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Journal of Educational Theory and Practice

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Understanding Teacher Feedback in Primary Education: A Comparative Analysis of a Three-Dimensional Framework

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Abstract: Teacher feedback plays a crucial role in supporting students' learning and engagement in primary education. While existing research often emphasized the cognitive function of feedback in improving academic performance, less attention has been paid to the affective and mediation dimensions involved in daily classroom practice. Therefore, this article aims to propose a three-dimensional framework for understanding teachers' feedback in primary education through integrating cognitive, affective, and mediation perspectives. The article adopts a qualitative comparative analysis approach by examining two previously published studies on teacher feedback practices in primary education conducted in Norway and Australia. The analysis shows that teacher feedback serves multiple functions in classroom interaction, including supporting the learning process, encouraging student engagement, and maintaining positive relationships. Therefore, this article highlights that teacher feedback should be viewed as a multi-dimensional pedagogical practice that dynamically integrates cognitive guidance, motivational support, and appropriate communication tools. And the proposed framework contributes to a wider theoretical understanding of feedback, offering a useful perspective for discussing feedback practices across diverse educational contexts.

Keywords: Teacher Feedback; Primary Education; Formative Assessment; Praise

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1. Introduction

Teacher feedback is widely recognized as an essential part of effective teaching and formative assessment. A large number of research shows that feedback can enhance learning outcomes by giving students information that helps them understand how to move from their current performance level to their learning goals (Black & Wiliam, 1998). In primary education, feedback holds particular importance. Piaget noted that young learners are still developing their cognitive and self-regulatory abilities (Piaget, J., 1972). As a result, they depend heavily on teacher guidance to interpret expectations and assess their progress

(Pekrun et al., 2014). Despite agreement on its significance, research on feedback has traditionally focused on its cognitive and instructional roles. Many key studies view feedback mainly as information that corrects errors or boosts task performance (Nicol & Macfarlane-Dick, 2006; Shute, 2008). While these perspectives have greatly advanced understanding of how feedback supports learning, they often ignore the relational and emotional aspects of feedback interactions, which can affect students' motivation, engagement, and participation in class (Panadero & Lipnevich, 2022).

From a sociocultural perspective, feedback can be viewed as a mediated exchange between educators and students in addition to being evaluative data. Based on Vygotsky and Cole (1978), feedback can serve as a scaffold to help students grow within their Zone of Proximal Development and guide them to more complex ways of thinking and problem-solving (Vygotsky & Cole, 1978). Within this view, feedback operates simultaneously as instructional guidance and relational support that shapes students' learning experiences and identities. In addition, recent developments in educational technology have further expanded the ways of providing and experiencing feedback. The rapid growth of digital learning environments, particularly during the COVID-19 pandemic, has led teachers to use a range of digital tools such as learning management systems, video conferencing platforms, and audio or video recordings to provide feedback. These changes highlight that feedback practices are not only shaped by their content but also by the media used to communicate them, affecting their timing, visibility and interaction status (Rapanta et al., 2020).

Although feedback has these advantages, there is still a significant gap between theoretical ideals and classroom practice. Recent scholarship has increasingly recognized that feedback practices are not neutral and are also shaped by national educational contextual constraints (Carless & Boud, 2018; Svanes et al., 2023). Thus, cross-cultural comparisons provide valuable opportunities to explore how feedback functions as a socially embedded pedagogical practice rather than a universal instructional technique.

Against this background, this article aims to develop a broader theoretical understanding of teacher feedback in primary education. Specifically, it adopts a comparative theoretical analysis of two empirical studies conducted in Norway and Australia that highlight different forms of feedback practices across contrasting educational contexts. By using the combined lens of social constructivist theory and the feedback model of Hattie and Timperley to examine these cases, the analysis seeks to demonstrate how feedback content, modality, and context interact in classroom practice (Hattie & Timperley, 2007). Finally, this article contributes to enriching the literature on feedback. It proposes a three-dimensional framework for analyzing teacher feedback, including cognitive, affective, and mediation, which provides a more integrated perspective for understanding feedback across educational contexts. Through these intersecting dimensions, the article demonstrates how feedback functions as a culturally embedded, technologically mediated, and developmentally sensitive practice.

The remainder of this article is organized as follows. Section 2 develops the theoretical reviews for conceptualizing teacher feedback and introduces the proposed framework. Section 3 presents a comparative analysis of the two selected studies. Section 4 discusses the theoretical and practical implications of the feedback analysis, and Section 5 summarizes the article.

2. Theoretical Conceptualization of Teacher Feedback

2.1 Feedback as Cognitive Scaffolding

Feedback has traditionally been understood as a cognitive process that helps learners enhance their performance by providing information about the gap between their current understanding and their learning objectives. One of the most influential frameworks in this area is the model proposed by Hattie and Timperley, who argue that effective feedback addresses three questions: what the learning goals are, how the current performance relates to these goals, and how to improve in the next step (Hattie & Timperley, 2007). Furthermore, these questions relate to different levels of feedback, including task-level, process-level, and self-regulation feedback, which have become widely referenced in educational research.

Similarly, research in formative assessment emphasizes that feedback plays a crucial role in supporting students to monitor their learning and adjust their strategies accordingly. Black and Wiliam highlight that formative feedback is most effective when it provides specific guidance to help learners close the achievement gap (Black & Wiliam, 1998). However, rather than simply correcting errors, effective feedback is expected to promote deeper understanding and encourage learners to engage in reflective thinking about their learning processes.

From the perspective of social constructivism, feedback can also be interpreted as a scaffolding role that supports learners' development within their Zone of Proximal Development (Vygotsky & Cole, 1978). For instance, teachers guide students' learning by providing temporary support that enables them to accomplish tasks beyond their independent capabilities. In this sense, feedback serves both evaluative and instructional functions, facilitating the gradual development of advanced cognitive skills.

However, even though these frameworks emphasize how feedback supports cognitive improvement and task completion, their insights into how learners' emotional responses, self-perception, and social relationships influence whether feedback is actually accepted and used are rather limited (Dann, 2014; Voelkel et al., 2020). This narrow focus means that traditional cognitive models of feedback offer an incomplete account, particularly for contexts such as primary education, where social and affective factors are especially influential.

2.2 Feedback as Affective and Relational Practice

While the cognitive perspective has an important influence on feedback research, both Fiskerstrand and Gamlem and Kluger and DeNisi emphasize that feedback is also an emotional and social practice embedded in the interaction between teachers and students (Fiskerstrand & Gamlem, 2024; Kluger & DeNisi, 1996). The effectiveness of students' uptake of feedback largely depends on their understanding of the teacher's intentions, tone, and perceived support. To be more specific, if the feedback (such as written feedback or verbal feedback) is regarded as judgmental or low grades, students may reduce their motivation or even decrease their participation in learning behaviors (Lipnevich & Smith, 2009).

Educational psychologists have therefore highlighted the importance of considering the emotional dimensions of feedback. Pekrun et al.'s theoretical model of achievement emotions provides a robust framework, positing that students' emotional reactions to feedback can subjectively influence their motivation, persistence, and academic performance (Pekrun et al., 2014). To be more specific, positive feedback can enhance learners' sense of competence and agency, while poorly delivered feedback may generate anxiety, shame, or avoidance behaviors (Pekrun et al., 2014). Despite its theoretical strength, Putwain et al. also admit that such a theoretical approach limits causal inferences about how feedback emotions develop over time (Putwain et al., 2018).

In primary education, the affective dimension of feedback is especially pronounced. Young learners frequently interpret feedback not only as commentary on a task but also as an evaluation of their self-worth and capability as learners (Dann, 2014; Lipnevich & Smith, 2009). Supportive and respectful feedback can foster confidence, participation, and intellectual curiosity, while harsh and impersonal feedback will have the opposite effect.

Nevertheless, by browsing the literature (e.g., Hattie & Timperley, 2007; Shute, 2008), it is found that most empirical works are concentrated in the field of higher education, and there is insufficient research on affective and relational feedback in primary school settings. Furthermore, existing literature often prioritizes theoretical frameworks over context-sensitive, actionable guidance for teachers, leaving a gap between conceptual insights and classroom practice (Ryan et al., 2022). Together, these limitations highlight the need for context-based research to integrate and develop the affective dimension of feedback in primary classrooms.

2.3 Digital and Multi-modal Feedback

The increasing use of digital technologies in education has expanded how teachers provide feedback. Digital platforms allow feedback to be delivered through various modalities, including audio recordings, video explanations, and synchronous online discussions (Van der Kleij et al., 2015). Pachler et al. argue that these multi-modal forms of feedback can provide richer explanations and allow teachers to communicate tone and emphasis more effectively than traditional written comments alone (Pachler et al., 2010). Similarly, Dawson et al. point out that students particularly value audio and video feedback for their personal quality and clarity, suggesting that modality choice significantly influences how feedback is received and used (Dawson et al., 2019). Furthermore, Rapanta et al. report that digital feedback can enhance accessibility and immediacy in online learning environments, enabling students to receive guidance more quickly and revisit feedback multiple times (Rapanta et al., 2020).

However, differences in economic development across regions, coupled with the COVID-19 pandemic, have revealed serious

limitations in shifting traditional strategies to the digital environment. For example, feedback is frequently reduced to ‘passive content delivery’ via prerecorded videos rather than interactive guidance in Malaysian primary schools (Sari et al., 2026). What’s more, this pedagogical degradation can be exacerbated by infrastructure disparities: schools in rural and low-income areas face technical barriers that prevent real-time digital support, leaving teachers unable to monitor student engagement or confirm understanding remotely (Van De Werfhorst et al., 2022; Sari et al., 2026). In addition, teachers’ digital teaching ability can affect the assessment interaction and learning experience. If teachers lack digital literacy, it will be a struggle for them to effectively manage remote classrooms, understand, and provide feedback (Yang & Du, 2024).

Consequently, digital environments risk exacerbating educational inequities while failing to replicate the affective and relational dimensions of face-to-face feedback essential in primary education. Therefore, effective digital feedback must move beyond digitizing traditional comments to intentionally design for emotional connection and dialog interaction.

2.4 Towards a Three-Dimensional Framework of Teacher Feedback

The preceding discussion highlights that teacher feedback cannot be understood only as an instructional tool. Instead, it represents a multifaceted pedagogical practice that integrates informational guidance, relational interaction, and communicative mediation, which reflects dynamic interactions among the dimensions. Building on the literature reviewed above, this article proposes a three-dimensional framework for analyzing teacher feedback in primary education.

The first dimension, the cognitive dimension, refers to the informational role of feedback in supporting students’ learning processes. This includes feedback that clarifies learning goals, identifies errors, and guides students toward improved strategies and understanding. The second dimension, the affective dimension, emphasizes the emotional and relational aspects of feedback interactions. Feedback influences students’ motivation, confidence, and engagement, and therefore plays a significant role in shaping classroom relationships and learning atmosphere. The third dimension, the mediation dimension, focuses on the tools and communication modes for transmitting feedback. With the increasing integration of digital technologies in education, feedback is often mediated through various digital platforms and multi-modal formats, which determine the way feedback is communicated and interpreted.

Together, the three dimensions provide a dynamic integration framework for understanding teacher feedback as a complex pedagogical practice. This framework will be used in the following section to analyze and compare feedback practices in the selected studies from Norway and Australia.

3. Comparative Analysis of Feedback Practices

3.1 Analytical Approach

This study adopted a qualitative comparative analysis, which was selected for its appropriateness in synthesizing cross-cultural educational research and generating theoretical insights regarding context-sensitive practices (Bray et al., 2014). In addition, rather than generating new empirical data, the analysis interpreted findings from two published studies from Norway and Australia. The two studies chosen for analysis were identified through purposive sampling based on the following criteria: (a) empirical focus on teacher feedback in primary education; (b) publication in peer-reviewed journals; (c) representation of distinct cultural and educational contexts; and (d) methodological rigor providing rich contextual data.

To be more specific, the Norwegian study by Svanes et al. investigates feedback practices during remote teaching implemented during the COVID-19 pandemic, which is a crisis state (Svanes et al., 2023). In contrast, the Australian study by Burnett and Mandel focuses on the role of praise as a form of teacher feedback in traditional and normal face-to-face primary classrooms (Burnett & Mandel, 2010). While both studies examine feedback in primary education, the contrast between digitally mediated feedback and praise provides a useful basis for investigating how feedback practices differ across communication environments and teaching contexts.

Furthermore, the analysis next applied the three-dimensional framework proposed in this article to interpret how feedback functions in each context. This approach enables a systematic examination of how informational guidance, motivational support, and communication modes interact in feedback practices.

3.2 Feedback Practices in the Norwegian Context

The study by Svanes et al. provides insight into how teacher feedback was adapted to digital learning environments during

the COVID-19 school lockdown in Norway (Svanes et al., 2023). In this crisis situation, teachers were required to maintain instructional interaction with students despite the absence of physical classroom contact. This suggests that feedback became one of the main mechanisms through which teachers attempt to guide learning and sustain student engagement and is closely intertwined with digital communication technologies.

From the perspective of the cognitive dimension, the study suggests that teachers frequently use feedback to clarify learning goals and guide students' understanding of tasks. Written comments on students' submitted work often included explanations of errors and suggestions for revision. These practices reflect a formative feedback approach, where the focus is not only on evaluating performance but also on supporting students' ongoing learning processes.

In addition, the study also highlights the importance of the affective dimension of feedback in the remote learning context. Teachers reported that students sometimes experienced reduced motivation and feelings of isolation when learning from home. In response, feedback frequently included encouraging comments and personalized messages intended to maintain students' confidence and sense of connection with their teachers. In this sense, feedback functioned not only as instructional guidance but also as a means of sustaining relational ties within the learning process.

Finally, the most distinctive feature of the Norwegian case lies in the mediation dimension of feedback. Teachers relied on a variety of digital tools, including learning management systems, written online comments, recorded video messages, and synchronous online meetings. These tools allowed teachers to combine asynchronous feedback with synchronous discussion, thereby creating multiple opportunities for dialogue about students' study. This aligns with Dawson et al.'s finding that effective feedback requires careful attention to design choices, as digital tools alone do not guarantee quality feedback interactions (Dawson et al., 2019). Thus, the study illustrates how technological mediation can reshape feedback practices by expanding the modes through which feedback is communicated.

However, correspondingly, the reliance on digital platforms also brings certain limitations. First, written online feedback lacks the immediacy and nuance of face-to-face interaction, which potentially affects students' understanding of teachers' comments. This suggests that although digital technologies create new possibilities for the transmission of feedback, they also require teachers to carefully consider how clarity and emotional tone are conveyed in intermediary communication. Another important issue highlighted by this study is the increased demands placed on teachers when providing feedback in the digital environment. For example, preparing video comments, organizing online meetings, and monitoring students' submissions required significant time and effort. This suggests that while digital tools expand the possibilities for personalized feedback, they also create additional challenges for teachers in maintaining consistent communication with students.

3.3 Feedback Practices in the Australian Context

In contrast to the Norwegian case, the study conducted by Burnett and Mandel investigates feedback practices in normal face-to-face primary classroom environments in Australia, with a specific focus on the use of praise (Burnett & Mandel, 2010). The findings indicate that praise constitutes a common element of daily classroom interaction. Teachers frequently provide verbal praise in response to students' effort, participation, and successful task completion.

From the perspective of the affective dimension, praise feedback plays a significant role in fostering positive classroom relationships. Students in the study reported that praise from teachers helped them feel recognized and valued, which in turn encouraged them to participate more actively in classroom activities.

Nevertheless, when considered through the cognitive dimension of the proposed feedback framework, praise-based feedback provides limited information about how students can improve their learning. General statements such as "good job" or "well done" acknowledge successful performance but do not necessarily explain why the work is effective or how it could be further developed. As a result, praise functions primarily as motivational reinforcement rather than as a specific instructor guide.

In terms of the mediation dimension, the Australian classroom reflects an immediate face-to-face communication environment. Feedback is delivered directly through verbal interaction between teachers and students during classroom activities, allowing teachers to respond quickly to students' behavior and learning progress. This immediacy enables spontaneous encouragement and rapid correction of mistakes. However, the informal and spontaneous nature of praise

sometimes limits opportunities for more elaborate feedback that requires reflection or detailed explanation.

Therefore, this analysis of the Australian context highlights both the strengths and limitations of praise-based feedback practices. Although praise can contribute to a supportive classroom atmosphere and strengthen students' enthusiasm, it is most effective when combined with more specific feedback that helps students understand how to further develop their skills and knowledge.

3.4 Comparative Discussion

The comparison between the Norwegian and Australian studies illustrates how feedback practices are shaped by the interaction between pedagogical goals, classroom relationships, and communication environments. Both studies demonstrate that feedback serves multiple important functions in primary education, including supporting learning, encouraging participation, and maintaining positive classroom relationships. However, depending on the different pedagogical conditions in which the teaching takes place, the relative emphasis on different dimensions of feedback varies, and so does the potential impact on students' learning.

3.4.1 Contexts Reflection: Crisis Teaching versus Normal Teaching

A critical reflection on the research contexts reveals that the two studies represent fundamentally different instructional conditions that extend beyond mere geographical or technological differences. The Norwegian data were collected during the COVID-19 school lockdown. This was a period of forced emergency remote teaching, with teachers and students being pushed into an unfamiliar digital environment without adequate preparation time or online teaching training (Svanes et al., 2023). This crisis context fundamentally shaped feedback practices in ways that may not represent sustainable or optimal teaching choices. What's more, teachers' reliance on written comments and recorded videos was partly driven by the asynchronous nature of remote learning and the absence of real-time interaction opportunities, rather than by deliberate instructional design (Svanes et al., 2023).

In contrast, the Australian study by Burnett and Mandel examined feedback practices in stable, face-to-face classroom environments where teachers had developed their approaches through years of professional experience and established classroom routines (Burnett & Mandel, 2010). The praise-based feedback observed in Australian classrooms represents accumulated pedagogical wisdom developed through ongoing interaction with students, rather than passive adjustments to external constraints. This distinction is crucial for interpreting the findings: Norwegian practices may demonstrate the potential of digitally mediated feedback under constrained conditions, whereas Australian practices illustrate the patterns that emerge when teachers have full command of their instructional environment.

This contextual difference has significant implications for the universality of the comparative insights. The Norwegian case may overstate the challenges of digital feedback because teachers work under crisis conditions and do not have sufficient time to develop digital teaching skills, losing the immediacy and emotional nuances of feedback. Conversely, the Australian case may understate the potential limitations of praise feedback, as teachers were required to document their assessment practices. Future comparative research would benefit from examining digitally mediated feedback in normal contexts, as well as investigating how face-to-face feedback practices change when teachers are required to convert their daily oral communication with students into digital records.

3.4.2 Dynamic Analysis: Interactions Among the Three Dimensions

The proposed three-dimensional framework conceptualizes cognitive, affective, and mediation dimensions as interacting rather than operating independently. The comparative analysis of the Norwegian and Australian cases reveals important tensions among these dimensions, which are worthy of in-depth examination.

In the Norwegian remote learning context, the mediation dimension became dominant due to the demands of technology. Consequently, the shift to digital platforms fundamentally restructured how feedback could be delivered, creating support and constraints, and thus reshaping the other two dimensions. For example, the asynchronous nature of much digital feedback allowed for more elaborated cognitive guidance—teachers could craft detailed written explanations, and students could revisit feedback multiple times, which supports deeper reflection than spontaneous verbal comments permit. However, this cognitive gain appears to come at a cost to the affective dimension. Teachers explicitly reported concerns about maintaining emotional

connection and motivation in the absence of physical presence, leading them to deliberately embed encouragement and personalized messages within written feedback (Svanes et al., 2023). Therefore, this reflects the three-dimensional framework by which digital platforms use text messages to restore and convey emotional support.

