support plays a significant role in students' mental health, academic performance, and overall well-being. It helps students alleviate academic and life-related stress, reduces the incidence of anxiety and depression, and—through encouragement and affirmation from peers—strengthens self-esteem and self-confidence, thereby fostering a positive self-identity.

Student well-being refers to students' overall satisfaction with their educational experiences, school environment, and various educational services. This satisfaction encompasses not only academic aspects but also extends to perceptions of school management, teacher-student

interactions, campus facilities, extracurricular activities, and social support. Typically measured through questionnaire surveys and feedback mechanisms, student well-being serves as a comprehensive evaluation indicator. Research shows that Chinese students' life satisfaction falls below the OECD average, reflecting how cultural contexts, educational environments, and social pressures shape subjective well-being. Enhancing students' life satisfaction requires focused attention on psychological health, reduction of academic pressure, and improvements in educational and living environments.

The Programme for International Student Assessment (PISA), initiated by the Organisation for Economic Co-operation and Development (OECD), assesses the capabilities of 15-year-old students in reading, mathematics, and science to evaluate the effectiveness of education systems across countries. The four Chinese provinces/municipalities of Beijing, Shanghai, Jiangsu, and Zhejiang participated in the 2018 assessment. Based on the PISA 2018 data, this study examines the impact of peer support on student well-being, with a specific focus on testing the mediating role of resilience. The research aims to elucidate the mechanism through which peer support enhances student well-being by fostering their psychological resilience. The findings not only deepen the theoretical understanding of this influential mechanism but also provide empirical evidence for educational practices aimed at enhancing student welfare by strengthening peer support and psychological resilience.

2. Theoretical Basis and Research Hypotheses

2.1 The Relationship Between Peer Support and Student Well-Being

Based on the relevant definitions of peer support, students who receive peer support in their academic and daily lives can often have their emotional needs met, alleviating feelings of loneliness and anxiety. In summary, this study proposes the following hypothesis:

2.2 Peer Support and Resilience

Resilience is the psychological adaptation and recovery capacity individuals demonstrate when facing stress or adversity. As a crucial component of psychological capital, it significantly influences an individual's mental health status and cognitive functioning. Resilience encompasses cognitive flexibility, emotion regulation, coping strategies, and social support, among other dimensions. Research indicates that with strong peer support, individuals are more likely to develop high levels of resilience and demonstrate more positive responses to stress and adversity. Based on this understanding, the following hypothesis is proposed:

2.3 The Mediating Role of Resilience

Resilience, as an individual's capacity to cope with stress and challenges, has a direct impact on student well-being. Students with high levels of resilience are better able to manage and regulate their emotions, thereby reducing the negative effects of emotional distress on life satisfaction. Furthermore, highly resilient students demonstrate greater adaptability in both social and academic contexts, enabling them to establish and maintain positive relationships while gaining increased support and recognition, which subsequently enhances their overall well-being.

2.4 The Moderating Role of Family Support

Family support, derived from family systems theory, refers to an individual's overall perception of two aspects: the degree to which family members care about their well-being, and the extent to which the family values their personal contributions. Based on this understanding, the following hypothesis is proposed:

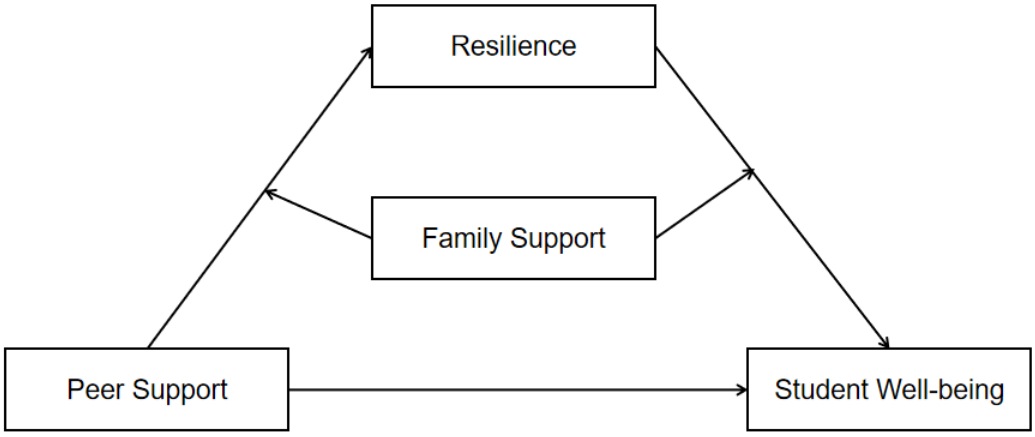

Figure 1. A Moderated Mediation Model

3. Research Methodology

3.1 Data Source

The data for this study are derived from the PISA 2018 assessment conducted in four Chinese provinces and municipalities. The sample consists of approximately 10,000 students from Beijing, Shanghai, Jiangsu, and Zhejiang. Data collection was carried out through computer-based tests and questionnaire surveys, encompassing multiple dimensions including students' academic performance, psychological well-being, family background, and school environment.

3.2 Measurement Instruments

3.2.1 Peer Support Questionnaire

This study utilized the social support module from PISA 2018, specifically focusing on questionnaire items related to peer support. These items measured students' perceptions of peer support, covering aspects such as academic, emotional, and daily life support from peers.

3.2.2 Student Well-Being Questionnaire

Student well-being was measured using the life satisfaction and well-being questionnaire in PISA 2018. The questionnaire items included students' evaluations of their overall life satisfaction, self-assessment, and emotional experiences.

3.2.3 Psychological Resilience Scale

Psychological resilience was measured through the mental health module in PISA 2018, which includes questionnaire items assessing students' coping and adaptive capacities when facing stress and challenges. Specific questions addressed students' emotional regulation, problem-solving abilities, and utilization of social support when encountering difficulties.

3.2.4 Perceived Family Support Questionnaire

Family support was measured by assessing students' perceptions of their family environment. The questionnaire items included family cohesion, family communication, and the level of parental care and support.

3.2.5 Control Variables

Considering the potential influence on peer support, student well-being, resilience, and perceived family support, the study controlled for students' gender, age, family socioeconomic status, school type, academic performance, and region. By integrating the above measurement tools, this study comprehensively evaluated the effects of peer support, psychological resilience, family support, and school environment on student well-being. This approach provides robust data support and an analytical foundation for investigating the mechanisms through which peer support influences student well-being.

3.3 Data Examination

The current study employed AMOS 22.0 and SPSS 22.0 for conducting moderation and mediation analyses. Data examination included tests for common method bias, descriptive statistical analysis, reliability and validity assessments, and multicollinearity diagnostics.

3.3.1 Common Method Bias Test

Given that all constructs in this study were measured through student self-reported questionnaires, rigorous common method variance (CMV) assessment was conducted. First, at the research design level, PISA 2018's anonymous administration and reverse-scoring design for certain items had already preemptively controlled for some CMV.

Second, two statistical validation methods were employed: 1) Harman's single-factor test revealed five factors with eigenvalues greater than 1, with the largest factor accounting for 28.4% of the variance, not constituting a majority; 2) Confirmatory factor analysis with an added latent method factor in the structural equation modeling showed no significant improvement in model fit indices (e.g., CFI, TLI, RMSEA) compared to the controlled model (ΔCFI < 0.01). Combined procedural and statistical evidence indicates that common method variance has limited interference with the study results.

3.3.2 Reliability Test

Internal consistency of each scale was assessed using Cronbach's α coefficient. The results demonstrated high internal consistency across all scales:

(1) Peer Support Questionnaire: α= 0.89

(2) Student Well-being Questionnaire: α= 0.91

(3) Psychological Resilience Scale: α= 0.87

(4) Perceived Family Support Questionnaire: α= 0.88

3.3.3 Validity Testing

Exploratory Factor Analysis (EFA) and Confirmatory Factor Analysis (CFA) were conducted to assess the structural validity of the scales. The results indicated that the items of each scale effectively reflected their respective measured constructs, demonstrating good structural validity.

3.3.4 Multicollinearity Test

Prior to conducting regression analysis, multicollinearity was assessed by calculating the Variance Inflation Factor (VIF) for all variables. The results showed that all VIF values were below 10, indicating no significant multicollinearity issues that would affect the regression analysis results.

4. Hypothesis Testing

In this study, data processing and analysis were conducted to test the following hypotheses, aiming to verify the relationships among peer support, student well-being, resilience, and perceived family support, as well as their moderating and mediating effects. The hypothesis testing included mediation analysis and moderation analysis.

4.1 Mediation Effect Analysis

This study hypothesized that psychological resilience mediates the relationship between peer support and student well-being. To test this hypothesis, the mediation analysis steps proposed by Baron and Kenny were adopted, and structural equation modeling was conducted using AMOS 22.0.

As shown in Figure 1:

- The effect of peer support (X) on psychological resilience (M): regression coefficient $\beta = 0.35$, $t = 5.57$, $p < 0.001$, indicating a significant positive effect of peer support on psychological resilience.

- The effect of psychological resilience (M) on student well-being (Y): regression coefficient $\beta = 0.45$, $t = 9.33$, $p < 0.001$, indicating a significant positive effect of psychological resilience on student well-being.