The Australian case presents an inverse pattern. The affective dimension was strongly activated through immediate praise in face-to-face interaction. The mediation dimension (instant communication in the classroom) supported rapid feedback delivery and allowed teachers to consider student emotional responses in real-time, adjusting their communicative approach instantaneously. However, this configuration seems to limit the cognitive dimension. The study found that praise often remained generic (e.g., “good job,” “well done”) without specific explanatory content about why the work was effective or how it could be developed further (Burnett & Mandel, 2010). Although face-to-face praise is emotionally satisfying, it may limit the opportunity for the kind of continuous cognitive guidance that takes time to form and reflect. Unlike the Norwegian teachers who could compose thoughtful written comments away from the pressures of simultaneous classroom management, Australian teachers operating in busy classroom environments may have prioritized maintaining a positive atmosphere and participation over providing detailed instructional guidance.

These observations suggest that the three dimensions do not merely coexist but are in dynamic tension, where enhancement of one dimension may inadvertently suppress others. Effective feedback practice, therefore, requires not simply attending to all three dimensions but striking an appropriate balance based on specific circumstances and adopting strategies to address the dimensions that are weakened by situational constraints. The Norwegian teachers’ deliberate affective scripting of written feedback and the potential for Australian teachers to supplement praise with more structured reflection opportunities represent such strategies. This dynamic analysis extends the theoretical understanding and supports the assertion that feedback is ‘multidimensional’ to specify how dimensions interact, under what conditions particular configurations emerge, and what kind of teaching work is required to maintain balance.

3.4.3 Shared Limitations Across Cases

Despite their contrasting contexts, both studies reveal common limitations in feedback practices that persist across technological and cultural boundaries, pointing to systemic challenges in primary education feedback.

Both cases indicate a relative neglect of student feedback literacy development. The Norwegian study focused primarily on teachers’ feedback delivery strategies and their perceptions of student responses, without a systematic examination of how students interpreted, utilized, or were affected by digital feedback. Similarly, the Australian study emphasized teachers’ praise practices and students’ general appreciation of recognition but did not investigate whether students could distinguish between motivating praise and actionable guidance or whether they developed capacities to seek and implement feedback independently. This shared limitation reflects a broader area in feedback research where the focus remains disproportionately on the teacher providing rather than the student absorbing (Carless & Boud, 2018). Thus, neither of these two studies answered the key question about how primary school-aged children develop metacognitive and self-regulatory abilities to engage productively with different forms of feedback.

In addition, both cases highlight challenges in balancing motivational and instructional functions. Norwegian teachers struggled to maintain motivation without the relational immediacy of physical presence; Australian teachers risked motivating without sufficiently instructing. This shared tension suggests that integrating affective support with cognitive guidance represents a persistent professional challenge that neither technical support nor established classroom practices can automatically resolve. Therefore, it indicates that teacher education and professional development need to specifically address how to combine encouragement with clear strategic guidance, how to make praise informative and motivating, and how to maintain affective support relationships while pushing students toward cognitive extension (Yang & Du, 2024).

In conclusion, these differences suggest that feedback effectiveness cannot be understood only from the perspective of information quality. On the contrary, feedback should be viewed as a multi-dimensional practice shaped by both relational and contextual factors. The Norwegian and Australian cases, despite their contrasting environments, converge in revealing that effective feedback requires a balance between cognitive guidance and motivational support, as well as careful consideration of the tools through which feedback is delivered. However, they also jointly clarify the persistent challenges, particularly in

student feedback literacy and teacher professional literacy, which demand continued attention from researchers and educators. Finally, the comparative analysis reinforces the usefulness of the three-dimensional framework proposed in this article and also determines the direction for its further improvement. By examining cognitive, affective, and mediation aspects together, the framework contributes to feedback research and provides a more comprehensive understanding of how teacher feedback operates across diverse educational environments, moving beyond isolated treatments of feedback content, relationships, or tools.

4. Implications

4.1 Implications for Feedback Theory

The discussions of this study suggest the need to expand existing feedback theories by considering multiple interacting dimensions of feedback practice in primary education rather than viewing it as a purely instructional technique. Much of the existing feedback literature has focused primarily on the cognitive role of feedback in supporting learning improvement. For example, research has demonstrated that feedback can significantly influence students' achievement when it helps them understand the gap between their current performance and desired learning goals (Hattie & Timperley, 2007). While this perspective provides valuable insights into how feedback supports learning, it may not fully capture the complexity of feedback practice in real classroom contexts. In addition, the comparison between the Norwegian and Australian cases indicates that feedback also performs important affective and mediation functions that shape how students experience and respond to feedback.

Building on the comparative analysis above, the three-dimensional framework proposed in this article contributes to feedback theory by integrating cognitive, affective, and mediation perspectives into a single analytical model. The cognitive dimension highlights the informational value of feedback in guiding learning processes, while the affective dimension emphasizes the motivational and relational role of feedback in supporting student engagement. At the same time, the mediation dimension draws attention to the tools and communication environments through which feedback is delivered. This dynamic integrated perspective aligns with recent discussions in feedback research that emphasize the interactive and socially situated nature of feedback processes. For instance, Carless and Boud argue that effective feedback depends not only on the quality of teachers' comments but also on students' ability to interpret and use feedback in their learning (Carless and Boud, 2018). By considering cognitive, affective, and mediation elements together, the framework developed in this article provides a broader theoretical perspective for understanding how feedback operates within educational environments.

4.2 Implications for Primary Teaching Practice

Although based on Norwegian and Australian cases, these findings also have practical implications for Asia-Pacific and even global teaching practice in primary education.

First, teachers should recognize that feedback serves various purposes in the teaching and learning process. In addition to providing information about students' performance, feedback can also influence students' motivation and confidence with learning tasks. Therefore, teachers may benefit from designing feedback strategies that not only clarify how students can improve their work but also encourage sustained participation in classroom activities. In primary education in particular, combining constructive guidance with supportive communication may help create learning environments in which students feel both challenged and supported. As formative assessment research supported, feedback is effective when it helps students understand learning goals while also maintaining their confidence and willingness to engage with challenging tasks (Black & Wiliam, 1998).

Second, teachers need to consider how the mode of feedback delivery influences students' engagement with feedback. As demonstrated in the Norwegian study, in digitally mediated learning environments, written feedback, recorded comments, and so on can provide opportunities for students to revisit teachers' suggestions and reflect on their own learning over time. When designed and used effectively, these tools can encourage more sustained engagement with feedback (Dawson et al., 2019). However, teachers should also ensure that digital feedback remains supportive and accessible to students, particularly in primary education, where learners may require additional guidance to interpret written feedback (Piaget, 1972).

Third, the analysis suggests that praise-based feedback should be used carefully and strategically. While praise can play

an important role in building a positive classroom climate and encouraging student participation, it is most effective when combined with specific feedback that helps students understand how to improve their work and focus on learning progress. Therefore, integrating motivational encouragement with constructive guidance may support both students' emotional well-being and their cognitive development. In this sense, teachers may benefit from considering feedback not only as information about performance but also as a pedagogical practice that integrates cognitive guidance, affective support, and appropriate mediation tools.

4.3 Implications for Future Research

This study highlights several directions for future research on teacher feedback. One important area concerns the growing role of digital technologies in mediating feedback practices. As schools increasingly adopt online platforms and blended learning models, further research is needed to explore how digital communication tools influence the clarity, accessibility, and effectiveness of feedback in different educational contexts.

A second direction involves examining how different feedback dimensions interact across diverse cultural and institutional settings. The comparison between the Norwegian and Australian cases suggests that feedback practices may prioritize different aspects depending on classroom norms, pedagogical traditions, and instructional conditions. Thus, comparative studies across additional educational systems could provide deeper insights into how feedback operates as a socially embedded pedagogical practice.

Finally, future research should continue to explore students' views on feedback. While many studies focus on teachers' feedback strategies, understanding how students interpret, value feedback, and act on it remains crucial for evaluating its educational impact. Therefore, investigating students' feedback literacy and their capacity to engage productively with feedback may contribute to the development of more effective feedback practices in primary education.

In conclusion, these implications highlight the importance of viewing teacher feedback as a complex pedagogical practice shaped by cognitive, affective, and mediation dimensions. Understanding how these dimensions interact may help educators design more effective feedback strategies and provide useful directions for future research on feedback practices in primary education. The final section concludes the article by summarizing the main findings and reflecting on the limitations of the study.

5. Conclusion

This article examined teacher feedback practices in primary education through a comparative analysis of two studies conducted in Norway and Australia. Drawing on the three-dimensional framework that combines cognitive, affective, and mediation perspectives, the study aimed to explore how different feedback dimensions operate within diverse instructional contexts. By analyzing feedback practices in both digitally mediated and face-to-face classroom environments, the study demonstrates that teacher feedback is not only an instructional technique for correcting student performance but also a complex pedagogical practice that simultaneously supports the learning process, student motivation, and classroom interaction.

The comparative analysis shows that different educational contexts emphasize different dimensions of feedback. In the Norwegian remote and crisis learning environment, the mediation dimension of feedback becomes particularly important, as teachers rely on digital platforms and written communication to maintain interaction with students. This form of feedback may provide students with continuous and repeated opportunities to engage in more reflective learning. By contrast, the normal Australian classroom context highlights the affective dimension of feedback through the use of praise and verbal encouragement during face-to-face teaching. While this type of feedback can effectively foster a positive classroom climate and support student participation, it may also provide fewer opportunities for sustained reflection on learning improvement. These findings suggest that feedback practices are shaped by the interaction between teaching goals, classroom relationships, and communication environments.

By integrating these observations within the three-dimensional analytical framework, the study helps to adopt a more diversified and dynamic perspective to understand teacher feedback in primary education. The framework emphasizes that effective feedback practices require the integration of cognitive guidance, motivational support, and suitable digital teaching

tools, rather than merely treating feedback as information for improving learners' grades. Recognizing these dimensions can help educators better understand the role of feedback in different educational settings and how to adjust the form of feedback to support the learning process and student engagement.

Despite these contributions, several limitations should also be acknowledged. First, the study relies on the analysis of two selected research cases, which may limit the universality of the research results. While the comparison provides useful insights into how feedback practices operate in different contexts, additional studies involving a wider range of educational systems and classroom environments would help to further test and refine the proposed framework. Second, the analysis focuses primarily on teachers' feedback practices rather than on students' responses to feedback. Therefore, future research could investigate how students interpret, use, and respond to different forms of feedback, particularly in the digitally mediated environment.

In conclusion, the findings of this study highlight the importance of viewing teacher feedback as a multidimensional pedagogical practice shaped by both relational and contextual factors. By bringing together cognitive, affective, and mediation perspectives, the proposed framework offers a useful lens for analyzing feedback practices in contemporary primary education. In the future, continued research in this area may further deepen our understanding of how feedback can effectively support both student learning and meaningful classroom interaction.

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Cultural Aphasia in Higher Education: A Case Study from Speech Communication Education in Broadcasting and Hosting Arts

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Abstract: In the context of educational globalization and internationalization, Chinese university students often face the phenomenon of “cultural aphasia” in cross-cultural communication, which refers to the lack of ability to freely express and disseminate local culture. This aphasia not only manifests as a deficiency in language skills but also reflects a lack of cultural awareness and narrative ability. Broadcasting and hosting, as specialized forms of speech communication, play a significant role in the international dissemination of Chinese culture. Through their vivid and authoritative expressions, they can effectively enhance the international influence of Chinese culture. This article summarizes the theoretical evolution of the concept of “cultural aphasia” based on relevant theories in linguistics and communication studies. It combines traditional Western language communication disciplines with the development of speech communication education in Chinese broadcasting and hosting art education, with a particular emphasis on the practical path of broadcasting and hosting in correcting cultural aphasia in universities. Research has pointed out that there is a problem with university broadcasting and hosting majors, where students can complete technical tasks but lack humanistic knowledge, leading to a lack of confidence in cultural expression and a tendency to be speechless. Through case analysis of broadcasting and hosting, their role in enhancing cultural expression is proposed. This article believes that integrating advanced research concepts of speech communication into the broadcasting and hosting art education system not only helps to solve the phenomenon of cultural aphasia but also promotes the international dissemination of Chinese culture and the construction of a discourse system.

Keywords: Cultural Aphasia; Speech Communication; College Education; Cross-Cultural Communication

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1. Introduction

The concept of “cultural aphasia” emerged in China in the 1990s, evolving from the earlier notion of “literary aphasia” in literary production to a broader concern within cross-cultural communication. In recent years, Chinese scholars have increasingly adopted the term to describe the marginalization of indigenous cultural expressions in global knowledge production and intercultural exchange. This phenomenon is often attributed to the lack of an effective discourse system and insufficient expressive capacity to articulate local cultural meanings within dominant global frameworks (Zhang, 2003).

Language is widely regarded as the primary carrier of culture, functioning not only as a medium of communication but also as a symbolic system through which cultural values and identities are constructed and transmitted. Within contemporary media

environments—primarily encompassing television, mobile internet, and print media—speech communication has become increasingly mediated, with television and digital platforms serving as its central channels. This mediated communicative space is often conceptualized as the “television context” (Yuan, 2016).

Against this backdrop, Zhang Song (2001) introduced the concept of “television aphasia,” drawing attention to the growing imbalance between visual dominance and linguistic expression in media communication. While television privileges visual imagery, the erosion of linguistic quality and expressive depth in spoken discourse has become increasingly evident. In some cases, the deterioration of language use in televised communication has raised concerns about the decline of rhetorical standards and cultural articulation.

In the context of globalization and rapid media transformation, the ability to effectively communicate cultural meanings through speech expression has become a critical issue. In particular, the adaptation of broadcasting and hosting arts programs in Chinese higher education to the evolving media ecology represents an important area of inquiry. It not only reflects broader challenges in cultural communication but also relates to questions of cultural identity construction and discourse power in global contexts.

Theoretical exploration of “cultural aphasia” in foreign academic circles: Hall’s (1976) high context/low context cultural theory reveals the asymmetry of communication modes between different cultures; Bourdieu’s “linguistic capital” theory states that language is not only a tool for communication, but also an important means of power and resource allocation. In recent years, cross-cultural communication research has emphasized the relationship between discourse power and identity construction (Gudykunst, 2004), providing theoretical references for understanding “cultural aphasia”. The Chinese academic community has been paying attention to “cultural aphasia” since the 1990s. Wang Ning (1997) proposed that the Chinese academic community has a “theoretical dependence” and “discourse absence” in global academic exchanges; Liu Kang (2000) further pointed out that cultural aphasia is reflected in the excessive reliance on Western theories in the knowledge system; Chen Pingyuan (2004) criticized the lack of explanatory power of traditional culture in higher education from the perspective of literary research. In recent years, research has gradually extended to the fields of language education and intercultural communication. Scholars believe that curriculum reform and educational intervention should be used to enhance students’ cultural expression (Zhang Guoliang, 2010; Li Chunyan, 2018). In terms of speech communication research, independent disciplines have emerged in foreign countries since the early 20th century, covering areas such as public speaking, interpersonal communication, and organizational communication (Ruben & Stewart, 2016). Since the 1980s, China has gradually introduced the concept of speech communication and conducted research in disciplines such as linguistics, communication studies, and education, emphasizing the important role of speech communication in cultivating students’ expressive and cross-cultural communication abilities.

Professor Gao Guiwu (2004) of Renmin University of China’s “On the Speech Communication Strategies of Hosts” combines speech communication with the development of hosts, drawing from Professor Wu Yu (1999) “The Language Art of Hosts”. The host’s spoken language should embody the essence of written language, emphasize standardized public speaking, be artistic in propaganda, possess a personalized formality, and exhibit witty responsiveness. Further research has been conducted on speech communication as a mode of discourse, that is, studying how people can most effectively use speech and other paralinguistic forms to influence their audience and bring about changes in their thoughts, concepts, behaviors, and actions. Speech communication is translated from Western speech communication. According to linguist Saussure’s classification of language and speech, some scholars have translated it as speech communication; Chinese scholars studying in the United States, Lu Shuming and Lin Cancu, translated it as communication and interaction. Broadcasting and hosting play a crucial role in the international dissemination of Chinese culture, and their professional speech expression and hosting skills can help Chinese students and educators better ‘tell Chinese stories’. However, college students often face the phenomenon of ‘cultural aphasia’ in cross-cultural communication, making it difficult for them to spread local culture freely. This is not only due to insufficient language skills but also related to the lack of cultural expression methods. This article is based on relevant theories of linguistics and communication, combined with the practical application of broadcasting and hosting, to explore the causes and correction paths of cultural aphasia in universities, emphasizing the role of broadcasting

and hosting in enhancing cultural narrative ability.

2. Analysis of the Causes of Cultural Aphasia from the Perspective of Broadcasting and Hosting

2.1 Cultural Capital and Language Ideology

Cultural capital, as a significant theory proposed by French sociologist Bourdieu, offers a theoretical support for us to comprehend the present teaching predicaments in broadcasting and hosting arts. This theory posits that there exists a symbolic system among social groups, which essentially forms a fixed “knowledge pattern” (Lévy-Strauss, 1962). In the realm of broadcasting and hosting art creation, achieving high-quality sound necessitates prolonged training. However, the audio market has long been monopolized and controlled by premium sound resources, resulting in an imbalance in the accumulation and distribution of cultural capital. Consequently, students majoring in broadcasting and hosting tend to favor conceptual and schematic expressions over highly contextualized and culturally rich ones. This shift in aesthetic and technological orientation creates tension with the emphasis on “dialogue construction based on aesthetic expression” emphasized by media integration, potentially leading to a structural contradiction. Within this framework, students of broadcasting and hosting often adopt Western discourse paradigms when facing the international stage, thereby diminishing the visibility and discourse power of local discourse. The convergence of media and the dominance of short videos in the communication ecology have led to a fragmented and fast-paced expression rhythm, reinforcing the tendency towards “surface level” and “entertainment-oriented” communication, and further compressing the space for deep cultural interpretation. These macro changes provide an external contextual foundation for the prioritization of skills and the weakening of cultural interpretation in hosting education.

2.2 Cultural Barriers and Absences in Language Expression

In actual radio hosting, teaching, and practice, the lack of speech communication skills is particularly significant. Many students exhibit a tendency towards “performance art” in their works, which overemphasizes technique and neglects connotation, pursuing exaggerated sound effects or forms, and lacking sensitivity and interpretation of the cultural significance carried by language. For a long time, the broadcasting hosting profession has emphasized the training of “skills” such as pronunciation, video recording, and stage control in teaching practice. This is crucial for cultivating standardized broadcasting abilities, but it is also easy to fall into the educational misconception of “only speaking without understanding culture”.

In recent years, research and practical suggestions on the reform of the broadcasting hosting profession have pointed out that the profession should strengthen course modules such as cross-cultural speech communication, content planning, and cultural interpretation (such as reform cases of broadcasting creation courses, compilation of improvisational speech expression themes, and practical reporting courses). Otherwise, although students can speak fluently, they cannot express cultural content in a colloquial, storytelling, and contextualized manner, resulting in aphasia of “not being able to speak” in cultural presentations.

This superficial expression has led to two types of aphasia: one is the unfamiliarity with local cultural discourse. Students often use “declarative” expressions or rigid speech templates in communication, and their understanding of cultural themes remains at the level of generalization rather than deconstruction. They are unable to vividly transform Chinese cultural symbols into tangible and narratable narratives through natural speech communication. On the other hand, due to insufficient cross-cultural practice training, narrative expression often becomes a one-way information infusion that the audience cannot obtain, lacking flexibility in dialogue in the world context.