- The direct effect of peer support (X) on student well-being (Y): regression coefficient $\beta = 0.23$, $t = 4.89$, $p < 0.001$, indicating a significant direct positive effect of peer support on student well-being.

Goodness-of-fit indices for the model indicated satisfactory model fit, and all path coefficients reached statistical significance ($p < 0.05$), suggesting that psychological resilience plays a partial mediating role in the relationship between peer support and student well-being.

The mediation analysis revealed that peer support not only directly predicts student well-being (effect size = 0.23) but also exerts an indirect influence through psychological resilience (effect size = 0.12). Bootstrap sampling tests showed that the 95% confidence intervals for both the direct and indirect effects did not include zero, confirming the statistical significance of these paths. The total effect was 0.35, with the direct and mediating effects accounting for 65.71% and 34.29% of the total effect, respectively.

Table 1. Statistical Results of the Mediation Model Testing the Effect of Peer Support on Student Well-being

Regression Equations (N=456)	Model Fit Indices	Coefficient Significance	F(df)	β	t
Outcome Variables	Predictor Variables	R^2			
Resilience (M)	Peer Support (X)	0.48	27.46(5)	0.35	5.57
Student Well-being (Y)	Resilience (M)	0.49	29.90(5)	0.45	9.33
Student Well-being (Y)	Peer Support (X)	0.52	28.04(6)	0.23	4.89

Table 2. Decomposition of Total, Direct, and Indirect Effects

Effect Type	Standard Error	Effect Lower Limit	Effect Upper Limit	Relative Effect Size
Total Effect	0.35	0.25	0.45	0.35
Direct Effect	0.23	0.15	0.31	0.23
Mediating Effect	0.12	0.07	0.17	0.12

By decomposing the total, direct, and mediating effects, the relationships among peer support, psychological resilience, and student well-being were further clarified, confirming the importance of psychological resilience as a mediating variable.

Multiple regression analysis further validated the above pathways: after controlling for variables such as gender and SES, the positive effects of peer support on psychological resilience ($\beta = 0.35$, $p < 0.001$) and of psychological resilience on student well-being ($\beta = 0.45$, $p < 0.001$) remained significant, consistent with the mediation analysis results.

4.2 Moderating Effect Test

To examine the moderating effect of perceived family support on the relationships between peer support and psychological resilience, and between psychological resilience and student well-being, this study employed Model 58 from Hayes' SPSS PROCESS macro. Control variables included gender, age, family socioeconomic status (SES), school type, and academic performance.

As shown in Figures 2 and 3 and Table 3, perceived family support significantly moderated the effect of peer support on psychological resilience and the effect of psychological resilience on student well-being.

When the interaction term between peer support and perceived family support was introduced into the regression model, the results showed a significant predictive effect of the interaction term on psychological resilience ($\beta = 0.22$, $t = 4.86$, $p < 0.001$). The test of the moderating effect in the first half of the mediation model indicated that perceived family support significantly moderated the relationship between peer support and psychological resilience. Simple slope analysis revealed that for individuals with high perceived family support (M + 1 SD), peer support had a strong positive predictive effect on psychological resilience (simple slope = 0.49, $t = 7.93$, $p < 0.001$), while for those with low perceived family support (M - 1 SD), the predictive effect, though still significant, was notably weaker (simple slope = 0.21, $t = 3.37$, $p < 0.001$). This suggests that perceived family support enhances the positive effect of peer support on psychological resilience, indicating a significant positive moderating effect.

When the interaction term between psychological resilience and perceived family support was introduced into the regression model, the results showed a significant predictive effect of the interaction term on student well-being ($\beta = 0.25$, $t = 5.21$, $p < 0.001$). This indicates that perceived family support moderates the latter half of the mediation pathway, where psychological resilience influences student well-being. Simple slope analysis demonstrated that perceived family support moderated the efficiency with which psychological resilience translates into

well-being. For individuals with low perceived family support (M - 1 SD), the predictive effect of psychological resilience on well-being was not significant ($\beta = 0.08$, $t = 1.38$, $p > 0.05$), whereas for those with high perceived family support (M + 1 SD), psychological resilience showed a strong positive predictive effect ($\beta = 0.49$, $t = 7.18$, $p < 0.001$). This confirms the positive moderating role of perceived family support in the relationship between psychological resilience and student well-being, indicating that psychological resilience more effectively translates into well-being only when individuals receive sufficient family support.

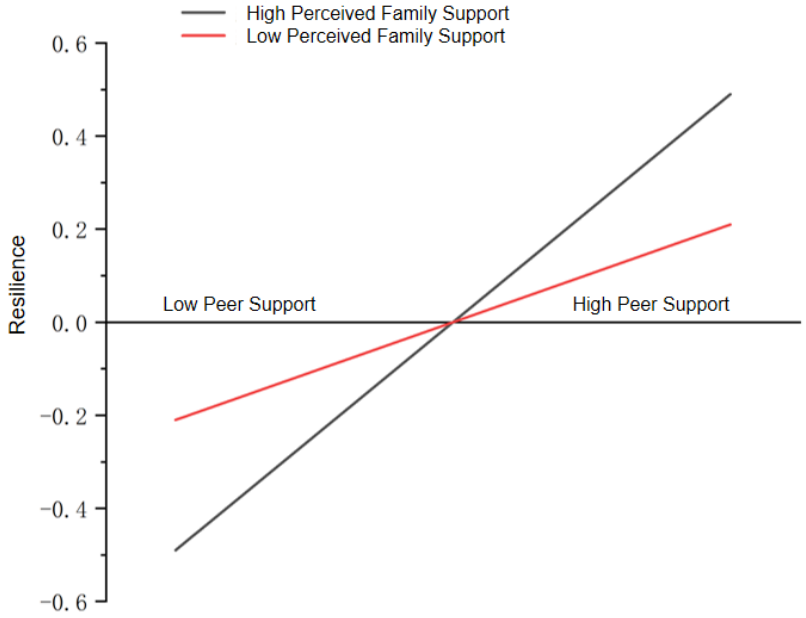

Figure 2. Moderating Effect of Peer Support on Psychological Resilience

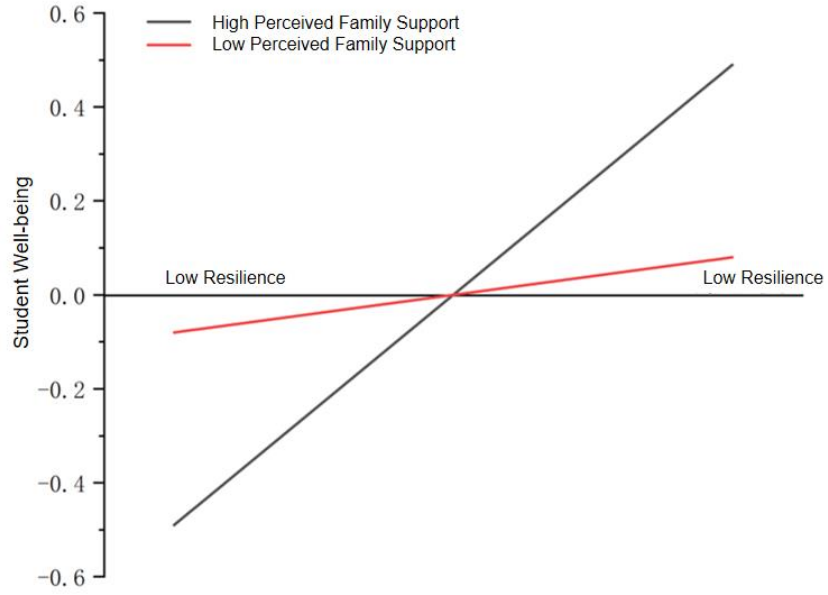

Figure 3. Moderating Effect of Psychological Resilience on Student Well-being

Table 3. Results of Moderating Effect Analysis

Regression Equations (N=456)	Predictor Variables	R^2	F(df)	β	t
Resilience (M)	Peer Support(X)	0.48	27.46(5)	0.35	5.57
	Peer Support×Perceived Family Support			0.2	4.76
Student Well-being (Y)	Resilience(M)	0.49	29.90(5)	0.45	9.33
	Resilience × Perceived Family Support			0.25	5.21

5. Discussion and Recommendations

5.1 Research Conclusions

Based on the analysis of PISA 2018 data, this study explored the mechanism through which peer support influences student well-being and verified the roles of psychological resilience as a mediating variable and perceived family support as a moderating variable in this process. The main conclusions are as follows:

Direct effect of peer support on student well-being: Peer support significantly and positively predicts student well-being, indicating that higher levels of peer support are associated with greater student well-being.

Mediating role of psychological resilience: Psychological resilience partially mediates the relationship between peer support and student well-being. Peer support enhances students' psychological resilience, which in turn improves their well-being.

Moderating role of perceived family support: Perceived family support significantly moderates the effects of peer support on psychological resilience and of psychological resilience on student well-being. Specifically, for students with high levels of perceived family support, the positive effects of peer support on psychological resilience and of psychological resilience on well-being are more pronounced.

5.2 Practical Implications

Enhancing Peer Support: Schools and educators should prioritize fostering peer support among students by organizing group activities, promoting teamwork, and facilitating class-building exercises. These initiatives can encourage positive interactions and emotional support among students.