2.3 Deficiencies in Students’ Cultural Identity and Expression Strategies

Schools are not only places for imparting technology and media, but also for cultivating students’ subjectivity and cultural identity. Without strengthening students’ cultural consciousness and discourse subjectivity, it will become very difficult for them to talk about their hometown characteristics or traditional Chinese culture in courses, resulting in the phenomenon of “not being able to say” and “not daring to say”. Recent research on speech communication education has pointed out that students generally tend to pursue “beautiful voice” and “formal effect” while neglecting the “essence of content”; when there is a lack of systematic cross-cultural exercises (such as bilingual hosting simulations and overseas exchange

practices), there will be a disconnect between knowledge and speech output (i.e., “knowing but unable to speak”). Research and teaching reform suggestions emphasize the reconstruction of students’ subjectivity and cultural expression ability in speech communication through methods such as the flipped classroom, scenario-based tasks, and cross-language training, such as professional hosting, international communication, cultural ceremonies, etc. The phenomenon of cultural aphasia in broadcasting and hosting art majors in universities, although the curriculum emphasizes the polishing of professional skills, the deep humanistic foundation is difficult to develop, resulting in a significant gap between practical operation and cultural depth. Students are prone to expression difficulties or aphasia in content fields with a foundation. In the field of broadcasting and hosting, “cultural aphasia” refers to the phenomenon where hosts are unable or find it difficult to effectively express local cultural connotations, aesthetic images, and value recognition in external or cross-cultural communication.

2.4 The Amplification Effect of the Media Environment and Consumer Culture

Teacher Zhang Song (2001) expressed in “Pan Cultural Theory: The Pathogens of Television Aphasia and Oratoria” that cultural aphasia is not only a problem for college students, but also a practical challenge faced by professional hosts. If the host lacks cultural consciousness in cultural translation, cultural interpretation, and identity construction, it is easy to fall into the trap of “speechlessness” or “eloquence”. Therefore, the speech communication education of broadcasting and hosting art majors in universities must strengthen the combination of cultural content and expression strategies to avoid the misconception of “voice present, culture absent” in this major. New media platforms (short videos, live streaming) focus on attention economy, advocate immediacy and visual impact, and easily promote the habit of “fast and shallow” expression. With the rise of short video and live broadcast platforms, presenters are no longer limited to traditional fields such as TV stations and radio stations but are widely active in new media platforms such as TikTok, Kwai, and Bilibili. The function of speech communication has gradually expanded from a single program to diverse forms such as knowledge dissemination, entertainment interaction, and social connections.

This media consumption tendency in turn affects the language style preferences of college students, making it difficult for them to maintain the necessary cultural depth and narrative patience on stage or in international communication settings. The current speech communication teaching in broadcasting and hosting art majors in universities has to some extent exacerbated this trend. On the one hand, many courses emphasize “new media adaptation” and “traffic orientation”, encouraging students to transform language arts into “explosive content” in short videos or live broadcasts, but often overlook the systematic expression and interpretation of cultural connotations. As a deep user group of new media, students majoring in broadcasting and hosting arts are often influenced by the consumption culture of this media unconsciously in their learning and practice process. Their expression habits are gradually leaning towards fragmentation and entertainment, lacking the ability for deep interpretation and sustained narrative. This media environment not only fails to provide neutral technical support, but also acts as an amplifier in the generation and diffusion of cultural aphasia. In recent years, research and training practices on media integration and hosting education have also called for equal emphasis on training in new media literacy and deep cultural expression.

3. The Cultural Feasibility and Practical Necessity of Educational Intervention in Speech Communication

A discussion on the issue of cultural aphasia addressed through the intervention of speech communication education, systematically analyzing the possibility and necessity of such intervention, and demonstrating it from the perspective of cultural inheritance, educational mission, and national strategy.

3.1 The Fundamental Alignment between Speech Communication Education and Cultural Expression

Speech communication, as a typical daily linguistic activity, possesses three major characteristics: practicality, situationality, and interactivity. It represents the dynamic discourse process of individuals in a social context for the purposes of expression, negotiation, education, entertainment, or information transmission. Its core goal lies not only in information exchange but also in how individuals effectively construct social interaction and order through language. Therefore, speech communication itself constitutes a cultural practice, carrying multiple functions such as self-awareness, world understanding, identity construction, and value transmission.

The core of cultural aphasia lies in the absence of cultural subject expression. In the field of higher education, students often possess a certain knowledge reserve, but lack the ability to effectively translate cultural connotations into discourse during their expression. The intervention of speech communication education can precisely address the key issues: firstly, integrating cultural knowledge such as history, literature, art, philosophy, etc. through the curriculum system, and “rooting Chinese culture” in the knowledge reserve level; secondly, through diversified training such as speeches, debates, interviews, and hosting, students can learn how to tell Chinese stories at the skill level; thirdly, through situational simulation and interactive practice, guide students to strengthen cultural consciousness in reflection and expression, and overcome the dilemma of “not daring to speak” and “not knowing how to speak”.

3.2 Structural Educational Response to the Issue of Cultural Aphasia in Universities

From the perspective of cultural function, the broadcasting and hosting arts profession itself shoulders the mission of cultural translation and value expression. Yao Xishuang and Wei Bolun (2020) pointed out in “60 Years of Development and Changes in China’s Broadcasting Higher Education” that China’s broadcasting higher education has formed an independent knowledge system and a relatively scientific talent training model. From the perspective of educational practice, despite the continuous updates of hardware facilities such as multi-functional laboratories and virtual studios, there is still a common tendency in the curriculum system to prioritize skills over culture, resulting in students who can master broadcasting skills but appear hollow in cultural narrative and cross-cultural expression. At the same time, in terms of teaching methods, “technologism” and “indoctrination” coexist, and students lack cultural expression training in real or simulated contexts, making it difficult for knowledge to be internalized into abilities. This structural defect not only weakens students’ ability to tell Chinese stories on the international stage but also highlights cultural aphasia in professional practice.

Therefore, it is necessary to incorporate speech communication education into the entire process of education through curriculum optimization, innovative teaching methods, and reform of the evaluation system, to achieve complementary skills training and cultural expression. From the perspective of social demand, the cultural function and social value of higher education in broadcasting in China are constantly deepening. This major not only cultivates language and artistic talents for media institutions but also undertakes the task of providing language training and cultural exchange for government departments, schools in ethnic minority areas, and overseas learners. It has become an important pivot for national cultural dissemination and international exchange. In the dual context of globalization and digitization, enhancing students’ cross-cultural expression and cultural subjectivity is not only a practical need for educational reform, but also an inevitable requirement for responding to the national “cultural going global” strategy and enhancing cultural soft power.

3.3 Re-examination of the Necessity of Education in the Context of Cross-Cultural Communication

In the context of accelerated globalization and digitization, college students are engaging in cross-cultural communication at an unprecedented depth. This is evident not only in academic conferences and study abroad activities but also extends to internships with international organizations, cross-border project collaborations, and overseas cultural dissemination. In this scenario, the necessity of speech communication education becomes even more prominent. It is imperative to cultivate English or bilingual program hosts who possess solid news business skills, are familiar with Western media discourse patterns, and possess a consciousness of cross-cultural dialogue. Gudykunst (2004) pointed out that the core of cross-cultural communication lies in cultural adaptability and effective negotiation ability. Students must not only be able to clearly express their own cultural cognition but also comprehend the cultural stance of others. Speech communication education serves as an effective means to train this dual ability.

In the spring-summer transition of 2019, the “debate” between China International Television host Liu Xin and Fox Finance Channel host Tracy Reagan achieved a historical record in the global dissemination effect of China International Television and Chinese issues. For students majoring in broadcasting and hosting arts, this signifies not only the ability to articulate local cultural cognition in clear and standardized language but also the capacity to understand and respond to other cultures with goodwill and an open attitude in the international arena. Simultaneously, individuals maintain their identity and cultural identity through language choices in cross-cultural communication. In line with the professional characteristics of the host, cultural self-presentation and identity maintenance are achieved through speech communication in interaction. From

the strategic perspective of internationalization of education, universities aim to cultivate talents with global competency. Enhancing the status of speech communication education not only helps alleviate cultural aphasia but also bolsters the international competitiveness and dialogue ability of universities.

3.4 Collaborative Leadership in Speech Communication Education and Broadcasting and Hosting Practice

Even with the enhancement of basic speech communication education, the correction of cultural aphasia still necessitates the guidance of professional practice. The broadcasting and hosting profession provides a typical paradigm for this. In recent years, cultural programs such as “China in Classics,” “Chinese Poetry Competition,” and “National Treasure” launched by China Central Radio and Television Station and major satellite TV stations have presented a comprehensive style of “standardized Mandarin, scholarly atmosphere, and emotional storytelling. Its expression not only conforms to the standardization and authority of news style but also integrates the narrative logic of documentaries and the affinity of mass communication.

These practices demonstrate that hosts are not only information transmitters, but also cultural interpreters and value guides. The expression method highly integrates cultural interpretation, knowledge transmission, and emotional guidance functions, becoming a valuable paradigm for speech communication education. By introducing practical experience and case teaching of broadcasting and hosting in the course, college students can more intuitively understand how to grasp language styles, construct cultural discourse power in different contexts, and achieve creative transformation. Speech communication education has become an extension of technical training and a deepening process of cultural understanding and identity recognition. Intervening in the issue of cultural aphasia not only has inherent cultural compatibility but also responds to the structural dilemma of higher education and is more in line with the needs of cross-cultural communication and national strategic mission. Only by incorporating the speech communication education system into talent training programs and combining it with vocational practice guidance and curriculum reform can we truly enhance the cultural expression and cross-cultural communication abilities of college students, thereby effectively alleviating and even overcoming cultural aphasia.

4. The Practical Path of Speech Communication Education in Colleges and Universities

In the context of “cultural aphasia”, higher education, as a crucial platform for knowledge inheritance, value guidance, and cultural innovation, bears an irreplaceable mission in empowering students with cultural discourse power. Speech communication education is not merely a technical aspect of language training but also serves as a pivotal intermediary connecting individual expression with cultural identity. It holds unique value in assisting students in achieving cultural consciousness and identity recognition. This chapter, grounded in practical dimensions, proposes a systematic and operable path, encompassing the positioning of course objectives, the reconstruction of content system, innovation in teaching methods, digital empowerment, professional ethics training, and the introduction of broadcasting and hosting cases.

4.1 Course Objective Positioning and Content System Reconstruction

Speech communication education should first clarify the orientation towards literacy in curriculum objectives. Curriculum design should not only focus on language standardization and skill training but also play a role in ideological and political education. It should integrate the value elements of excellent traditional Chinese culture, revolutionary culture, and advanced socialist culture into the classroom, guiding students to deepen their cultural identity in language learning. At the same time, cross-cultural understanding and tolerance should be an important component of goal positioning. Students need to participate in cross-cultural practice and dialogue with an open and cautious attitude while respecting cultural diversity. In addition, aesthetic experience is also indispensable. Speech communication education should help students form correct language and cultural views through emotional cultivation and value shaping.

In terms of the content system, a three-layer progressive structure needs to be designed: the first layer focuses on training technical expression, including pronunciation and intonation, logical structure, and situational language; the second level focuses on the cultivation of cultural narrative ability, enhancing students’ level of interpretation and dissemination of Chinese culture through practical activities such as speeches, hosting, and commentary; the third layer is oriented towards cross-cultural contexts, strengthening students’ adaptability and flexibility in multicultural communication.

4.2 Innovation in Teaching Methods and Technological Empowerment

In terms of teaching methods, speech communication education must break away from the traditional linear model of “explanation-imitation-practice” and fully integrate digital technology to achieve the dual goals of method innovation and ability expansion. For instance, improvisation training can leverage artificial intelligence dialogue models to digitally diagnose and optimize students’ speaking strategies, assisting them in handling language and cultural issues more flexibly in international settings. Simultaneously, the application of virtual reality and immersive technology provides students with a genuine context for cross-cultural communication, enabling them to gain a near-real speech experience in virtual international conferences, exhibitions, or interviews, thereby effectively enhancing their confidence and sense of presence in cross-border expression. Furthermore, cultivating multimodal content production capabilities is equally crucial. The introduction of short video creation, AI dubbing, and digital storytelling not only aligns with the principles of new media communication but also provides students with a novel platform to showcase cultural narratives. By assisting students in mastering multilingual cultural narrative strategies, we have produced hundreds of original bilingual cultural products and achieved significant results in cross-cultural communication education practice.

4.3 Professional Ethics Training and Introduction of Broadcasting and Hosting Cases

China’s broadcasting higher education emphasizes the field of audio language arts, offering courses such as reciting classic works and performing literary works, and organizing a series of recitation practice activities. In the curriculum system, a dedicated unit titled “Appreciation of Broadcasting and Hosting Works” incorporates typical cases of contemporary cultural program hosts, such as the in-depth content interpretation demonstrated by the announcer during the “National Day Parade”, the youth discourse guidance embodied by Sa Beining in “Let’s Talk”, and Bai Yansheng’s broadcasting expression in the CCTV Opera Spring Festival Gala. These hosts not only showcased language expression and discourse organization strategies but also accomplished the re-encoding and international translation of cultural symbols through posture, intonation, and situational construction. For students, case studies not only aid in mastering language skills but also guide them in understanding how cultural narratives can achieve a dual transformation from “localization interpretation” to “international expression” through hosting language.

In terms of teaching strategies, text analysis can be employed to assist students in mastering narrative logic and rhetorical strategies by deconstructing opening remarks, string words, and guest interviews in cultural programs. Simulated hosting training can also be conducted to allow students to practice introducing cultural elements such as Peking Opera, Cantonese Opera, and tea culture in Chinese or bilingual, thereby enhancing their cultural storytelling skills through on-site expression. Additionally, multimodal training methods such as video, audio, and on-site simulation are introduced to strengthen the comprehensive cultivation of language, imagery, attitude, and cultural interpretability. Especially in scenario-based training for cultural program hosting, simulating hosting segments of international cultural exchange evening parties not only hones students’ voice expression and stage control abilities but also promotes accuracy and confidence in conveying cultural information and values.

4.4 Educational Insights from Case Teaching Hosting Narrative

In the education system of broadcasting and hosting arts, speech communication is not only a process of cultivating language skills, but also an important way for students to construct subjectivity, achieve cultural consciousness, and express cultural identity in a multicultural context. The spoken language in television communication belongs to the category of language art. It not only needs to express emotions and meanings but also needs to convey emotions and thoughts. The language should be standardized, the voice pleasant, the emotions sincere, the semantics complete, the language flow smooth, the behavior elegant, the image dignified, the body graceful, the clothing simple, and the self-respecting, showing the national style of public image. University broadcasting and hosting art education must fully respond to the needs of cross-cultural communication in curriculum design, teaching methods, and practical paths, so that students can demonstrate standardized, professional, and culturally rich expression abilities when facing communication objects from different cultural backgrounds.

Tiered Instruction

An important method for addressing individual differences among students in broadcasting and hosting education. There are

significant differences in language proficiency, pronunciation conditions, and cultural accumulation among students majoring in broadcasting and hosting. Therefore, curriculum design needs to be addressed through a layered and progressive approach. In basic courses such as “Mandarin Phonetics and Pronunciation”, “Introduction to Broadcasting and Hosting”, and “Stage Recitation Art”, the teaching focus should be on tone control, breath control, and language logic training to ensure students’ unity in standardized expression. For students with a higher basic level, further guidance can be provided in advanced courses such as program hosting art and broadcasting creation to enhance their cultural narrative and cross-cultural communication abilities. Classified by professional directions into Mandarin broadcasting and hosting, English broadcasting, and Cantonese broadcasting, audio language creation is based on the dissemination of cultural connotations. Only through accumulated reading and a certain level of literary appreciation and comprehension, can creators better express their language through feelings, and thus convey the cultural connotations, thoughts, and emotions of their works. Offering characteristic courses based on the local advantages of the Guangdong-Hong Kong-Macao Greater Bay Area, systematically understanding the basic knowledge of Cantonese and Cantonese broadcasting, understanding the history and culture of Lingnan, and proficiently mastering the professional skills of Cantonese broadcasting and hosting. In practical teaching, a progressive path of “phonetic norms cultural narrative cross-cultural hosting” has been established, enabling students to gradually transition to cultural narrative and international expression while mastering speech communication techniques, thus forming a multi-level and systematic talent cultivation model.

Situational Simulation / Role-Playing Pedagogy

The distinctive characteristics that set broadcasting and hosting majors apart from other language-related disciplines. Linking speech communication with real-life scenarios, training in simulated real-life contexts through practical courses, combining “scripted broadcasting” with “improvisation without script”, emphasizing both normative expression and highlighting improvisational adaptability and cross-cultural compatibility. In courses such as “On-Camera Journalist Live Reporting,” “Improvisational Speech Expression,” and “Radio and Television News Broadcasting,” the classroom can be extended into a training ground for real communication by simulating news broadcasts, variety shows, international cultural forums, and hosting cross-border evening events. According to the 2025 annual report of the China Network Audiovisual Program Service Association, the number of certified online hosts has reached 223,000, of which 32% have a professional background in broadcasting and hosting. In the context of diversified development of online programs, the role of broadcasting hosts has expanded from the traditional “connecting people” to narrative constructors, cultural translators, situational regulators, emotional resonance creators, and value guides. The function of speech communication is also showing a trend of diversification. Students are grouped for group training as bilingual hosts for radio and television programs or international cultural exchange activities, to enhance their cultural interpretation and stage control skills in diverse contexts, as shown in Figure 1 scenario simulation program training. This situational training not only enhances students’ ability to express themselves on the spot but also strengthens their cultural confidence and cross-cultural communication skills.

Table 1. Scenario simulation program training

Program	Type	Host role/identity	speech communication function
Online news/ information	News lives	Anchor, on-site reporter	information transmission (timely and accurate reporting); Credibility Construction (Linguistic Authority)
	Review program	Commentator, host	Discourse guidance (interpretation of views); Cultural Topic Setting (Guiding Public Opinion)
Web interviews/ conversations	In-depth interview	Dialogue leader, topic refiner	knowledge translation (colloquialization of abstract ideas); Identity construction (host as a cultural bridge)
	Easy conversations	Atmosphere maker, resonance maker	interpersonal communication (shortening distance); Cultural identity construction (translating culture through colloquial expression)
Online educa- tion/knowledge	Knowledge short video	narrator, knowledge translator	popular science communication (simplification of complex concepts); Multimodal Presentation (Language + Visual + Subtitles)

Program	Type	Host role/identity	speech communication function
Webcast	MOOC/ Open course	Lecturer/course facilitator	systematic dissemination of knowledge; Educational function (guided learning and value construction)
	Live commerce	Promoter, interactive facilitator	consumer narrative communication (story-based delivery); Emotional resonance (verbal motivation + fan interaction)
	Live broadcast of the show	Performer, interactive host	entertainment communication (combination of language + performance); Emotional mobilization
Online documentary	PK interaction	Host	competitive narrative construction: Instant interactive communication (lead voting, mobilize participation)
	Micro-documentary	Narrator, storyteller	cultural narrative dissemination (telling folklore, food, etc.); Emotional evocation
	Documentary series	Cultural narrator and communicator	in-depth cultural interpretation (historical/artistic interpretation); International Communication (Cross-Cultural Translation)
Interactive/experimental programming	Interactive Film and Television	Branch facilitator, narrator	Participatory communication (guiding the audience to choose); Narrative regulation
	Immersive live streaming	Virtual host, guide	immersive cultural communication (VR explanation); Cross-language communication

Project-Based Learning, PBL

Project-Based Learning (PBL) holds significant importance in the education of broadcasting and hosting majors. It emphasizes the shift from the small classroom of school to the big classroom of society, closely integrating professional learning with social practice by completing projects with practical communication significance through teamwork. In courses such as “Television Program Broadcasting and Hosting,” “New Media Anchor Professional Practice,” and “Research on Famous Chinese and Foreign Hosts,” students can directly participate in cultural expression and communication practice by planning and hosting cultural programs, producing bilingual short videos or podcast projects. By understanding the differences in language communication between China and foreign countries and adopting adaptive expression strategies in cross-cultural programs, students can avoid cultural misreading. Students are divided into groups to produce short videos and disseminate them on social media platforms. Cross-cultural short program production projects, such as the theme of “Overseas Communication of Chinese Traditional Festivals,” involve students planning, shooting, and editing a 3–5-minute bilingual short video or podcast, which can introduce the origins, customs, and cultural connotations of festivals such as the Spring Festival, Mid-Autumn Festival, and Dragon Boat Festival. Simulating the production of a 3-minute micro-documentary about “Chinese Urban Culture” for an international brand or overseas institution, emphasizing the integration of traditional culture and modern life in Chinese cities, etc. This model enables students to master the full process skills of program planning and hosting, accumulate cross-cultural communication experience through international exchange projects, overseas practice, and other channels, and enhance the international expression ability of Chinese voices. It cultivates students’ comprehensive abilities in cross-cultural narrative and international communication, fully reflecting the “output-oriented” and “learning for application” characteristics of broadcasting and hosting education.

Reflective Practice Pedagogy

The phenomenon of cultural aphasia is not a single-dimensional issue, but a comprehensive symptom influenced by multiple contexts. For instance, in the direction of Mandarin, students often master standardized pronunciation and expression skills, but lack deep-level cultural connotation support, which is the so-called lack of “cultural core”; in the direction of Cantonese, there is a problem of insufficient “mainstream narrative channels”, leading to students’ lack of effective expression platforms in national cultural dissemination. The root of this “Chinese cultural aphasia” lies in the weakening of mainstream cultural identity in the context of cross-cultural communication (Shi Bingyun, 2020). Therefore, reflective practical teaching is used to

reconstruct learners' cultural identity and discourse ability. In core courses such as "Appreciation of Hosting Works", "Online Program Hosting", and "Comprehensive Training of Broadcasting and Hosting", reflective teaching links such as video playback, peer evaluation, and teacher-specific feedback are introduced to build a training mechanism for students to improve in a circular manner. Through video analysis, students can examine their own performance from an external perspective, identifying deficiencies in breath control, speed adjustment, style selection, and cultural symbol interpretation; peer evaluation provides students with a multidimensional feedback channel, enabling them to discover potential problems and improvement spaces in their expression from the perspective of peers; teacher-specific feedback further plays a professional guiding role, helping students make targeted corrections at the detailed level. Unlike traditional imitative training, reflective practice emphasizes students' subjective construction and personalized exploration, enabling them to avoid "one-size-fits-all" while finding expression methods that align with their own cultural identity. For example, in classroom training simulating international cultural exchange scenarios, students not only need to achieve accurate language expression but also need to be able to appropriately translate Chinese cultural symbols into cross-culturally comprehensible narrative resources.

5. Conclusion

Research indicates that: Firstly, cultural aphasia is a comprehensive phenomenon characterized by the absence of cultural identity and expression dilemmas. Its root lies in both the dominant position of Western discourse in the context of globalization and the deficiency in excessive instrumentalization and neglect of cultural narrative ability cultivation in higher education. Secondly, speech communication education theoretically aligns highly with the treatment of cultural aphasia. It provides students with an effective platform for expression and narrative through three dimensions: knowledge accumulation, skill training, and subject construction. Thirdly, addressing cultural aphasia in universities requires the construction of a systematic path, including curriculum system reconstruction, teaching method innovation, evaluation mechanism optimization, and case-based practice, to effectively enhance students' cultural consciousness and expressive ability. Fourthly, the existing curriculum reforms in universities and the application practices of new media, VR/AR, and other tools have preliminarily demonstrated the practical effectiveness of speech communication education intervention.

From an overall perspective, speech communication education in universities should be centered around the main thread of "goal orientation - method innovation - platform support - professional quality training". It serves as a tool for skill enhancement and a pathway for cultural identity reconstruction. Through optimizing course structures, innovating teaching methods, and introducing hosting cases, students can gradually alleviate "cultural aphasia" in cross-cultural contexts, achieving a leap from "being able to speak" to "speaking well". Especially by referring to typical cases such as hosting large-scale cultural programs on CCTV and participating in international cultural forums, it can provide students with practical paradigms for cultural narration, helping them achieve cultural confidence and reconstruct discourse power in global communication scenarios. This study breaks through the limitations of previous research that only focused on macro-level criticism or cultural reflection, proposes specific corrective paths in the sense of education, and expands the theoretical boundaries of research on cultural aphasia. At the practical level, this paper provides a reference for curriculum construction and talent cultivation in universities. By introducing speech communication education, it not only helps enhance students' expressive abilities in cross-cultural communication but also promotes the international dissemination of Chinese culture and the construction of a discourse system, serving the fundamental task of "cultivating students with virtue" and cultivating talents with cultural confidence in universities in the new era.

In the era of globalization and digitization, universities are not only places for imparting knowledge but also crucial frontiers for cultivating students' cultural consciousness. To address the issue of cultural aphasia, it is imperative to integrate speech communication education into the educational curriculum, enabling students to confidently and independently construct their own national culture and freely disseminate it in cross-cultural exchanges. As the "culture going global" continues to develop and the pace of educational internationalization accelerates, speech communication education will bear greater responsibility in both talent cultivation and cultural dissemination in the future. Simultaneously, through ongoing theoretical and teaching research, we can ultimately establish a speech communication education system that aligns with China's national conditions and possesses Chinese characteristics, thereby supporting the overseas dissemination of Chinese culture and the construction

of its discourse system.

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Conflict of Interests

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

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Research on the Contemporary Significance of Creating the Sense of Community for the Chinese Nation: A Case Study of Red Education Cultural Relics in Guangdong

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Abstract: At present, China is undergoing a period of profound transformation unseen in a century. Taking cultural relics related to revolutionary education as a focal point to promote the creative transformation and innovative development of China's outstanding culture represents an effective pathway for the inheritance and development of Chinese culture, as well as for upholding a shared national spirit. This study takes educational cultural relics in Guangdong as its subject matter, integrating multidisciplinary perspectives from ethnology, cultural heritage studies, and pedagogy to construct a theoretical model of "cultural relics–cultural identity–sense of community" and to reveal its underlying operational logic and mechanisms of transformation. Concurrently, the study explores the logical connection between revolutionary educational cultural relics and the consolidation of a sense of community for the Chinese nation. It analyses how the creative transformation and innovative development of these cultural relics can help build outstanding cultures across all ethnic groups, thereby fostering a sense of community within the Chinese nation. It summarizes Chinese wisdom and solutions in this regard. This study posits that revolutionary educational cultural relics contribute to the formation of a shared understanding of the origins of Chinese education and represent a practical pathway to creating a shared historical memory. They are conducive to strengthening cultural identity with the great motherland, the Chinese nation, the Communist Party of China, and the path of socialism with Chinese characteristics.

Keywords: Red Education Cultural Relics; Guangdong; Sense of the Chinese National Community; Contemporary Significance

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1. Introduction

Educational cultural relics refer to tangible cultural heritage within the field of education that embodies the essence, elements, and forms of cultural heritage and possesses cultural values in history, science, art, and education (Wang, 2018). Chinese President Xi Jinping emphasized: "Red resources bear witness to our Party's arduous yet glorious struggle and represent our most precious spiritual wealth." Creating a strong sense of the Chinese national community is a fundamental and systematic undertaking for the realization of the great rejuvenation of the Chinese nation. It constitutes the central theme of the Party's ethnic work in the new era. In March 2022, Guangdong Province formally implemented the "Guangdong Provincial Regulations on the Protection of Revolutionary Sites", which explicitly require the "deepening of the exploration, interpretation and dissemination of the value of revolutionary sites". The Guangdong region was the cradle of China's modern

and contemporary democratic revolution, leaving behind an extremely rich and distinctive array of red educational cultural heritage resources. Consequently, Guangdong's red educational cultural heritage holds significant theoretical value and contemporary significance in terms of creating a strong sense of the Chinese national community, propelling all ethnic groups towards modernization, and building a shared spiritual home for the Chinese nation.

2. Literature Review

To summarize the relevant academic findings, research into revolutionary cultural relics has attracted the attention of scholars. In summary, this research can be divided into four main themes:

Firstly, the construction of a knowledge framework for red revolutionary cultural resources and the preservation of revolutionary sites. Representative works include Wang (2022), who argues that Shaoguan's revolutionary culture has its own practical and theoretical logic underpinning its formation and development. Chen (2022) takes the development of information technology in Guangdong as a starting point; this study explores in depth the pathways for the conservation and development of revolutionary heritage sites. At the same time, it proposes targeted measures to explore new media technologies and create diverse forms of communication, whilst prioritizing conservation. Second, the value and role of integrating red educational cultural relics into the practical teaching of ideological and political courses. Representative works include Shi (2024), which explores the integration of revolutionary heritage with the ideological and political education of grassroots rural cadres. Given that current research primarily focuses on university students, it proposes incorporating revolutionary heritage into the ideological and political education of grassroots rural cadres. Zhan (2016) believes that education in the "red culture" draws upon the material and spiritual heritage created and bequeathed by our forebears since modern times to promote, propagate and instil the mainstream ideology of socialism with Chinese characteristics. This enables those receiving such education to consciously develop a sense of historical and cultural identity with the Party and the nation's history, thereby deepening their understanding of socialism with Chinese characteristics. As the birthplace of China's modern democratic revolution and a frontier of reform and opening-up, Guangdong is rich in resources relating to the "red culture". Liu and Ding (2025) believed that tangible testimonies to the Communist Party of China's century-long struggle, revolutionary cultural relics, embody a rich heritage of revolutionary spirit and culture and serve as vital resources for ideological and political education in primary, secondary, and tertiary institutions. Integrating revolutionary cultural relics into the integrated development of ideological and political education courses across these levels holds significant contemporary value. Thirdly, the exploration and construction of the revolutionary spirit of the Communist Party of China through red revolutionary cultural relics. Representative works include Lian (2019), who believed that "red culture" represents the culmination of the Communist Party of China's nearly century-long struggle. From the revolutionary era to the period of socialist construction, countless patriots and idealists, in their fight for the liberation, independence and prosperity of the Chinese nation, achieved immortal feats and demonstrated an indomitable spirit through their struggle, dedication and even sacrifice; these have coalesced into "red culture". Consequently, "red culture" encompasses not only the revolutionary culture of the New Democratic era but also the various spiritual traditions that emerged during the period of socialist construction. Tang and Gui (2023) examined the history of the Communist Party of China's pioneering endeavours, struggles, and revolutionary spirit through the lens of red cultural relics, vividly illustrating the Party's resplendent revolutionary spirit. Fourthly, the exploration of pathways for integrating artificial intelligence with revolutionary cultural relics. Representative works include Sun (2025) took the "Former Site of the Shandong Provincial Government and the Headquarters of the 115th Division of the Eighth Route Army" as an example, by applying a methodology that integrates revolutionary cultural relics with artificial intelligence—and with the robust support of AI technology—these relics can contribute to the practice of ideological and political education across multiple dimensions, including digital conversion, intelligent guided tours and personalized learning. Shen and Li (2025) proposed that efforts to protect and preserve revolutionary cultural relics should focus on enriching the substance of intellectual property through humanistic values, utilizing artificial intelligence to create a new system for smart experiences and management, and employing digital media to foster new forms of dynamic dissemination. Wang et al. (2025) Using a literature review and logical analysis, this study systematically examines the underlying logic, practical challenges, and implementation pathways by which new-quality productive forces empower the conservation and utilization of revolutionary cultural heritage.

Since the concept of “creating a strong sense of the Chinese national community” was first proposed in the new era, scholars have been discussing how to integrate the protection and utilization of cultural relics and heritage with this objective. Three main strands of research can be identified: firstly, treating cultural relics and heritage as cultural resources that can be utilized to foster a strong sense of the Chinese national community; secondly, exploring new approaches to the protection and utilization of cultural relics and heritage with this objective as the central theme; and thirdly, examining the reciprocal relationship between fostering a strong sense of the Chinese national community and the protection and utilization of cultural relics and heritage.

In summary, whilst existing research findings offer diverse perspectives, there is a tendency towards a narrow focus in academic approaches, manifested primarily in the following ways: Firstly, comprehensive research on cultural relics related to revolutionary education exhibits a marked lack of geographical and curricular diversity, centring almost exclusively on a few historic revolutionary base areas across the country and ideological and political education courses, whilst neglecting a comprehensive study of such relics in Guangdong; Secondly, China National Knowledge Infrastructure (CNKI) contains few case studies or comprehensive analyses of Guangdong’s revolutionary educational heritage, indicating that research into and exploration of such heritage in Guangdong has not been sufficiently in-depth or meticulous; thirdly, research on Guangdong’s revolutionary educational heritage from the perspectives of architecture, art and ideological and political education currently dominates the field, whilst studies adopting the perspectives of cultural heritage and pedagogy are virtually non-existent. This study aims to analyse the logical connection between Guangdong’s revolutionary educational heritage and the consolidation of the Chinese nation’s shared consciousness. The research question is to analyse the dialectical relationship between the two in terms of thematic focus, value objectives and specific contexts, and to explore the cultural connotations of Guangdong’s revolutionary educational heritage within the context of Chinese culture.

3. How Is This Possible: A Theoretical Examination of Red Educational Cultural Relics in Guangdong

Revolutions and wars have always been part of history, and the cultural heritage that emerges alongside them is also regarded as a vital component of historical education. Red education cultural relics in Guangdong refer to material cultural relics of historical, artistic and scientific value that have been preserved from educational activities carried out during the period of the New Democratic Revolution led by the Communist Party of China in the history of the Guangdong revolution. These primarily include the former sites of schools of all levels and types established by the Communist Party of China in Guangdong, along with their associated exhibition halls and museums; they also encompass the former residences and memorial halls of Guangdong’s revolutionary educators; furthermore, they include various educational cultural relics such as educational documents, textbooks, graduation certificates and old photographs, as well as precious educational artworks and decorative arts. The red educational relics of modern Guangdong have developed in tandem with the revolutionary and military struggles. The numerous red educational sites and representative buildings in Guangdong stand as historical witnesses to the revolutionary history of modern Guangdong, possessing significant historical, academic, artistic and educational value.

3.1 Historical Characteristics: The Non-Renewable Nature of Revolutionary Educational Cultural Relics

The irreplaceable nature of red educational relics refers to the fact that, as products of a specific historical period, their physical form, historical information and educational value are unique and cannot be replicated. Once damaged or lost, even with modern restoration or conservation techniques, it is impossible to restore their original historical authenticity and unique cultural value. The former site of the Republic of China Military Academy, also known as the Army Officers’ School, is situated on Changzhou Island in Huangpu District, Guangzhou, China. Originally housing the Qing Dynasty’s Army Primary School and Naval School, it is a significant historical site and representative architectural complex in modern educational history. It was designated a Provincial-level Cultural Heritage Site in Guangdong in 1962, and the site itself was designated a National-level Cultural Heritage Site in 1988.

However, on 25 February 2010, the Guangzhou Daily published a report entitled “The Former Site of the Republic of China Military Academy Alumni Association: Deep Excavation of Foundations and Forced Structural Alterations-Who Destroyed the Cultural Heritage to Open a Nightclub?” Following an investigation, the competent authority for the former site of the

Republic of China Military Academy is the Guangzhou Municipal Bureau of Culture. On this occasion, the tenant carried out renovations without approval, resulting in damage to the site. This has provoked a strong reaction both China and abroad, particularly among the vast number of Republic of China Military Academy and their relatives, and has caused a serious negative impact.

Red educational cultural relics originated during the era of revolutionary warfare. Despite the harsh conditions, the Communist Party of China continued to prioritize education at all levels and in all forms, mobilizing teachers, students, and patriotic figures to play active roles in accordance with local circumstances. Due to the materials used and the specific environments in which they were situated, these cultural relics are difficult to preserve, and the ravages of war have caused significant damage. With the advancement of modern technology, there is a misconception that the conservation and restoration of modern and contemporary buildings is straightforward. Furthermore, as the economic and collectable value of red educational cultural relics is not considered as high as that of ancient cultural relics, they are often overlooked. Cultural relics themselves contain a wealth of historical information. As physical materials that supplement written records, their material properties are of great importance; consequently, their value is equally irreplaceable. Behind every piece of revolutionary heritage lies untold information. At a time when China is undergoing a once-in-a-century transformation, the protection and transmission of such heritage is crucial. Taking these cultural relics as a focal point to promote the creative transformation and innovative development of China's outstanding culture is an effective means of preserving and advancing Chinese culture, whilst upholding our shared national spirit.

3.2 Cultural Characteristics: The Uniqueness of Red Education Cultural Relics

Red educational heritage sites are directly linked to the development of revolutionary and military history, forming a vital part of China's educational history. They bear witness to the evolution of revolutionary and military education, embody the strengthening of such education, and bear a distinct "revolutionary" character. Guangdong Province boasts over 4,300 revolutionary sites and numerous red educational bases, including 13 national red tourism classic scenic spots and several batches of Guangdong Provincial Patriotic Education Bases. In October 2023, the Publicity Department of the Guangdong Provincial Committee of the Communist Party of China designated 20 new sites as the tenth batch of Guangdong Provincial Patriotic Education Bases. For example, in the Guangzhou area, these include the former site of the Peasants' Movement Training School founded by Comrade Mao Zedong, the Guangzhou Uprising Memorial Hall and Martyrs' Cemetery, the Sanyuanli People's Anti-British Struggle Memorial Hall, Huanghuagang Seventy Two Martyrs Cemetery, and the former site of the Republic of China Military Academy. Other key sites include: Memorial Museum of Marshal Ye Jianying in Meizhou City, the Ye Ting Memorial Hall in Huizhou City, Lianhua Shan Park in Shenzhen, the former site of the Red Palace and Red Square in Shanwei City, the Sun Yat-sen Former Residence and Memorial Hall in Zhongshan City, and the Opium War Museum in Dongguan City. Each site bears the memories of revolutionary and military education, and its unique educational value is of great importance to both social development and personal growth.

Located in Nanhai District, Foshan City, Guangdong Province, the Kang Youwei's Former Residence was the home of Kang Youwei, a renowned modern educator, revolutionary and thinker. In his early years, Kang Youwei founded the The Myriad Trees Academy in Changxingli, Guangzhou, where he gathered disciples to teach, researched reformist ideas and nurtured reformist talent. It was in this old house that Kang Youwei spent the most formative years of his youth. In 1983, the Kang Youwei Former Residence was restored and designated as the "Kang Youwei Historical Exhibition Hall". In 1986, the "Kang Youwei Memorial Hall" was established on the site of the former residence. In 1987, a new Kang Youwei Memorial Hall was constructed adjacent to the former residence. Through various educational cultural relics and historical materials, the exhibition halls provide an objective and comprehensive account of his life's quest to save the nation and its people. The former residence preserves and displays a wealth of precious historical documents and educational cultural relics, possessing unparalleled historical, educational and cultural significance.