Developing Psychological Resilience: Educators should focus on cultivating students' psychological resilience through mental health education, stress management, and emotional regulation training. Such programs can enhance students' ability to cope with challenges and adapt to adversity.

Strengthening Perceived Family Support: Families should emphasize emotional support and understanding toward their children, creating a warm and nurturing home environment. By enhancing students' perceived family support, the positive effects of peer support and psychological resilience on well-being can be further amplified.

5.3 Research Limitations

First, while the sample from PISA 2018 possesses certain representativeness, its coverage is limited to four Chinese provinces and municipalities, necessitating further validation for generalizability. The use of cross-sectional data prevents definitive causal inferences; future studies could adopt longitudinal designs to track long-term effects. Additionally, refining specific dimensions of the variables could offer more precise guidance for practical applications.

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Digital Intelligence Empowers International Chinese Language Teachers' Development: Construction of Competence Improvement Framework and Resource Platform

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Abstract

In the post-pandemic era, the digital transformation of international Chinese language education is urgent, and teachers face issues such as uneven competence in applying digital intelligence technology and mismatched resources. This study surveyed 370 international Chinese language teachers and found that while their use of digital resources has become routine, it lacks depth. To address this, the study, combining the *Standards for Professional Competence of International Chinese Language Teachers* and the TPACK theory, constructs a "three-stage and nine-dimensional" competence improvement framework and designs an integrated international Chinese language digital resource platform with four modules—resource supply, training, interaction, and feedback—providing support for teachers' digital intelligence-driven development and the high-quality development of Chinese language education.

Keywords: international Chinese language, teacher development, digital intelligence, platform construction

1. Introduction

In the post-pandemic era, the global pattern of language and cultural communication and the development environment of international education have undergone profound changes. "Internet + Education" has become an important strategy to promote educational modernization and build a powerful education country. As a bridge for cultural exchanges between China and foreign countries, the digital transformation of international Chinese language education is not only key to its own high-quality development, but also an important measure for China to build a Digital China and a powerful education country. Currently, although international Chinese language education in the new era has entered a stage of high-quality and connotative development, the construction of teaching resources still faces challenges such as uneven quality of teaching materials, insufficient applicability, and inadequate technology integration. At the same time, with capabilities in data processing, intelligent analysis and personalized services, digital intelligence

technology provides new possibilities for the professional development and teaching innovation of international Chinese language teachers. Li Baogui et al. (2025) pointed out that data elements can inject new impetus into the high-quality development of international Chinese language education by reshaping teachers' roles and optimizing resource allocation (Li, B. G., & Li, H., 2025). However, teachers still face problems such as uneven competence in applying digital intelligence technology, mismatched resources, and incomplete support systems. Therefore, building a systematic digital intelligence competence improvement framework and an integrated intelligent resource support platform has become an urgent need to promote the professionalization and digitalization of international Chinese language teachers.

2. Theoretical Foundation and Research Framework

This paper aims to construct a theoretical and analytical framework for the research on the professional development of international Chinese language teachers empowered by digital intelligence. First, we will define the core connotation of teachers' professional development, and clarify the key dimensions of teachers' competence by combining the authoritative standards of international Chinese language education; second, we will explore how digital intelligence technology empowers teachers' professional development, and finally construct an integrated analytical framework to guide subsequent research.

2.1 Theoretical Foundation

Traditional teacher development models face obvious limitations in the context of the new era; previous research and practice have mostly focused on offline phased training, which is restricted by time, space and costs, and it is difficult to integrate digital education strategies (Goktas, Y., 2015). Teacher Professional Development (TPD) is a dynamic and continuous process, whose core lies in promoting the simultaneous improvement of teachers' knowledge, skills, teaching beliefs and independent development capabilities (Darling-Hammond, L., Hyler, M. E., & Gardner, M., 2017). In the field of international Chinese language education, teachers' professional development is directly related to the quality of teaching and the effect of cultural communication. The Standards for Professional Competence of International Chinese Language Teachers (referred to as the Standards) divides teachers' professional competence into four dimensions: language knowledge and skills, teaching knowledge and skills, intercultural communication, and professional ethics and professional development. It provides a core basis for teachers' self-assessment and career planning, and this study is based on these standards to explore the supporting role of digital means in helping teachers meet the standards.

To better understand how technology can effectively empower teaching, this study introduces the Technological Pedagogical Content Knowledge (TPACK) framework as a core theoretical tool. First proposed by Mishra and Koehler in 2006, this theory expands the traditional teaching knowledge framework and emphasizes the complex interaction and integration among Technological Knowledge (TK), Pedagogical Knowledge (PK), and Content Knowledge (CK) (Mishra, P., & Koehler, M. J., 2006). The framework argues that truly effective technology-integrated teaching is not a simple combination of these three types of knowledge, but rather teachers' ability to creatively integrate technology, pedagogy, and subject knowledge according to specific teaching content and contexts. For international Chinese language teachers, the application of the TPACK framework means their professional competence needs to achieve synergy in three aspects: they must not only have solid knowledge of Chinese language and culture (CK) and effective second language teaching strategies (PK), but also proficiently master and properly use various digital tools and platforms (TK) to optimize teaching design, innovate interaction modes, and ultimately improve the overall quality of teaching.

2.2 Research Framework

Based on the above theories, this study constructs an integrated analytical framework that combines the Standards and the TPACK framework, aiming to systematically guide subsequent data collection and the construction of the resource platform.

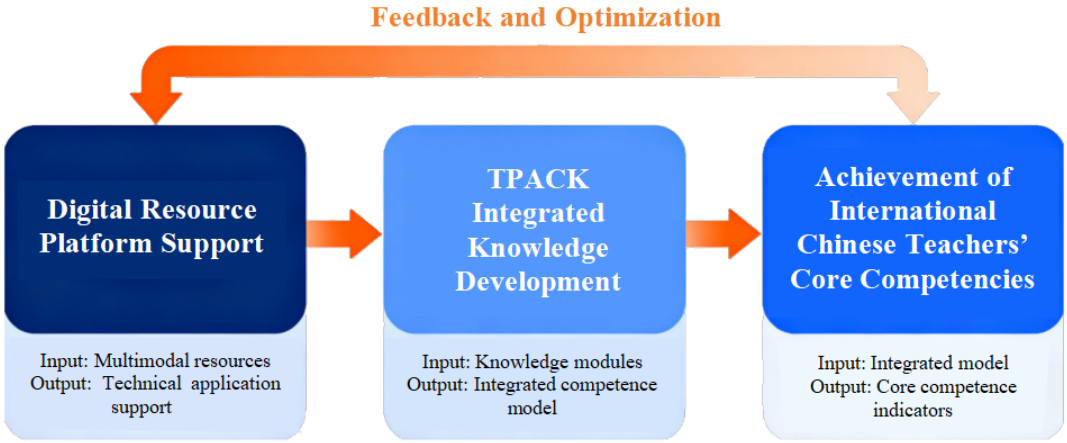

Figure 1. Framework of Core Competence Development Process for International Chinese Language Teachers

This framework is divided into three layers: core, middle, and outer. The core layer is the core competence of international Chinese language teachers, which directly corresponds to the four professional competence dimensions specified in the Standards and serves as the ultimate goal of teachers' professional development; all technology empowerment designs must be oriented toward the achievement of these competences. The middle layer is TPACK integrated knowledge, which acts as a bridge connecting competence goals and technology empowerment, emphasizing that teachers need to develop integrated TPACK to adapt to the digital intelligence teaching environment. The outer layer is the digital intelligence resource platform support system, i.e., the international Chinese language digital resource platform planned to be built in this project. It will be designed around the core and middle layers, providing systematic support modules such as teaching resource libraries, excellent case libraries, online training courses, and interactive communication communities. This analytical framework not only provides clear guidance for data collection in this study but also establishes a theoretical basis for the functional design and content construction of the resource platform. It also emphasizes that the goal of platform construction is not a one-time skill training, but to provide a sustainable, adaptive, and personalized environment for the long-term career planning of international Chinese language teachers, helping them achieve continuous growth and development throughout their careers.

3. Data Collection and Analysis

3.1 Questionnaire Design

Based on the analytical framework for the usage behavior and needs of digital resources among international Chinese language teachers, this study developed the Questionnaire on the Current Status of Digital Resource Usage by International Chinese Language Teachers, which consists of seven parts. The first part covers teachers' basic information, including gender, age, teaching experience, highest education level, type of institution, age group of students, and teaching format, laying a foundation for analyzing differences in resource usage among teachers with different backgrounds. The second part investigates the frequency of digital resource usage through single-choice and multiple-choice questions, including whether resources are used, daily usage frequency, and main source channels. The third to fourth parts focus on resource usage scenarios and type preferences: the scenario part uses single-choice questions to examine the focus of resource usage in links such as lesson preparation, in-class teaching, after-class tutoring, and performance assessment, as well as in the teaching of language elements and course types; the type preference part uses multiple-choice questions to identify the resource types that teachers frequently use and find most helpful. The fifth to seventh parts concentrate on resource satisfaction, usage effects, and demand expectations: they not only investigate teachers'

satisfaction with the resources of their institutions, the actual effects of resources on teaching and student engagement, and usage problems, but also collect teachers' specific needs for resource types and platform functions, as well as their suggestions for digital teaching training and future resource development through multiple-choice and open-ended questions.