3.3 Shared Characteristics: The Social Educational Value of Red Cultural Relics

Red educational cultural relics possess immense artistic and educational value; their aesthetic, pleasurable and visual qualities offer people opportunities for leisure, enjoyment, learning and innovation. Precious red educational sites provide aesthetic

enjoyment and a historical immersion, serving as places of learning. Precious red educational crafts, works of art, and the calligraphy and paintings of revolutionary educators allow people to experience aesthetic pleasure and be imbued with traditional cultural knowledge.

Sun Yat-sen's calligraphy is held in the archives of Fudan University. Sun Yat-sen, the great pioneer of modern Chinese democratic revolution, a revolutionary, statesman and theorist, is revered as the Father of the Nation. Throughout his long revolutionary career, Sun Yat-sen left behind numerous calligraphic works, which serve as a testament to his revolutionary endeavours, a vehicle for his ideas, and a banner of revolutionary culture. Among Sun Yat-sen's surviving works, many deal with the theme of revolutionary education, mostly reflecting his famous sayings, aphorisms, aspirations and ideals regarding education.

Sun Zhongshan placed great importance on education throughout his life and inscribed famous mottos for various schools. For example, Sun Yat-sen personally wrote the Republic of China Military Academy's motto. "Latercomers Surpassing the Pioneers" is a work personally inscribed by Sun Yat-sen and presented to Cuiheng School; it is preserved at the Sun Yat-sen Former Residence Memorial Hall in Cuiheng Village, Guangdong. "Carrying Forward the Past and Opening Up the Future" was inscribed by Sun Yat-sen for Zhengxian School; "Strive for a Bright Future" was inscribed by Sun Yat-sen for the Fudan Annual. "Seek knowledge broadly, inquire diligently, reflect carefully, distinguish clearly, and practise earnestly" is Sun Yat-sen's handwritten inscription of the famous educational maxim from The Book of Rites The Doctrine of the Mean, which served as the school motto inscribed for the inauguration ceremony of the National Guangdong University (also known as the "Literary Hall", renamed Sun Yat-sen University in the autumn of 1923).

The collection, exhibition and study of cultural relics relating to revolutionary history can enrich the content of school education, address its shortcomings, and provide new venues and opportunities for both school and family education. Such cultural relics serve as vital centres for patriotic education; they act as classrooms and textbooks, playing a crucial role in enhancing people's cultural literacy.

4. Why It Is Feasible: Practical Considerations Regarding Red Education Cultural Relics in Guangdong

4.1 Historical Identity: Uncovering Historical Resources of the Chinese Nation's Community through Guangdong's Red Educational Cultural Relics

"Patriotism is the deepest and most enduring emotion in the world; it is the source of moral integrity and the foundation of meritorious deeds." (General Office of the State Council, PRC, 2020) Red education cultural relics are material cultural heritage left behind by humanity's revolutionary historical activities, possessing historical, educational and scientific value. They are imbued with the profound patriotic sentiments and earnest aspirations of our predecessors, and serve as vivid teaching materials for patriotic education among students.

Guangdong's revolutionary heritage sites embody the collective memory of the Chinese nation's unity and resistance during crises in modern history. The former site of the Guangdong People's Anti-Japanese Liberation Army Headquarters—the Yu Clan Ancestral Hall in Heshan—is a prime example. This ancient building, which blends Lingnan architectural art with the spirit of revolutionary struggle, witnessed the formal establishment of the Guangdong People's Anti-Japanese Liberation Army and the issuance of the "Telegram" on 20 January 1945, marking a new phase in the Party's independent leadership of the anti-Japanese armed struggle in the central Guangdong region. (JM D, 2025) As an irreplaceable historical witness, the Yu Clan Ancestral Hall bears the weight of profound collective national memory; its historical significance is embodied in a "tangible history textbook". (JM D, 2025) They bound their own lives inextricably to the future of the motherland and the nation's destiny, transforming their patriotic fervour into concrete action and interpreting the spirit of patriotism with their youth and blood.

Making effective use of resources relating to revolutionary heritage means unearthing the historical and cultural elements they contain, preserving the patriotic educational values left behind from the revolutionary era, and promoting the spirit of patriotism. Revolutionary heritage museums, exhibition halls, and similar venues have a duty to provide patriotic education. Fully exploring Guangdong's revolutionary heritage resources is essential for us to appreciate and understand our contemporary educational mission; it is also a vital component of in-depth, high-quality education and educational development, as well as a

key basis for formulating strategies to protect revolutionary heritage. The development of a digital repository of Guangdong's revolutionary educational heritage provides primary, secondary and tertiary institutions with a vivid, engaging and locally relevant source of ideological and political education, thereby enhancing its appeal, impact and effectiveness, and fulfilling the fundamental task of fostering virtue through education.

4.2 Identity: Carrying forward the Spirit of the Chinese Nation's Community through Guangdong's Revolutionary Heritage

Striving is the source of hope and light for the nation; it is precisely through this spirit of striving that the Chinese people have upheld the backbone of the nation. Red educational cultural relics represent the history of the Communist Party of China, leading the people to forge ahead with perseverance and hard work, bearing witness to the hardships and challenges of the revolutionary process. They embody the shared values and cultural heritage forged by the Chinese nation through prolonged revolutionary struggles and practical endeavours in nation-building, constituting a spiritual treasure shared by all Chinese people. As a key cradle of the modern Chinese revolution and a vanguard of reform and opening-up, Guangdong's revolutionary educational cultural relics are imbued with rich elements of communal culture.

The Dongguan Dalingshan Anti-Japanese Base Area has developed the "Retracing the East Column's Path" initiative into a signature educational programme. Young people wear replicas of the era's military uniforms and, within the complex of historic sites, take part in simulated forced marches, learn battlefield first aid, and sing "The Song of the Dongjiang Column". This immersive experience is not intended to recreate the brutality of war, but rather to allow participants to 'step into' the shoes of revolutionary soldiers and understand "why they were willing to sacrifice everything for the nation". Inside the Liu Clan Ancestral Hall at the site, the guide emphasizes that most of the guerrilla fighters back then were local Hakka youths, defending their fellow villagers and the land where their ancestors had lived. "Defending one's hometown is defending the nation"—this natural elevation from local to national identity strikes a chord with visitors through the spatial narrative.

Through in-depth research into and the widespread dissemination of these cultural cultural relics, more people can gain a profound understanding of the historical inevitability of the formation of the Chinese national community, and recognize the shared roots and the interdependence of our destinies. This fosters a strong sense of belonging and identity, thereby further consolidating the cultural foundations of the Chinese national community. At the same time, the spirit of pioneering courage and pragmatic progressiveness embodied in Guangdong's revolutionary heritage aligns with the demands of China's reform, opening-up and modernization, providing valuable cultural resources for strengthening national cohesion and centripetal force under new historical conditions.

4.3 Shared Identity: Tracing the Cultural Roots of the Chinese Nation through Guangdong's Red Educational Cultural Relics

The progression from "historical identity" to "identity" and then to "shared identity" is a gradual process that moves from objective understanding to subjective belonging, and from individual belonging to collective consensus. Shared identity addresses the core question of "what we collectively uphold"—it does not dwell on differences but focuses on common ground; it does not emphasize boundaries but highlights integration. Ideals guide the direction of life, and convictions determine the success or failure of one's endeavours. Without ideals and convictions, one will suffer from a "lack of calcium" in one's spirit."(Xi, 2022) The cultural relics of Guangdong's revolutionary education embody precisely those shared values, shared sentiments and shared spiritual pursuits that the Chinese nation forged amidst the perils of modern times, transcending region, class, ethnicity and even political parties. Each of these historic sites is a true reflection of the faith sought by the vast numbers of Guangdong students pursuing revolutionary ideals, chronicling the arduous journey of teachers and students in the revolutionary base areas as they established and ran schools amid the smoke of battle.

Among Guangdong's revolutionary cultural relics, nothing evokes a stronger sense of shared identity than the common will of the entire nation to "resist Japan and save the nation". The Dongjiang Column was a people's anti-Japanese armed force led by the Communist Party of China in Guangdong, yet its historical records reveal a remarkable 'unity in diversity'. The original copy of the "Declaration on the Establishment of the Dongjiang Column" (2 December 1943), preserved at the Guangdong Dongjiang Column Memorial Hall, begins with the words: "We have come together under the leadership of the

Communist Party of China, uniting the brave people's soldiers from the Dongjiang, Pearl River and Han River regions, as well as all patriotic compatriots who refuse to be slaves of a conquered nation, to form this organization." The declaration bears not only the signatures of the Column's leaders. However, it is also accompanied by letters of support from various groups, including workers, farmers, students, overseas Chinese, and compatriots from Hong Kong and Macao. This demonstrates that the Dongjiang Column was not an armed force representing a single class or region, but rather a community of shared destiny formed by patriots from all walks of life in South China, united by the common principle of "refusing to be slaves of a conquered nation".

Mr Fei Xiaotong's maxim, "Each admires its own beauty, admires the beauty of others, shares in the beauty of all, and achieves a harmonious world", succinctly encapsulates the logic underlying the formation of shared identity. The cultural roots of the Chinese national community, as embodied in Guangdong's red education heritage, represent precisely this wisdom of "diversity within unity": it acknowledges the cultural characteristics of different ethnic groups such as the Cantonese, Hakka and Chaoshan, whilst also embracing the distinct experiences of overseas Chinese, compatriots from Hong Kong and Macao, and ethnic minorities; it respects everyone's attachment to their homeland, love for their dialect and roots in their clan, yet consistently guides people to integrate the individual into the collective, to elevate local identity to national identity, and to extend kinship ties into bonds of the nation.

5. What Can Be Done: The Contemporary Value of Guangdong's Red Education Cultural Relics in Strengthening the Sense of a Chinese National Community

Red educational cultural relics embody the spiritual qualities of the Chinese Communist Party and offer rich educational value in history, science, art, and society. As China enters a new era of building socialism with Chinese characteristics, it is essential to explore and effectively leverage the contemporary value of red educational cultural relics to forge a strong sense of the Chinese national community. These cultural relics serve not only as a spiritual bond that unites the collective memory of the Guangdong-Hong Kong-Macao Greater Bay Area, but also as a practical pathway to promote the creative transformation and innovative development of red culture; furthermore, they constitute a strategic resource for addressing cultural shocks in the era of globalization and strengthening national identity.

5.1 Strengthening the Sense of Shared Identity within the Chinese Nation through the Tangible Heritage of Guangdong's Revolutionary Education

The "tangible forms" of Guangdong's red educational heritage refer to the transformation of the grand theme of creating a strong sense of the Chinese national community into tangible, accessible, and interactive physical forms and spatial vessels. These forms are not abstract ideological preaching, but rather shared memories and emotional connections embedded within specific revolutionary sites, cultural relics, commemorative spaces and symbolic systems.

Guangdong has brought forth cultural relics from the depths of history, each containing specific details and clues that help to forge a strong sense of the Chinese national community. For example, among the 209 cultural relics on display at the "Bay Area in Flames, an Immortal Monument-Guangdong-Hong Kong War of Resistance Exhibition", Ye Ting's passport—used when he travelled to Vietnam to raise funds for the anti-Japanese war effort—is particularly noteworthy. (GD D, 2025) This passport is not merely a document of personal identity; it embodies the historical ties that bind the people of Guangdong and Hong Kong, sharing the same breath and destiny, and serves as tangible evidence of the close connection between overseas Chinese and the motherland during the War of Resistance. The "Declaration on the Establishment of the Dongjiang Column of the Guangdong People's Anti-Japanese Guerrilla Force" on display was donated in 1965 by Mo Guangzhi, a soldier of the Dongjiang Column. The declaration states: "Under the leadership of the Communist Party of China, we have brought together the brave people's soldiers from the Dongjiang, Pearl River and Hanjiang regions, as well as all patriotic compatriots who refuse to be slaves of a conquered nation, to organise ourselves collectively." The "tangible" nature of this declaration lies in the fact that it captures, in written form, the shift in identity among a multi-class group of patriots, from acting "for their own masters" to "uniting to face the nation's crisis".

Guangdong's cultural relics related to revolutionary history foster a sense of shared identity within the Chinese national community through "tangible means", manifesting in multi-layered practices ranging from the macro to the micro: cultural

relic trails weave a spatial network for the community; digital technology constructs virtual spaces for shared experiences; the details of cultural relics carry the specific codes of communal identity; ceremonial activities create participatory spaces that foster shared emotions; and architectural remains embody the overlapping layers of identity. Together, these “tangible” approaches form an accessible, tangible and participatory educational system for the community.

5.2 Reflections on the Practice of Red Education through Cultural Relics in Guangdong, and the Promotion of Inter-Ethnic Interaction within the Chinese National Community

Guangdong’s revolutionary heritage sites hold unique contemporary value in promoting ethnic unity. A striking feature of these sites is that many of the revolutionary sites are themselves spaces of traditional culture—clan halls, academies, temples and guild halls. Communists and revolutionaries skilfully utilized these spaces, transforming traditional social organizational resources into networks for revolutionary mobilization. This approach did not sever ties with tradition, but rather revitalized it, creating a relationship in which revolutionary identity overlapped with, rather than replaced, local and clan identities.

The Heshan Yu Clan Ancestral Hall (the former site of the Guangdong People’s Anti-Japanese Liberation Army Headquarters) served as a venue for the Yu clan to worship their ancestors, hold meetings and run schools. It was no coincidence that the anti-Japanese guerrilla forces chose to establish their headquarters here in 1945. On the one hand, the ancestral hall held authority and influence within rural society; holding meetings there made farmers feel that these were “matters concerning their own people”; on the other hand, the cause of resisting Japanese aggression and saving the nation was highly aligned with traditional values such as “defending the ancestral home” and “bringing honour to the family”. When addressing the troops, guerrilla leaders frequently equated “saving the nation” with “protecting the home”, translating revolutionary principles into the language of the clan. This rhetorical strategy transformed the grand narrative of the Chinese national community into “matters within the ancestral hall” and “our own family’s affairs”, thereby significantly lowering the threshold for identification. Today, visitors to the Yu Clan Ancestral Hall can admire traditional features such as the distinctive “wok-ear” walls, plaster reliefs and wood carvings, whilst also viewing anti-Japanese telegrams, battle maps and the daily necessities of the guerrilla fighters. Here, tradition and modernity, clan and nation, converge to present a vivid picture of “unbroken cultural roots and an enduring revolutionary legacy”.

5.3 Harnessing the Tangible Achievements of Guangdong’s Revolutionary Heritage to Foster Unity within the Chinese Nation

The cohesive power of the Chinese national community is founded not only on shared ideals and symbols, but also on shared memories of suffering and glory. The relics of Guangdong’s martyrs are a core resource for building this emotional community. The martyrs’ graves and memorials within the Guangzhou Uprising Martyrs Cemetery, as well as the relics housed in the cemetery museum—a tattered photograph, an unsent letter home, a military uniform riddled with bullet holes—all serve as tangible vessels through which visitors can express their grief and pay their respects. Every year on Qing-ming Festival, tens of thousands of citizens come of their own accord to pay their respects; among them are descendants of the martyrs, but the majority are ordinary citizens who have never met them. The wreaths and memorial couplets they present bear inscriptions such as “Revolutionary martyrs shall live forever” and “The people shall never forget”. This collective act of remembrance unites scattered individuals into a shared emotional ritual, creating a sense of “we”—we are all beneficiaries and guardians of the martyrs’ spirit.

As important repositories of revolutionary history and a source of national cohesion, Guangdong’s revolutionary heritage sites play an irreplaceable role in fostering unity within the Chinese nation. Red heritage sites such as the Yu Clan Ancestral Hall in Heshan are not only witnesses to historical events but also living educational resources. They closely link the grand narrative of the revolution with the daily lives and cultural traditions of the people, allowing visitors to experience an emotional resonance through direct engagement with history, thereby strengthening their sense of identity and belonging to the Chinese national community. Through the protection, restoration and revitalization of these revolutionary heritage sites, more people can gain an understanding of the outstanding contributions made by our revolutionary forebears to national independence and ethnic liberation, and experience the patriotic spirit, spirit of sacrifice and unwavering conviction embodied in them. This spiritual inspiration transcends geographical, ethnic, and generational boundaries, uniting people from diverse groups into a powerful synergy that drives the great rejuvenation of the Chinese nation.

6. Conclusion

The organization, analysis, and digitization of cultural relics related to revolutionary education from a cultural heritage perspective are essential to our appreciation and understanding of our contemporary educational mission. They constitute a vital component of in-depth quality education and high-quality educational development, and serve as a key basis for formulating strategies to protect such relics. Red educational cultural relics in Guangdong hold immense contemporary value in creating a strong sense of the Chinese national community. They not only address the questions of “why they are necessary today” and “what can be achieved in the future”, but also serve as a spiritual bond that unites the collective memory of the the Greater Bay Area (GBA). Furthermore, they represent a practical pathway for the creative transformation and innovative development of red culture, as well as a strategic resource for addressing cultural shocks in the era of globalization and strengthening national identity.

The future development of a digital repository of revolutionary cultural relics in Guangdong will provide primary, secondary and tertiary institutions with a vibrant, engaging and localized form of ideological and political education that is both compelling, thereby fulfilling the fundamental task of fostering virtue through education. However, there remain practical challenges to fully realizing the contemporary value of Guangdong’s revolutionary cultural relics. Firstly, the process of passing on revolutionary culture suffers from oversimplification and formalism in education, as well as a lack of participation from younger generations (Sun, 2023); Secondly, the methods used to disseminate and promote certain revolutionary resources remain traditional and lack interactive mechanisms; thirdly, Guangdong’s revolutionary cultural heritage resources face issues such as insufficient public awareness, limited influence, inadequate policy safeguards, insufficient inter-departmental coordination, and inconsistent standards for the protection of some cultural relics (GD D, 2026); Fourthly, in the information age, the impact of emerging cultures has, to some extent, affected the aesthetic recognition and willingness to pass on red culture. To address these challenges, it is necessary to strengthen overall coordination further, reinforce academic support, deepen the integration of culture and tourism, and utilize digital and intelligent technologies to bring cultural relics to life truly.

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Conflict of Interests

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

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Teaching Strategies for Promoting Student Engagement in Primary Mathematics Classrooms in China: A Case Study

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Abstract: Student engagement is a critical predictor of learning outcomes in primary mathematics. However, low classroom engagement remains a persistent challenge in Chinese primary mathematics instruction, particularly under the Double Reduction policy. This qualitative case study selected two fourth-grade mathematics classes in a public primary school in East China to examine how targeted teaching strategies influence student engagement. Data were collected through classroom observations, semi-structured student interviews, and teacher reflective journals. Three effective approaches were identified: life-based situational teaching, small-group interactive cooperative learning, and hierarchical progressive task design. Preliminary data indicated that implementing these strategies was accompanied by improved student engagement (behavioral, emotional, cognitive), reduced off-task behaviors, and increased learning confidence. This study clarifies implementation paths and optimization suggestions for primary mathematics classrooms in China, offering actionable references for mathematics educators and researchers in the Asia-Pacific region.

Keywords: Primary Mathematics Classroom; Student Engagement; Teaching Strategies; Case Study; China; Asia-Pacific Education

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1. Introduction

1.1 Research Background

In the Asia-Pacific region, primary mathematics constitutes a foundational component of basic education, and student engagement is widely recognized as a core indicator of high-quality classroom instruction (Appleton et al., 2008). As one of the most influential educational regions globally, the Asia-Pacific area has been exploring paths to improve basic education quality, and mathematics learning achievement and classroom participation have long been regarded as key measurement dimensions. In recent years, countries such as South Korea, Japan, Singapore, and China have successively carried out curriculum reforms centered on student development, aiming to transform traditional teacher-centered teaching into student-centered learning environments.

In China, the implementation of the Double Reduction policy and revised mathematics curriculum standards has shifted instructional priorities from exam-oriented knowledge transmission to the development of students' core competencies, learning initiative, and active classroom engagement. The Double Reduction policy emphasizes reducing excessive homework burden and off-campus training pressure, requiring schools to improve classroom teaching efficiency and

stimulate internal learning motivation. Under this policy background, primary mathematics classrooms can no longer rely on mechanical practice and repeated training; instead, they must attract students' initiative participation through high-quality teaching design. Nevertheless, low engagement remains prevalent in many primary mathematics classrooms: students often listen passively, lack deep cognitive participation, demonstrate limited interaction, and display frequent off-task behaviors. These problems reduce instructional efficiency and weaken long-term learning motivation, conflicting with the goals of high-quality basic education.

Student engagement is a multidimensional construct comprising behavioral, emotional, and cognitive engagement (Fredricks et al., 2004). Behavioral engagement reflects students' participation in classroom activities, emotional engagement represents their affective experience and interest, and cognitive engagement refers to deep thinking and independent exploration. For primary school students in a critical period of cognitive and affective development, student-centered instructional strategies are essential to stimulate holistic engagement. Compared with large-scale quantitative studies, case studies situated in authentic classroom settings can better reveal practical effects and implementation procedures, supporting contextually appropriate teaching innovations. Therefore, taking real primary mathematics classrooms as research scenarios and exploring effective strategies to improve student engagement has important theoretical and practical value.

1.2 Research Significance

Theoretically, this study enriches empirical evidence on student engagement in Chinese primary mathematics classrooms and supports the localized application of engagement frameworks in Asia-Pacific basic education. Most existing engagement theories originate from Western educational contexts, and their applicability in large-class teaching environments in East Asian countries needs more empirical support. This study takes Chinese primary mathematics classrooms as examples to verify the effectiveness of specific teaching strategies, providing a localized theoretical basis for the improvement of student engagement.

Practically, it summarizes replicable, classroom-ready strategies to help frontline teachers optimize instruction, address low engagement, and implement high-quality mathematics teaching under current curriculum reforms. The three strategies formed in this study—life-based situational teaching, small-group cooperative learning, and hierarchical task design—have strong operability and can be directly applied to daily teaching. The findings also provide implications for mathematics education reform in other emerging economies in the Asia-Pacific region with similar educational contexts, such as large-class teaching, exam-oriented tradition, and curriculum transformation pressure.

1.3 Research Questions

1. What targeted teaching strategies can effectively improve student engagement in Chinese primary mathematics classrooms?
2. How do these strategies influence students' behavioral, emotional, and cognitive engagement?
3. What challenges emerge during implementation, and what optimization approaches can be adopted?

2. Literature Review

2.1 Connotation and Measurement of Student Engagement in Mathematics

Fredricks et al. (2004) proposed a three-dimensional model of student engagement that has been widely adopted internationally. This model divides engagement into three interrelated and relatively independent dimensions: behavioral, emotional, and cognitive engagement. In mathematics education, behavioral engagement refers to active participation in discussions, activities, and task completion; emotional engagement reflects interest, enjoyment, and a sense of achievement; and cognitive engagement involves deep thinking, independent problem-solving, and reflective learning (Lee & Johnston-Wilder, 2017).

With the deepening of research, scholars have further expanded the connotation of student engagement. Some studies have added social engagement, emphasizing students' communication and collaboration in the learning process. However, the three-dimensional model is still the most widely used framework in mathematics classroom research. In terms of measurement, researchers usually adopt a combination of classroom observation, scale evaluation, and interview to obtain comprehensive data, avoiding the limitations of a single method.

Key influencing factors include teaching methods, teacher–student relationships, task design, and classroom environment.

Positive teacher–student relationships can enhance emotional engagement, interesting teaching methods can improve behavioral participation, and challenging task design helps stimulate cognitive investment. Western studies support the effectiveness of situational teaching, collaborative learning, and differentiated instruction, but their applicability to large-class, examination-oriented Chinese classrooms requires further validation (Martin & Collie, 2019).

2.2 Teaching Strategies for Enhancing Student Engagement

Internationally, strategies to improve engagement focus on three aspects: embedding mathematics in real-life contexts to reduce abstraction, increasing interactive and student-centered activities, and designing differentiated tasks to meet diverse learner needs (Campbell et al., 2020). Situated learning theory holds that learning occurs in specific scenarios, and connecting mathematics with real life helps students understand knowledge meaningfully. Cooperative learning can promote peer interaction and enable students to learn from each other. Differentiated instruction respects individual differences and allows each student to experience success.

In China, although scholars have emphasized student engagement, most research remains theoretical or focuses on single strategies, lacking systematic classroom-based case studies—especially under the Double Reduction policy. Many studies stay at the level of theoretical discussion and lack practical teaching cases and long-term intervention effects. In addition, few studies combine the characteristics of large-class teaching in China to design targeted strategies, resulting in limited practical guiding value.

2.3 Research Gap

Existing literature has two major limitations. First, most Western studies are based on small-class environments and may not fit Chinese large-class settings. Class sizes of 45–50 students are common in Chinese urban primary schools, which puts forward higher requirements for the organization and implementation of teaching strategies. Second, domestic studies lack in-depth, process-oriented case evidence, reducing practical operability for frontline teachers. Most studies only focus on whether strategies are effective, but rarely explain how to implement, what problems may be encountered, and how to adjust and optimize. This study addresses these gaps by investigating strategy implementation in authentic primary mathematics classrooms.

3. Research Methodology

3.1 Research Design

This qualitative case study used a non-randomized controlled design. Case study is suitable for exploring “how” and “why” problems in real scenarios, and can obtain in-depth and detailed data. This study took two complete classes as research units to ensure the authenticity and integrity of the teaching process.

We chose this design because it lets us explore the phenomenon deeply within our specific context. The trade-off is clear: we cannot statistically generalize what we find to larger or different populations. Participants were two parallel fourth-grade classes in a public primary school in Jinan, Shandong Province. The two classes were taught by the same mathematics teacher, which excluded the interference of teacher factors on the experimental results. Class A served as the experimental group using optimized strategies; Class B served as the control group using traditional teaching. The intervention lasted 12 weeks, covering four mathematics instructional units: fractions, area, four arithmetic operations, and statistics.

3.2 Participants

The school represented typical urban public primary education with large classes (45–48 students). The regional economic and educational development level was medium, which had good representativeness. The two classes showed no significant pre-intervention differences in academic performance, cognitive level, or classroom climate. The pre-test results of mathematics scores were tested by independent samples t-test, and there was no significant difference ($p > 0.05$). Both mathematics teachers had more than five years of professional teaching experience, had obtained senior teacher professional titles, and had rich teaching experience.

3.3 Data Collection

Data came from three sources, each collected systematically. Protocols guided every stage, and we maintained consistent timing across all four.

1. Classroom observations: Non-participant observations recorded active participation, off-task behaviors, interaction frequency, and task completion rates. Each class was observed 2 times per week, and 48 observations were conducted in total. The observation records were sorted out in time after class.
2. Student interviews: Semi-structured interviews were conducted at Weeks 4, 8, and 12 with 10 students per class at high, medium, and low achievement levels. Each interview lasted 15–20 minutes, and the content was recorded and transcribed.
3. Teacher reflective logs: Weekly records of strategy implementation, challenges, and adjustments. A total of 12 reflective logs were formed, recording detailed information such as teaching design, student performance, and effect feedback.
4. Learning artifacts: Classroom assignments, performance data, and learning feedback documents. These materials provided objective evidence for analyzing students' engagement and learning effects.

3.4 Data Analysis

Data were organized, coded, and analyzed using NVivo 12 qualitative software. Thematic analysis was used to analyze three-dimensional engagement. First, two researchers independently conducted open-coding on the transcribed data to extract initial concepts; discrepancies were resolved through discussion to enhance reliability; then, axial coding was carried out to categorize the concepts; Cross-group comparisons and methodological triangulation (observation, interview, reflective logs, artifacts) were applied to ensure the reliability and validity of the analysis. Data from observation, interviews, and reflective logs were mutually verified to improve the credibility of the research results.

3.5 Ethical Considerations

The study obtained approval from school administrators, teachers, and parents. All participation was voluntary. Students and their parents were informed of the research purpose, process, and rights in advance. Data were used solely for academic research, and all identities were anonymized to protect personal privacy.

4. Instructional Strategy Design and Implementation

4.1 Life-Based Situational Teaching

This strategy connects abstract mathematical concepts to daily experiences, reducing the cognitive load of students and enhancing learning interest. Primary school students are in the stage of concrete operational thinking, and they are more receptive to intuitive and vivid knowledge. Life-based situational teaching transforms abstract mathematical symbols and formulas into real-life scenes that students can contact every day.

For example, fractions were taught through snack sharing and stationery measurement; area was taught by measuring desks, blackboards, and classrooms; and four operations were applied to shopping and pocket-money budgeting. Teachers created situational problems such as “how to divide cakes equally” and “how to calculate the cost of stationery” to guide students to think mathematically.

Teachers posed real-life mathematical problems to stimulate curiosity, guided exploration within authentic contexts, and supported students in applying knowledge to solve practical problems. This approach reduced learning difficulty and increased student interest. Students no longer felt that mathematics was far from life, but realized that mathematics was everywhere and could be used to solve real problems.

4.2 Small-Group Interactive Cooperative Learning

Students were assigned to heterogeneous groups of 4–5 (high/medium/low achievement). Heterogeneous grouping ensures that students with different levels can help each other, avoiding the polarization of homogeneous grouping. Clear roles—recorder, presenter, checker, and discussant—ensured full participation. Each student had clear responsibilities, which effectively prevented “free-riding” behavior.

Teachers provided real-time guidance, followed by group presentations and peer evaluation. During group activities, teachers walked around the classroom to answer questions and guide the discussion process. After group cooperation, representatives were selected to share results, and other groups evaluated and supplemented. This structure expanded opportunities for verbal participation and reduced passive listening. Students learned to express their own opinions and listen to others' ideas, improving communication and cooperation skills.

4.3 Hierarchical Task Design

Tasks were divided into three levels to meet the learning needs of students with different foundations: basic tasks for all students (foundational knowledge and skills), enhanced tasks for middle-to-high levels (knowledge application), and innovative tasks for advanced students (creative problem-solving). Basic tasks focus on mastering core knowledge, enhanced tasks emphasize the application of knowledge, and innovative tasks cultivate divergent thinking and innovation ability.

Students selected tasks matching their ability levels, and teachers provided personalized feedback to foster confidence and success experiences. Low-achieving students can successfully complete basic tasks and gain a sense of accomplishment; high-achieving students can challenge innovative tasks and develop their potential. The control class used traditional whole-class teaching with unified tasks and no situational or cooperative design.

5. Results

After 12 weeks of intervention, descriptive and comparative evidence showed that the experimental class demonstrated relatively elatively higher behavioral, emotional, and cognitive engagement than the control class. The data from observation, interviews, and assignments all showed consistent results.

5.1 Behavioral Engagement

Active participation increased from 18 to 39 instances per class (+116.7%). Off-task behaviors decreased by 72.3%. The frequency of students leaving their seats, chatting, and doing small movements was significantly reduced. Task completion rate was 96.2% in the experimental class and 78.5% in the control class. Students maintained attention longer and volunteered more frequently to answer questions and participate in activities.

In classroom observation records, students in the experimental group took the initiative to raise hands, participate in group discussions, and complete tasks carefully. In contrast, students in the control group were more passive, with more inattentive phenomena and low task completion quality.

5.2 Emotional Engagement

A total of 87.5% of experimental students reported that mathematics class was interesting and enjoyable, compared with 32.5% in the control group. Mathematics anxiety decreased significantly; students preferred real-life tasks and group work and expressed greater pride and confidence. In interviews, many students said that they looked forward to mathematics class and no longer felt that mathematics was boring and difficult.

Students' emotional experience was significantly improved, which further promoted their participation in classroom activities. Positive emotions formed a virtuous cycle with learning behavior, making students more willing to invest in mathematics learning.

5.3 Cognitive Engagement

Experimental students showed deeper thinking, independent reasoning, and persistence with challenging tasks. They could put forward different solutions and reflect on their own learning process. Control students relied heavily on teacher explanation, lacked exploratory spirit, and struggled with complex problems. The experimental class also exhibited a more positive classroom atmosphere and stronger learning motivation.

In terms of homework and test performance, the experimental group not only had higher accuracy but also more diverse problem-solving methods, reflecting higher-level cognitive participation.

6. Discussion

6.1 Effectiveness of the Strategies

Situational teaching, cooperative learning, and hierarchical task design appear to effectively improved student engagement, consistent with international findings (Appleton et al., 2008; Campbell et al., 2020). These methods align with children's cognitive development rules, shift instruction from teacher-centered to student-centered, and stimulate intrinsic motivation. Life-based scenarios reduce abstraction, cooperative learning enhances interaction, and hierarchical tasks respect differences. They are feasible in large-class settings without specialized equipment. Teachers do not need expensive teaching tools; they only need to optimize teaching design, which has strong promotion value. This is particularly important for most ordinary primary schools in China and the Asia-Pacific region.

6.2 Challenges and Optimization

Challenges included over-reliance on peers in group work, avoidance of advanced tasks by low-achieving students, and limited teacher attention in large classes. Individual students in group work depended on others to complete tasks, and some students were unwilling to challenge difficult tasks.

Optimizations include clarifying group roles, encouraging progressive task attempts, and implementing peer tutoring and after-class support. Teachers should strengthen individual guidance, establish a supervision mechanism for group cooperation, and set up progressive task paths to help students gradually improve their difficulty.

6.3 Implications for Asia-Pacific Mathematics Education

The findings may be applicable to other Asia-Pacific regions facing large classes, exam pressure, and low student engagement (e.g., South Korea, Japan, Southeast Asia). These regions have similar educational culture and classroom environment, and the strategies in this study can be adjusted and applied according to local conditions. Localized adaptation can support improvements in mathematics teaching quality and student engagement across the region.

7. Conclusion

7.1 Research Conclusions

Within the context of this case study, Life-based situational teaching, small-group cooperative learning, and hierarchical task design are associated with improve behavioral, emotional, and cognitive engagement in Chinese primary mathematics classrooms. They tend to reduce off-task behaviors, enhance interest and confidence, and improve instructional efficiency. These strategies are practical and scalable in large-class settings and provide promising solutions for improving teaching quality under the Double Reduction policy.

7.2 Limitations

This study was conducted in one urban primary school; thus, findings may not generalize to rural schools and other grades requires further verification. The 12-week intervention limits conclusions about long-term effects. Given the small sample and qualitative design, causal claims cannot be made from this study. Future large-scale quantitative studies are recommended to verify the universality of the results.

7.3 Future Research

Future research may expand to rural schools, cross-grade and cross-subject comparisons, long-term impacts on academic performance and core competencies, and integration with AI and digital tools to support smart education in the Asia-Pacific region. With the development of educational technology, the combination of digital means and engagement strategies will become an important research direction.

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

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The “SPOC + mobile platform” Blended Teaching Model in College English in the Context of Sino-Foreign Cooperative Education Exploring Optimization Paths for Oral English Teaching—Taking Xianda College of Economics and Humanities Shanghai International Studies University as an Example

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Abstract: The model of “SPOC+mobile platform” blended teaching is being actively used in oral English instruction nowadays, and this leads to additional shifts in oral teaching. The paper uses the example of School of International Education, Xianda College of Economics and Humanities Shanghai International Studies University, a Sino-foreign Cooperative Education School to examine the implementation of “SPOC+ mobile platform” model that is hybridized and promoted by Sino-foreign cooperation education in the reform of oral English teaching in colleges. The paper, which adopts the case analysis approach, and bilingual personnel arrangement and student cross-culture characteristics in School of International Education of Xianda, SISU, provides a deep analysis regarding its localization. It suggests that the competency of spoken English, as well as inter-cultural communication, in the students, can be enhanced with the help of this mode of practice in order to make the educational quality and the learning process effective and optimize the instructing approach and improve it further. It is hoped that the new teaching mode could have a positive effect on the oral teaching reform in future English of Sino-foreign cooperative education program.

Keywords: SPOC+Mobile Platform; Blended Teaching Model; Sino-Foreign Cooperative Education; College Oral English Teaching

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1. Introduction

Over the past few years, the accelerated globalization trend in higher education has put unprecedented demands and stringent requirements on the English oral competence of the students in the Sino-foreign cooperative education programs. Thus, the existing models of oral English teaching are not sufficient to cope with the issues of large gaps between the English backgrounds of students and poor cross-cultural communication abilities. The School of International Education, Xianda

College of Economics and Humanities Shanghai International Studies University is a key institution in the internationalization process of the university dedicated to the development of international talents. The college also has a training model of 3+1 and 2+2, where students study in dual Chinese and English academic status in their home institutions based on use of original textbooks and small classes teaching in English or bilingual formats. Since 2005, more than 2,200 graduates have gone on to study at foreign institutions with the majority of them going on to undertake their studies at the masters or doctoral level. They have also collaborated with the leading international universities by offering specialized courses like business and art design which have provided a diversified route to higher education. Nevertheless, the university also faces various challenges in its development, such as the significant differences in students' language proficiency and insufficient cross-cultural communication skills in English oral teaching.

Reformation of college English oral teaching in the Sino-foreign cooperative education under globalization background must constantly adapt to the new needs of internationalization. The current paper will discuss the path of optimizing Sino-foreign joint education of English oral teaching by conducting a detailed study of English oral teaching practices in Xianda's School of International Education. SPOC online course is a small-scale course run by a private group. It can overcome the drawbacks of teaching in large classes because of its benefits of accuracy and customization. The mobile learning platforms will be able to introduce additional opportunities of language output practice that can overcome the time-space barriers through the application of the timely feedback and simulation of the scenarios. The organic combination of the merits of online and offline learning can not only enhance the present condition of inadequate input and small output prospects of students in oral English teaching, but also give new horizons and new ways of fostering internationally competitive compound talents, and can also be replicated and scaled solutions to other similar institutions.

2. Literature Review

Conventional university English teaching often focuses on conveying knowledge of the English language while neglecting the cultivation of English application skills. Nonetheless, the Guidelines for College English Teaching (2020) clearly states that English teaching in the university is supposed to focus on the development of the English application skills, which is the skills to communicate and interact in English in learning, in everyday life, and in the workplace. Thus, the development of English oral skills is one of the major areas of university English teaching reform.

Conversely, the comprehensive advancement of information technology in the education sector has steadily rendered the model of blended teaching SPOC (Small Private Online Course) + mobile platform a major focus in the future educational change. The model has huge benefits in Sino-foreign cooperative education and language teaching since it combines both online and offline resources and streamlines the teaching processes. It also gives a new direction of change in the traditional education transformation. The following is a systematic review and analysis of relevant research:

2.1 "SPOC+ Mobile Platform" Blended Teaching Model.

A course format that was initially suggested by Armando Fox, a professor at the University of California Berkeley, is called SPOC (Small Private Online Course). It seeks to support the issue of low completion rates even after a big number of users in MOOC (Massive Open Online Course). It has entry barriers and a restricted number of students, which provides it with accurate teaching and has evolved into a fairly advanced blended learning platform. Over the last few years, as mobile internet has become popular, the education sector is also pursuing the profound combination of SPOC and mobile devices, taking advantage of the convenience and interactive nature of mobile devices to create an online-offline fusion, eliminate barriers to time and space, and slowly create a learning environment that can be accessed at any place, anytime. Students are more inclined towards self-directed learning in real-time and process-oriented feedback.