3.2 Survey Participants

To fully understand the current status of digital resource usage among international Chinese language teachers, this study distributed questionnaires and collected data via the "Wenjuanxing" online survey platform from July 1, 2024 to July 1, 2025. In terms of sampling design, to avoid the impact of sample singularity on research conclusions, multiple channels were used to target international Chinese language education scenarios of different types, including domestic colleges and universities, primary and secondary schools, private education and training institutions, as well as overseas Confucius Institutes and Chinese schools. At the same time, emphasis was placed on covering teacher groups with different teaching experience levels, educational backgrounds (bachelor's, master's, doctoral degrees), and student age groups, so as to ensure the structural integrity of survey participants and the representativeness of the sample. A total of 419 questionnaires were collected in this survey; after screening out invalid questionnaires with logical contradictions, excessively short response time, etc., 370 valid questionnaires were finally obtained, with an effective recovery rate of 88.3%. In terms of sample structure, the age range of participants covers all stages from 25 years old and below to over 55 years old; the distribution of teaching experience is even, covering all levels from novice teachers to senior teachers; the educational background is mainly bachelor's and master's degrees; at the same time, the types of institutions and teaching formats show significant diversification characteristics. Details of the specific sample distribution are shown in Table 1.

Table 1. Basic Information of Survey Participants

Basic Information	Category	Frequency	Proportion (%)	Basic Information	Category	Frequency	Proportion (%)
Gender	Female	316	85.41	Highest Education	Bachelor	160	43.24
	Male	54	14.59		Master	205	55.41
	Total	370	100.00		Doctoral	5	1.35
Age	⩽25	215	58.11		**Total**	370	100.00
	26 - 35	143	38.65	Institution Type	Domestic Colleges/Vocational Schools	10	2.70
	36 - 45	9	2.43		Domestic Primary & Secondary Schools	52	14.06
	46 - 55	3	0.81		Overseas Confucius Institutes	127	34.32
	Total	370	100.00		Overseas Colleges/Primary & Secondary Schools	18	4.87
Teaching Experience	< 1	130	35.14		Other Educational Institutions	163	44.05
	1-3	156	42.16		**Total**	370	100.00
	4-6	10	2.70	Teaching Format	Offline	254	68.65
	7-10	52	14.05		Online	63	17.03

	> 10	22	5.95		Mixed	53	14.32
	Total	370	100.00		**Total**	370	100.00
Student Age Group	6-12	92	24.86	Student Age Group	19-45	77	20.81
	13-18	138	37.30		Mixed	63	17.03
Total						370	100.00

3.3 Data Analysis

International Chinese language teachers face multiple problems in the use of digital resources. First, the depth of resource use is insufficient: although 75.68% of teachers use digital resources, the application in after-class tutoring is weak, with most teachers only using them occasionally or barely using them at all; the application in performance assessment is also limited, as most teachers only refer to electronic question banks occasionally, failing to form a complete teaching cycle. Second, there are shortcomings in resource sources and quality: 81.08% of teachers obtain resources from social media, 72.97% of teachers create and organize resources by themselves, the utilization rate of high-quality official resources is low—only 40.54% of teachers obtain resources from official websites—and 75.68% of teachers report that the quality of resources is uneven. Third, resource adaptability is poor: the application rate of digital resources in phonetics teaching, Chinese character teaching, listening courses, speaking courses, and reading-writing courses is much lower than that in vocabulary and grammar teaching and comprehensive courses. Specifically, the application rate is 45.95% for phonetics teaching, 54.05% for Chinese character teaching, 29.73% for listening courses, 13.51% for both speaking courses and reading-writing courses, while it reaches 64.86% for vocabulary and grammar teaching and 89.19% for comprehensive courses. Fourth, there is a lack of platform functions: 56.76% of teachers report that there is no effective resource integration platform, and the needs for accurate resource search functions and resource sharing and communication functions among teachers are not met. Fifth, the training system is incomplete: 72.97% of teachers have not received training related to digital teaching, and there is a significant gap in systematic digital teaching skills training and recommendations for high-quality digital resource libraries.

4. Construction of Competence Improvement Framework and Resource Platform

4.1 Framework for Improving the Digital Intelligence Competence of International Chinese Language Teachers

Combining the four dimensions of the *Standards for Professional Competence of International Chinese Language Teachers* and the TPACK theory, this study constructs a "three-stage and nine-dimension" competence improvement framework. This framework covers the entire growth cycle of teachers, from basic adaptation to high-level innovation, and the competence requirements at each stage correspond clearly to the empowerment direction of digital intelligence technology. The specific content is shown in Table 2.