Existing studies on SPOC center primarily on two dimensions teaching model construction and teaching practice. To illustrate, the subject of the application practice of the design principles of the teaching model in the design of the course through the use of the teaching model by Taylor was elaborated by Jin Chengda (2023), who thought that the design of the multimodal oral practice activities is appropriate in terms of organization and implementation using the blended online and offline teaching structure. As another example, Hao Bei and Liu Ruifei (2022), using the practice of Xi'an Railway Vocational and Technical College as an example, on the reform of Russian teaching based on SPOC and cloud classroom, they not

only completed the cooperation between Chinese and foreign teachers but also processed data analysis tools to understand the progress of the students, and it has a quantitative foundation of cultivating the cross-cultural compet. Despite the active attempts to incorporate new models in teaching activities at many universities, applied courses in humanities and practical courses in science are the most common ones, and the research on teaching English remains insufficient. The new model of blended learning, which involves SPOC and mobile technology, is only at the exploration phase and requires continued enhancement in practice to suit the requirements of different teaching scenarios. We must keep on investigating the functions and roles of this new model in the future, fully utilize its benefits, consider the optimization of resources, enhance information literacy of teachers. Meanwhile, individual differences among students should also be considered, and effective actions should be taken to reduce academic performance polarization, and promote the in-depth development of educational and teaching reforms.

2.2 The Special Benefits of the Sino-Foreign Cooperative Education of “SPOC + Mobile Platform”.

The existing problems that the Sino-foreign cooperative education programs frequently experience include cross-cultural communication, cooperation between the faculties, and variations in the teaching standards. As an illustration, Sun Wenxue (2023) used the example of Jilin University Lambton College, examined the pros and cons of faculty development in Sino-foreign cooperative education under the conditions of digitalization, and discussed how the teacher community can be established. To address the above issues, the solution is “SPOC + mobile platform”. First, the cloud resource library can effectively coordinate the course materials of the Chinese and foreign teachers so that there is continuity of course content. Secondly, mobile devices contribute to real-time working and asynchronous discussions that serve to overcome communication barriers due to geographical and time differences.

2.3 The Benefits of Teaching a Language through the Application of “SPOC + Mobile Platform”.

This blended learning approach is especially beneficial in language lessons, because it has the potential to produce a language immersion environment. As an illustration, it can utilize mobile terminals to deliver listening resources, speech recognition training packages, or AI-powered human-computer dialogue oral mock tests to realize breakthroughs in the listening, speaking, reading, and writing skills. Moreover, based on the data on student learning behavior obtained on the platform (the number of video replays and video hotspots, the distribution of error rates in exercises, the time of maximum activity of access, etc.), teachers can make specific changes to the learning status of students. In their practice in English classes, Liu Xiaoyan and Chen Zhan (2024) demonstrated that this model much enhanced the participation and confidence of students due to the effective use of fragmented time and the formative evaluation system involving the timely feedback mechanisms. Li Xiaoyu and Li Lie (2021) suggested to increase the confidence of students in expression and language accuracy over time through micro-lesson tiered instructions and AI speech correction methods in order to correct the low rate of students speaking.

The adoption of the model of the “SPOC + mobile platform” is also based on the enhancement of information literacy among teachers, the optimization of the technical support system, and the development of the self-directed learning skills in students. The next steps in the field of exploration are the creation of intelligent algorithm-based personalized recommendation systems and the application of the virtual reality technology to the simulation of the language context. Concisely, “SPOC + mobile platform” is also shifting the scale to quality (personalization), which introduces new horizons in the balanced development of globalized education.

3. Case Study of Oral English Teaching Practice on “SPOC + Mobile Platform” at the School of International Education, Xianda College of Economics and Humanities Shanghai International Studies University.

The new model of the Sino-foreign cooperative project of Xianda College of Economics and Humanities Shanghai International Studies University, “SPOC + mobile platform” has also had a great impact on enhancing the English speaking ability of students. With the small and compact features of online courses that SPOC provides, educators develop brief video clips on different subjects (such as life and business every day), and the students are able to view them at any time and anywhere through the mobile platform without having to deal with time and space constraints. The classroom is made a communication

and interaction space. Students will be able to be confident and speak fearlessly through the structure of group discussions, mock performances, and individual presentations. The immediate feedback given by the interaction on the platform also enables the teachers to know the students and attain individualized teaching. Such a combination of online and offline instruction not only contributes to the constant increased autonomy of the student, but also allows them to gain oral communication skills and cross-cultural competencies in practice and prepares the foundation of further learning and professional growth in the global context. Special details of implementation are the following:

3.1 Teaching Model Design

3.1.1 Online Teaching Components

Learning resources on the SPOC platform are micro-lecture videos, audio files, online tests, and discussion forums. Online learning and discussions allow learners to study on their own and teachers can also track the learning process of the students, respond to their questions promptly and also give them personalized instructions.

At this moment, those online teaching materials utilized in the college in teaching oral English are mostly courseware and pre-class preparation materials like the links of micro-lessons and they are shared via QQ groups. QQ group is a convenient and stable system with a high capacity making it suitable to use it to publish and store courseware and to trace the information which is why it is well suited to group operation. This system has been operational in the college over the years and is better than WeChat. Second, based on the Chaoxing Learning Platform and the introduction of the SPOC teaching model in the courses of English reading and writing by Liu Yanlin (2018), the oral English teaching and research group has integrated SPOC and mobile platform in the oral English teaching. As an illustration, the current online platform utilized in the gathering of online works of students is Chaoxing Learning Platform. The first-year students will have to showcase a single video work per semester (interview videos, introductions to scenic spots, dubbing works, etc.) and will be able to use the Learning Platform software to upload large video attachments with the help of a QR code scanner, which is quite convenient when it comes to the tasks that require high standards of listening and speaking in oral English. The teachers are able to post tasks and receive assignments in regard to the time nodes and simultaneously, mark and summarize in regard to the pre-established online scoring criteria. Oral English group are now enjoying this software enormously in receiving mid-term and final assignments, which does not only enhance the work efficiency to a large extent, but also acts as an archive when it comes to classifying and storing assignments. Third, the application of the software Learn While Lying Down. According to the profound elaboration of the “SPOC + mobile platform”, the college started to consider a model of blended online and offline teaching officially in the second half of 2024. The school and the creators of the online software program decided to create an online learning pilot area because the first-year language students need to attain IELTS scores before they can enroll in their second-year major courses. This area tracks the time the students are studying, where they are making errors that they are concentrated on, and they also give timely feedback. Students will be able to modify their learning according to the real-time feedback, and teachers will be able to assist more precisely. Also, online learning software updates the IELTS speaking question bank on real-time and offers online AI digital speaking mock tests, which have been shown to significantly increase the IELTS speaking scores of students.

3.1.2 Offline Teaching Components

① Oral English Teaching Practice.

Teachers arrange similar practical assignments in the classroom offline in accordance with the progress of the online learning experience of the students, including group discussion, role-plays, and individual presentations. At the same time, timely interaction and feedback in the classroom is carried out by using mobile platforms, e.g., real-time voting and surveys via the Wenjuanxing software, or online random attendance checks via the Xuexitong software, to enhance student participation and learning motivation.

Beyond the classroom, the college offers students numerous practical activities, including internal international cultural festivals, international study abroad exhibitions, speech contests, dubbing competitions and vocabulary competitions. An additional innovation was done on the English Activity Practice Week, May 2025, which was successful hosting the competition writing poems in the garden, speech contest telling Chinese stories in English. The contesting was done on the basis

of points; to pass, the students were required to finish three challenges of English activities in a week. The day of the event was completely booked in all activities and competitions and the students were very much involved and excited. At the same time, with the help of the various cultural resources on campus, lectures on Chinese culture and Western culture, international food festivals were organized, and students were able to encounter and use English in their daily lives, which enhanced their language abilities in an unconscious manner. Another thing that is promoted in the school is that students should identify language partners in different activities and strive to achieve their goals and make steady progress. Outside the school, students are also proposed to engage in different kinds of competitions, including business English challenges and English speech contests, which encourages learning and competition, and thus learning and combining learning and competition.

② Oral Examination Practice

Various Oral Assessment: The oral examinations of the college are set with varying examination plans depending on various teaching purposes. To reach the IELTS language score criteria in order to be admitted to the university, two IELTS Speaking Mock Tests are organized in the first semester in an assessment plus feedback model in the first-year language courses. Each student has a special experience in preparation, which is offered by a one-on-one appointment system with a Chinese or foreign teacher. The mock exams are based on the standard procedure of the Speaking test of IELTS. The question bank comprises of well chosen questions in the question bank of this year IELTS Speaking that include various topics including introduction of self, questions and answers and discussion of the topic. The purpose is to guide the students to become very conversant with the format, content and grading standards of the IELTS test, which forms the basis of further IELTS preparation. Given the soundproofing and privacy needs of the IELTS Speaking test, the research team chose classrooms properly and ensured that they were well-lit so that the test could be administered in a quiet and uninterrupted environment. The classes are large and well-lit just like the speaking test rooms of the majority of IELTS test centers that recreates the real-life testing environment as closely as possible to the students. Moreover, the mid-term and final preparation and scoring of the mock tests allow the students to contemplate their progress and work towards improvement.

Oral English teaching of the second semester is based on the theme of Planning. Various activities and evaluations are built around three dimensions including personal development, academic development and career development. As an example, self-awareness part of personal development will involve in-class quizzes or case studies, e.g., personality type tests, learning style tests, case studies involving how to organize banquet seating depending on personality and career information. The midterm exam is a personal presentation about the subject of the introduction of desirable universities in the academic development trend. Students are required to gather and compile university information in advance, and subsequently introduce the university wholesomely, why they have selected the university, and the plans. This assists students to have time planning, understand important points and learn. The last test is the group presentation on the subject of business planning in the career development direction. Students will be grouped to show in English how to open a store, or how to assist a company with a meeting place or to select appropriate candidates to a given position under a given situation. The preparation process requires that students keep in touch with the group members and keep on progressing, which also serves to enhance their overall skills, including, but not limited to, teamwork, oral expression and time management.

Clarity of Scoring Criteria: The speaking research team follows the scoring criteria strictly, where students are rated in various dimensions such as fluency and coherence, vocabulary and grammar, pronunciation and intonation, content structure, and communication skills. Scoring criteria provide a way of teachers to evaluate the levels of students talking objectively and fairly, in particular, balance when several teachers do the assessment. The teachers who will be in charge of the assessment will ensure that they give students a detailed feedback after the exam highlighting their weak and strong areas and give them suggestions on how to improve. This feedback is timely and effective to make students objectively assess their oral performance, to understand their further direction, and to improve their learning outcomes.

3.2 Teaching Organization

In recent years, the English teaching at School of Xianda International Education has gained valuable experience in the following aspects of teaching management which have benefited all subjects such as listening, speaking, reading and writing. Its input in the reform of English oral instruction is predominantly in the form of real time and targeted nature of online practice,

the timeliness of feedback, the collaborative lesson planning between Chinese and foreign teachers, and the professional oral English orientation.

3.2.1 Differentiated Teaching Strategies

The Sino-foreign cooperative education program based on the blended learning model of the “SPOC + mobile platform” applies a tiered teaching system with reference to the level of students. The resources available in the system, including case studies and course videos, are allocated to different levels. The mobile platform allows students to learn anytime, anywhere, whereas teachers can check student learning data and make changes to their teaching strategies. This design will eliminate the restrictions of time and space, serve a variety of students' needs, open up their potential, and help them learn effectively, excel, and gain out of their learning. This practically enhances the quality of teaching and the efficiency of international talent development, which will make the cooperative education reach another level. At the same time, offline teaching is also stratified and divided according to the levels of students and offers specific advice. As an illustration, separate students by class and class, the more difficult content is offered to those students, who have already acquired IELTS scores, and those students, who have already not received any scores, are able to analyze their strong and weak points, develop confidence and gradually improve.

3.2.2 Elite Mentorship System

The School of International Education implements the mentorship system, with the help of one teacher, who mentors a group of students usually 20-30 students, and communicates and guides them regularly. This also assists the teachers in a better way to monitor the learning progress of each student, giving individual guidance and feedback on time, thus enhancing the teaching effectiveness. This is ideally consistent with the small-scale concept of SPOCs.

3.2.3 Cooperation between Chinese and Foreign Teachers.

International Education College of the school has oral English classes in which Chinese and foreign teachers teach together. All-English classes in different subjects are assigned to foreign teachers, and bilingual classes in the preparation of the English pronunciation and IELTS speaking test are offered by the Chinese teachers. There are substantial benefits of this complementary and collaborative teaching model. Through their natural language production, foreign teachers can assist students to learn the native pronunciation and learn the real local culture. By learning the knowledge base and learning peculiarities of Chinese students, Chinese teachers can work on the weak aspects of these students in particular. The classes with foreign teachers are easy and playful, whereas the classes with Chinese teachers are strict and thorough: they support each other and develop students in terms of language proficiency and cultural literacy.

3.2.4 Professionally Oral English Tasks.

Taking the “3+1” SQA AD program at Xiandan, SISU and as an example, the first year of the program focuses on language courses, while the second and the third year are dedicated to professional courses. Given a higher language requirements for students going abroad in the future, the “SPOC + mobile platform” gives a new prospect of professionally oriented oral communication activities. The nature of each major can be used to customize course content and students can preview the content repeatedly through watching micro-lecture videos and could also practice interactively at any time and location on the mobile platform. As an illustration, a business major introductory course can have a simulated business negotiation activity, where students post videos on the platform, and the teachers leave timely comments and feedbacks. The platform also allows students to work in groups and use fragmented time to discuss and refine their work. This model not only helps in the self-directed learning of students but also helps them to apply professional knowledge in oral expression in real-life situations.

3.3 Teaching Process Restructuring

The article by Xia Bing (2023), *A Study on the SPOC Blended Teaching Model of College English Based on the Learning Platform of the “U Campus”*, reveals how a digital platform can be used to provide complete process management of the pre-class preparation, in-class cooperation, and post-class consolidation. The group presentation and the online exams among others have direct reference value in developing the oral expression skills. The detailed practices of Xianda College in this regard are as:

3.3.1 SPOC Self-directed Learning (pre-class).

Teachers make pre-class preparation materials available before classes on QQ or Learning Tong platform, such as micro-lessons, courseware, and exercises. With the tasks posted by the teacher, students define what they are expected to learn, prepare, and engage in classroom works. As an example, the students may post in advance their questions in the activity discussion section, and teachers may decide to respond online or offline according to the situation on the ground. Such a method of pre-learning and post-teaching is more specific and allows focusing on the main and problematic aspects of teaching.

3.3.2 In Class: Task-Driven Classroom.

The platform can be used during class by the teachers to provide answers to frequently asked questions, brainstorming and thematic discussions on the important contents, etc., to enhance the effective learning of important and challenging knowledge among the students. This step will help students to clear up the points of knowledge, expand their thinking in solving problems, and be able to think and summarize what is taught in the classroom, which is quite helpful in enhancing classroom effectiveness.

3.3.3 Post class: Mobile Platform Extension Exercises.

Teachers give online homework after the classes according to the teaching content. As an example, the teachers of oral English will be able to use the mobile platform known as the Learn While Lying Down to set homework like vocabulary check-ins, oral English mock tests, and practice with the question bank based on the real demands of the group. This m-based platform will be able to not only support practice on the part of students, but it will also be able to offer learning progress recordings. The platform allows teachers to see the real-time records which will give them an opportunity to motivate excellent students immediately and, at the same time, to issue certain warnings to students with poor underpinnings and take necessary steps so that they can accomplish learning tasks by themselves, thereby enhancing the performance of after-class teaching.

3.4 Evaluation System Reform

3.4.1 Process-Oriented Evaluation Mechanism

The process-oriented assessment mechanism largely embraces various assessment strategies, that is, formative evaluation, summative evaluation, and dynamic evaluation. Formative assessment is aimed at looking at how students perform in the process of learning oral language on a daily basis, which include class attendance, performance in group activities, activities to practice language, and assignment completion. Formative evaluation will allow comprehending the learning status of students on time, detecting and resolving any problems, and enhancing the consistent and productive learning of students. Summative assessment mainly relies on examinations in order to verify the overall performance of the students upon learning spoken English. Summative assessment enables more objective and fair assessment of student grades as well as offer students some opportunities and platforms to demonstrate their learning outcomes. Dynamic assessment is more of a continuous adjustment and the evaluation content is reviewed in the midst of the teaching process and adjusted accordingly where necessary depending on how learning is progressing and the teaching situation. Dynamic assessment is concerned with the modification of student learning requirements and teaching goals, which is effective in enhancing the relevance of learning. Indicatively, in the spoken English course of the college, the final grade is 60 percent exam based and 40 percent coursework which is of great importance. Extracurricular projects can be used as a valuable source of the coursework grade, including dubbing, making videos that narrate Chinese tales in English, and attending AI-selected spoken English tests. Learning potential of students is aroused by various explorations, interest in learning spoken English is developed, and deeper learning is attained that will eventually enhance the results of learning.

3.4.2 Multiple Evaluation Subjects.

The evaluation subjects are also diversified, not only are the methods of evaluation diversified. First, being the primary source of oral assessment, teachers may provide full-scale assessment according to the classroom performance of students, the completion of their homework, and their academic performance, which enables the teachers to get to know the whole picture of the situation of the students and quickly find and resolve the issues. Second, the students are promoted to perform self-assessment, which will lead to the reflection and summarization of the acquired knowledge with the help of online and offline sources and platforms. Student self-assessment may enhance students autonomy and self-management skills and may

also assist students to be able to clarify their learning objectives and directions. Third, there is peer evaluation, classroom discussions, and speech contests, which enable students to assess each other and gain experience on the basis of other students. The peer evaluation allows the development of the language expression and evaluation skills of the students, their awareness of collaboration and teamwork spirit. Fourth, foreign instructors are invited to take part in oral tests. The work experience and language proficiency of the foreign teachers in Xianda College is strictly vetted. The inclusion of foreign teachers to oral assessment enables the assessment of oral proficiency of students based on various aspects, such as language authenticity, the cultural connotation, and cultural literacy. The assessment of foreign teachers offers students more global outlook and professional language instructions, which also help to enhance the oral skills.

3.4.3 Use of Intelligent Assessment Tools.

The intelligent technologies used in the college include Learning Pass, Learn While Lying Down, and iFLYTEK, which are used to capture the online oral performance of students accurately. A typical example is the ability to analyze pronunciation, fluency, vocabulary, and grammatical accuracy in real time during practice and simulations with the help of the “Learn While Lying Down” platform and rapidly produce detailed evaluation reports. Students will have access to real-time feedback through online and offline means and clearly know their strengths and weaknesses and hence improve in time. The fact that Chaoxing Learning Platform continued to be used since 2020 and the mobile platform Learn While Lying Down was used in the 2024-2025 academic year is a full indication that this model can overcome the constraints of time and space, effectively assist in improving spoken English, and make education and learning more scientific and effective.

4. Recommendations to the Optimization of the English Oral Teaching in “SPOC + Mobile Platform” Blended Teaching Model

The optimization in the blended teaching model of “SPOC + mobile platform” can be practiced in various perspectives to enhance the quality of oral teaching in English.

First, the reinforcement of teacher training is of interest. Frequent professional training may be offered to motivate teachers to thoroughly investigate SPOC theory and technology, how to create interactive activities based on the real features of students, and constantly enrich the information technology application skills and teaching design and guidance skills of teachers.

Second, it is unavoidable to enrich the functions of the teaching platform and thoroughly integrate digital technology. As an illustration, inclusion of online pronunciation test and immediate feedback on pronunciation issues; virtual reality, like ordering food, airport customs, and hotel front desk environment, which make the scene look first-person, enhancing the level of simulation and enhancing fun and effectiveness; team functionality, introducing a set of configurations that allow the students to practice in a group.