Table 2. Framework for improving the digital intelligence competence of international Chinese language teachers

Competence Stage	Core Goal	Corresponding Competence Dimensions
Basic Adaptation Stage	Adapt to the basic needs of digital intelligence teaching and realize the initial integration of technology and teaching	1. Digital tool operation competence (basic TK) 2. Standardized resource application competence (CK + resource matching) 3. Basic online teaching management competence (PK + technology adaptation)
Advanced Integration	Deepen the integration of technology and teaching, and improve the ability	1. Resource integration and secondary development competence (TK + CK)

Stage	of resource integration and personalized teaching	2. Data-driven teaching adjustment competence (TK+PK) 3. Cross-cultural digital teaching design competence (cross-cultural communication + technology)
High-level Innovation Stage	Innovate digital intelligence teaching and lead the optimization of teaching models and professional radiation	1. Intelligent teaching program design competence (in-depth TPACK integration) 2. Digital teaching research competence (professional ethics and professional development + technology) 3. High-quality resource and experience radiation competence (professional development + sharing technology)

4.2 Construction of the International Chinese Language Digital Resource Platform

The International Chinese Language Digital Resource Platform takes the "three-stage and nine-dimension" competence improvement framework as its core and is designed around four functional modules: resource supply, competence training, interactive communication, and data feedback. It covers the entire teaching process of teachers and the full cycle of their professional development, and can solve the problems identified in the survey, such as fragmented resources, single platform functions, and large training gaps. The platform adopts an architecture of "1 core entrance + 4 major functional modules + N scenario-based sub-columns", with a simple and easy-to-use interface. The core entrance is equipped with competence assessment and demand matching functions, which can provide personalized guidance for teachers. The four major functional modules not only undertake core functions independently but also coordinate through data interconnection. Among them, the resource library module builds a resource library classified by teaching scenarios, content, and competence stages, and also establishes review and evaluation mechanisms to ensure resource quality; the competence training module sets up online courses, practical training camps, and one-on-one tutoring in accordance with the "three-stage and nine-dimension" framework to fill the gap in digital teaching training; the interactive communication module sets up teacher communities, theme topics, and Q&A sections to solve the problem of lack of experience sharing channels; the data feedback module embeds statistics and analysis functions to provide teachers with teaching data and competence development feedback, helping teachers grasp their growth trajectory.

In addition, the platform has three key features and innovations. First, scenario-based adaptation: all functions and resources are designed around teachers' real teaching scenarios to avoid technology for technology's sake. For example, it provides "low-bandwidth adaptive resources" (such as compressed audio and offline courseware) for teachers in overseas Confucius Institutes to solve network instability issues. Second, a collaborative ecosystem: it links universities, overseas Chinese education institutions and senior teachers. Universities provide theoretical support and expert resources, institutions offer frontline teaching cases, and teachers are both resource users and creators, forming a multi-party co-construction and win-win ecosystem. Third, sustainable operation: it establishes a resource upload incentive mechanism—after review, teachers who upload high-quality resources can obtain platform points (redeemable for training courses or consulting services). Meanwhile, it regularly launches resource update plans, updating resources and functions in line with changes in international Chinese education policies (such as the International Chinese Language Education Standards for Chinese Language Proficiency) and new teaching needs to ensure the platform serves teachers' development in the long term. After completion, the platform will first be piloted among teachers and students of TCSOL (Teaching Chinese to Speakers of Other Languages) majors in several universities and teachers of cooperative overseas Confucius Institutes. It will optimize functions and resources based on user feedback, then gradually promote to universities nationwide and overseas Chinese education institutions, becoming a core support platform for the digital and intelligent development of international Chinese language teachers.

5. Conclusion

This study focuses on digital intelligence empowering international Chinese language teachers, constructing a competence improvement framework and a digital resource platform via literature review, theoretical analysis and empirical research, to support teachers' professional growth. Surveys show international Chinese education has shortcomings in resource integration and technology application, with teachers facing fragmented resources and single-function platforms. The proposed "framework + platform" solution, supported by educational informatization and AI, breaks traditional training limits and builds a career-cycle digital ecosystem. Theoretically, it enriches teacher development and educational digitalization research, supporting the *Standards for Professional Competence of International Chinese Language Teachers*. Practically, it provides operable plans for institutions to improve teaching efficiency. Strategically, it aligns with "Educational Power" and "Digital China", boosting Chinese language's global influence. Despite limitations in sample size and platform prototype (to be addressed via future research), this study offers a systematic solution for teachers' digital growth. With optimization, it is expected to drive high-quality international Chinese education and support Chinese language dissemination and global educational cooperation.

Fund Project

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