Third, teaching students how to be self-directed learners. By mentoring and inspiring students to create their own learning plans, using every possible fragmented time to read aloud and imitate, training them to adjust to blended learning better.

Fourth, develop teaching content and forms. The cross-cultural factor can also be injected into the design and implementation of the “SPOC + mobile platform” blended teaching model, considering the nature of Sino-foreign cooperative teaching, and produce more teaching material based on international exchange. Simultaneously, different types of implementation may be utilized, including simulated conferences, cross-cultural exchange activities, and various assessment strategies, to make most out of online and offline blended teaching and leave students with more practical application skills.

Finally, consider school implementation avenues. Indicatively, a Sino-foreign teacher collaborative SPOC studio can be set up to enhance the collaborative lesson planning between Chinese and foreign teachers. In the meantime, the profession-oriented oral English lesson can be reinforced further, e.g., additional case analysis and discussion in English can be introduced among business majors.

5. Conclusion

To conclude, the “SPOC + mobile platform” is efficient in integrating the online and offline teaching materials, breaking the time and space constraints of traditional education classes, offering students more diversified learning materials and tailored learning experiences, addressing the special needs of English oral teaching in the programs of Sino-foreign cooperation

education, and is more favorable to arousing the learning enthusiasm and initiative of students. In the case of English oral teaching in the School of International Education, Xianda College of Economics and Humanities Shanghai International Studies University, the analysis of the case involving English oral teaching shows that the optimization of the English oral teaching in Sino-foreign cooperative universities is primarily associated with the accurate positioning and orientation, innovation and diversification of teaching models, the adoption of differentiated teaching strategies, training of teaching personnel, extension of extracurricular. Such measures can not only contribute to enhancing the ability of students to express themselves in English orally and communicate across cultures, but also enhance the overall quality of the student in a professional sense and nurture complex talents with global competitiveness.

Nevertheless, this model has certain problems to practice, including the necessity to enhance the information literacy of teachers, the necessity to enhance the teaching evaluation process, deficiency of technical equipment, and disparities related to the self-learning capacity of students. However, the most common theme in the future teaching reforms will be blended learning. This means that we should follow the evolution of the educational technology, constantly streamline the teaching models, e.g. augment the training of the teachers, the services of the digital platform, the monitoring records of self-learning of students, the enrichment of teaching materials and the provision of a reasonable and adequate evaluation system. With concerted efforts, this model of teaching can contribute more to the Sino-foreign cooperative education programs, raise more talents who have international perspectives and competitiveness, and bring the internationalization of my country higher education to a new stage.

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Research on the Reform of BIM Experimental Teaching Based on the OBE Teaching Philosophy: A Case Study of Chengdu Technological University

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Abstract: Based on the Outcomes-Based Education (OBE) philosophy, this study systematically reconstructs the BIM experimental teaching system in response to the new demands placed on engineering cost professionals by the intelligent transformation of the construction industry. Traditional teaching models suffer from difficulties in interpreting two-dimensional drawings, fragmented professional knowledge, and a disconnect between theory and practice, making it challenging to support the training objectives of “digital cost engineers”^[1]. To address these issues, this research relies on a real completed comprehensive teaching building project, integrating architectural, structural, mechanical, electrical, and plumbing drawings, as well as quantity take-off lists, to construct a project-driven BIM virtual simulation experimental teaching platform. Three core reform measures were implemented: first, introducing real project resources to deepen the integration of theoretical knowledge and engineering practice; second, adopting a team-based collaborative learning model to enhance students’ organizational coordination and cross-disciplinary communication skills; and third, innovatively conducting a “three-calculation comparison” analysis among BIM model quantities, results from traditional measurement software, and manual calculations, aiming to cultivate students’ multi-dimensional verification and data-driven decision-making abilities. Teaching practice demonstrates that this model effectively improves students’ BIM technology application proficiency, problem-solving capabilities for complex engineering issues, and cross-disciplinary collaboration skills, providing a practical and replicable path for the systematic training of engineering cost professionals in applied undergraduate institutions.

Keywords: Outcomes-Based Education (OBE); Applied Undergraduate Education; BIM Technology; Experimental Teaching Reform

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1. Introduction

Against the backdrop of rapid development in the digital economy and smart construction, the informatization and digital transformation of the construction industry continue to deepen^[2]. Building Information Modeling (BIM) technology, as a key tool for managing the entire lifecycle of engineering projects, has extended its application from the design phase to cost estimation, construction, and operational management^[3]. This transformation imposes new demands on the knowledge structure and competency of engineering cost professionals. The traditional teaching model, centered on manual calculations and two-dimensional drawing interpretation, has become outdated. Cultivating “digital cost engineers” who possess technical

application skills, data-driven thinking, and cross-disciplinary collaboration abilities has become an urgent priority^[4].

The Outcomes-Based Education (OBE) philosophy emphasizes focusing on students' final learning outcomes and designing curricula and teaching processes in reverse, providing clear guidance for engineering education reform^[5]. Numerous scholars in China have implemented OBE-based teaching practices across various disciplines, validating its effectiveness^[6-8]. In the field of BIM education, existing research primarily focuses on software skill training or integrating BIM technology into single theoretical courses^[9-10]. However, there remains room for deeper exploration in systematically constructing an experimental teaching system based on real and complex projects, with an emphasis on cultivating students' multi-dimensional verification and engineering decision-making abilities^[11].

Therefore, this study, grounded in the training orientation of applied undergraduate education and guided by the OBE philosophy, first clarifies the core competencies required for cost professionals in the context of smart construction. It then designs teaching content and methods in reverse. By integrating real engineering projects throughout the research process and employing strategies such as resource integration, team collaboration, and "three-calculation comparison," this study systematically constructs and implements a new BIM virtual simulation experimental teaching system. The aim is to effectively address the shortcomings of traditional teaching and provide empirical references for the reform of engineering cost education.

2. The OBE Educational Philosophy and Its Instructional Guidance

Outcomes-Based Education (OBE) is an educational paradigm centered on student learning outcomes, characterized by reverse design and forward implementation^[12]. Its core principles include "clarity of focus," "expanded opportunities," "high expectations," and "reverse design"^[13]. In teaching practice, OBE requires educators to first define the competency goals students should achieve upon graduation, then design the curriculum, teaching content, and assessment methods accordingly, and continuously improve to ensure all students have opportunities to attain high-level goals^[14].

This philosophy has achieved significant results in teaching reforms across multiple disciplines in China. For example, Li Qingyi et al. applied the OBE model in medical nursing experimental teaching, enhancing its effectiveness and feasibility^[6]; Wu Zufeng et al. focused on engineering competency, fostering students' inquiry and innovation abilities through self-designed experiments^[7]; and Fang Bo integrated the OBE philosophy into the professional talent training program, reconstructing the curriculum system and strengthening students' initiative and practical innovation abilities^[8]. In the field of civil engineering and construction, Zhang Yanfang et al. constructed a BIM practical teaching framework based on the OBE-CDIO philosophy, effectively improving students' BIM application and comprehensive abilities^[15].

The above practices provide important references for this study. Guided by the OBE philosophy, this research first defines the core competencies required for digital cost engineers, such as BIM modeling, multi-source data integration, and cost analysis and decision-making. It then systematically designs the projects, tasks, and evaluation mechanisms for BIM experimental teaching in reverse, ensuring that the teaching process closely aligns with the final learning outcomes.

3. The Development Status and Value of BIM Experimental Teaching

3.1 Current Status of BIM Teaching Development

In response to national policies on construction informatization, universities in China have widely implemented teaching reforms integrating BIM technology into civil engineering and construction-related disciplines^[16]. Current practices mainly include integrating BIM with professional courses such as engineering management^[17]; incorporating BIM technology applications into courses like civil engineering drafting, architectural design, and steel structures^[18]; or combining BIM with graduation design to promote vertical connections among course knowledge^[19]. These explorations have yielded positive progress, but most still focus on theoretical teaching or single-skill training, leaving room for improvement in constructing a cohesive experimental teaching system centered on in-depth practice and competency verification^[20].

3.2 Core Value of BIM Experimental Teaching in Engineering Cost Education

First, it responds to the inevitable demands of industry digital transformation. In the context of smart construction, BIM skills have become essential for cost professionals. Experimental teaching must transcend software operation and focus on

cultivating data-driven cost management abilities^[21].

Second, it effectively addresses cognitive barriers in two-dimensional teaching. BIM technology, through three-dimensional visual models, concretizes and integrates abstract two-dimensional drawings and textual calculation rules, helping students intuitively understand spatial relationships and component connections in buildings. It also integrates professional information from architecture, structure, and MEP, solidifying the foundation of professional knowledge^[22].

Finally, it serves as a critical pathway for empowering data-driven decision-making abilities. BIM models are engineering databases rich in parameters. Experimental teaching guides students from “modeling” to “using models,” enabling real-time cost estimation, scheme comparison, and optimization using model data. This cultivates students’ data sensitivity and data-driven engineering economic decision-making abilities, which are core competencies for digital cost engineers^[23].

4. BIM Experimental Teaching Reform Strategies Based on OBE

To achieve the transformation from “software operation training” to “project practice and innovation capability cultivation,” this study implements the following three core reform strategies.

4.1 Integrating Real Project Resources to Build a Theory-Practice Integrated Teaching Platform

Guided by the OBE philosophy and with industry competency demands as the ultimate outcome goal, this study selects a completed comprehensive teaching building project from teachers’ horizontal research topics and integrates its complete real data^[24]. This forms a project-driven BIM experimental teaching resource library, and teaching is conducted in a virtual simulation laboratory. Students can engage with real engineering scenarios during their studies, combining theoretical knowledge with complex engineering practice. The modeling process, with physical references, significantly reduces drawing interpretation errors caused by insufficient spatial imagination^[25].

4.2 Implementing Team Collaboration Models to Enhance Comprehensive Professional Competencies

The teaching organization adopts project groups of 3–4 students, allowing free team formation and democratic division of labor^[26]. Team members are responsible for BIM modeling and quantity analysis of different modules, such as architecture, structure, and MEP, while the group leader coordinates overall efforts. Through regular technical seminars, model integration, and conflict resolution, the entire process simulates the collaborative mode of real engineering project teams. This effectively trains students’ soft skills, such as organizational coordination, cross-disciplinary communication, and project management, highlighting students’ central role in teaching^[27].

4.3 Innovating the “Three-Calculation Comparison” Method to Strengthen Multi-Dimensional Verification and Decision-Making Abilities

The core innovation of this reform lies in introducing the “three-calculation comparison” analysis. Students are required to obtain quantities for the same engineering component using three parallel methods: automatic extraction based on BIM models, calculations using traditional measurement software, and manual calculations strictly based on drawings^[28]. Subsequently, students are guided to conduct cross-comparisons and deviation analyses of the three sets of data, exploring the causes of differences and the advantages and limitations of each method^[29]. This process not only consolidates students’ traditional cost estimation skills but also cultivates critical thinking, data validation abilities, and decision-making capabilities based on multi-source information^[30].

5. Conclusion and Outlook

This study, based on the OBE educational philosophy, constructs and implements a BIM virtual simulation experimental teaching system characterized by real projects, team collaboration, and “three-calculation comparison.” Teaching practice demonstrates that this model effectively enhances students’ in-depth BIM technology application abilities, problem-solving capabilities for complex engineering issues, and cross-disciplinary teamwork skills, achieving the integrated cultivation of knowledge, skills, and competencies. It provides an operable solution for training applied engineering cost professionals^[31].

In the future, the team will focus on establishing a quantitative evaluation and continuous improvement mechanism based on OBE attainment, dynamically updating the teaching case library, and further deepening industry-education integration. By incorporating the latest industry technologies, standards, and practical demands into teaching, the teaching system will remain

advanced and adaptable, continuously supplying high-quality professional talent for industry transformation and upgrading^[32].

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Pathways for the Intercultural Hermeneutics of Chinese Excellent Traditional Culture

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Abstract: Against the backdrop of strengthening international communication capacity and building a culturally strong nation in the new era, the international communication of fine traditional Chinese culture has increasingly become an important task for enhancing China's cultural soft power and expanding the influence of Chinese culture. At present, although the international communication of fine traditional Chinese culture has formed a basic pattern characterized by the participation of multiple actors and the parallel use of multiple channels, it still faces such problems as insufficient depth in content interpretation, difficulties in discourse transformation, inadequate platform adaptation, weak coordination among actors, and an incomplete evaluation system for communication effectiveness, all of which constrain the improvement of overall communication performance. On the basis of sorting out the practical foundations and major problems of the international communication of fine traditional Chinese culture, this paper, centering on its goals and overall framework, proposes a structure guided by the enhancement of national international communication capacity, supported by a value-interpretation system for Chinese civilization and an international communication platform system, and focused on value interpretation, audience segmentation, and digital innovation. It further discusses the issue from two dimensions: mechanism construction with coordinated improvement, and pathway design with practical advancement. The study argues that improving the effectiveness of the international communication of fine traditional Chinese culture requires adherence to the unity of cultural subjectivity and internationalized expression, the coordinated advancement of content supply, discourse transformation, platform support, and feedback evaluation, as well as the integrated planning of communication layout, audience-specific communication, digital empowerment, and practical guarantees, thereby promoting a deeper transformation from merely "being communicated abroad" to "achieving effective communication."

Keywords: Fine Traditional Chinese Culture; International Communication; Communication Mechanisms; Pathway Design; Cultural Communication

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1. Practical Foundations and Major Problems of the International Communication of Fine Traditional Chinese Culture

Fine traditional Chinese culture is an important spiritual emblem of Chinese civilization and also an important resource for enhancing China's cultural soft power and international influence. With the continuous growth of China's overall national

strength, the sustained expansion of opening up, and profound changes in the landscape of international communication, the importance of the international communication of fine traditional Chinese culture has become increasingly prominent. In recent years, relying on multiple approaches such as cultural exchanges, media communication, educational cooperation, digital platforms, and the overseas circulation of literary and artistic works, the international communication of fine traditional Chinese culture has acquired a certain foundation. However, compared with the requirements for building international communication capacity in the new era, there remains a considerable gap.

First, in terms of the overall foundation, the international communication of fine traditional Chinese culture has already formed, in many fields, a basic pattern involving multiple actors and multiple parallel channels. Government departments, mainstream media, university think tanks, cultural institutions, enterprise platforms, and individuals in civil society all participate in communication practices at different levels, while such content as traditional festivals, intangible cultural heritage skills, opera and calligraphy, Chinese cuisine, and traditional Chinese medicine has also exerted a certain influence overseas. Overall, however, various communication resources remain relatively scattered, and different actors lack unified planning and coordinated linkage. Problems such as repetitive content, dispersed branding, and insufficient synergy have affected the overall effectiveness of international communication.

Second, in terms of communication content, the international communication of fine traditional Chinese culture still shows a tendency toward superficiality. Cultural symbols such as traditional festivals, clothing and food, martial arts, and calligraphy are easier to communicate and more likely to leave direct impressions. Yet many communication practices still remain at the level of formal display and the introduction of factual knowledge, without sufficient excavation of the ideas, humanistic spirit, and value connotations behind them. Some content is “visible” but not “deeply explained”: overseas audiences may perceive the uniqueness of Chinese culture, but find it difficult to further understand its spiritual essence and contemporary significance.

Third, in terms of discourse expression, the international communication of fine traditional Chinese culture still faces the problem of “difficulty in internal-external transformation.” Fine traditional Chinese culture was formed within a specific historical context, and many of its concepts and value propositions bear distinct characteristics of Chinese discourse. Once they enter the field of international communication, if necessary translation, adaptation, and reconstruction are lacking, a situation may easily arise in which “much is said, but little is truly understood.” Some communication content still tends to rely on localized modes of expression and seldom interprets Chinese culture from the cognitive habits and cultural backgrounds of overseas audiences, thereby constraining communication effectiveness^[1].

In addition, in terms of channels and platforms, although the international communication of fine traditional Chinese culture has gradually expanded from traditional media and offline exchanges to new platforms such as social media, short-video platforms, and digital exhibitions, the use of platforms remains insufficiently mature. Some communication content is merely “placed on platforms” rather than truly “adapted to platforms,” and its form, narrative style, and interaction design are not sufficiently aligned with the communication logics of overseas platforms. There is also a lack of effective coordination between online communication and offline exchanges, as well as between short-term popularity and long-term influence, so the continuity and stability of communication still need to be strengthened.

It can thus be seen that the problems currently facing the international communication of fine traditional Chinese culture are markedly systemic in nature, involving not only content supply and discourse transformation, but also platform use, actor coordination, and effectiveness evaluation. To truly improve the effectiveness of international communication, it is necessary to further improve communication mechanisms and optimize communication pathways on the existing basis, so as to promote a transformation in the international communication of fine traditional Chinese culture from merely “having communication” to “communicating well.”

2. Goal Orientation and Overall Framework of the International Communication of Fine Traditional Chinese Culture

Under the requirements of strengthening international communication capacity and building a culturally strong nation in the new era, the goal of the international communication of fine traditional Chinese culture is not only to expand cultural

influence, but more importantly to enhance the international community's understanding, identification, and resonance with Chinese culture. In light of new changes in the international communication environment and the practical needs of promoting Chinese culture globally, its goals may be summarized as follows: taking the interpretation of the values of Chinese civilization as the core, effective communication with international audiences as the orientation, coordinated dissemination across multiple platforms as the support, and the enhancement of cultural identification and the promotion of mutual learning among civilizations as the ultimate aim, thereby promoting the international communication of fine traditional Chinese culture from symbol display to value communication, from one-way output to two-way interaction, and from stage-based communication to sustained communication^[2].

Centered on this goal, the overall framework for the international communication of fine traditional Chinese culture may be summarized as "one overarching guidance, two supports, and three priorities." "One overarching guidance" means incorporating the international communication of fine traditional Chinese culture into the overall national framework of external communication under the general deployment of strengthening international communication capacity and building a culturally strong nation, coordinating content interpretation, platform construction, actor collaboration, and communication innovation, clarifying its important role in enhancing China's cultural soft power and expanding the influence of Chinese culture, and making it an important component of the international communication system in the new era.

The "two supports" refer, first, to a value-interpretation system for Chinese civilization. The international communication of fine traditional Chinese culture cannot remain at the level of simple displays of cultural symbols and surface phenomena such as traditional festivals, intangible cultural heritage skills, and classical literature. Rather, it should systematically sort out the historical lineage, spiritual core, and contemporary value of Chinese civilization around the ideas, humanistic spirit, and moral aspirations embedded in it, thus forming a content-support system with a clear main line and prominent focal points. The second support is an international communication platform system. In the face of a communication landscape characterized by multiple platforms and multiple scenarios, it is necessary to coordinate traditional media, social platforms, short-video platforms, digital exhibitions, educational cooperation, and cultural exchanges, promote the integration of online communication and offline exchanges, and connect authoritative expression with mass communication, thereby building a three-dimensional and multi-level network of international communication platforms.

The "three priorities" are, first, to strengthen the systematic interpretation of the core values of Chinese civilization. Whether dealing with traditional festivals, intangible cultural heritage projects, philosophical thought, Chinese aesthetics, or ways of life, communication should be grounded in the developmental trajectory and internal logic of Chinese culture, clearly explaining the cultural significance and value connotations behind them so that international audiences can not only "see the culture," but also "understand the culture." The second priority is to strengthen precise, audience-specific communication aimed at international audiences. In view of differences among countries, regions, and groups in cultural background, cognitive habits, aesthetic preferences, and media usage, differentiated content design and expressive transformation should be promoted to enhance the relevance, affinity, and receptivity of communication. The third priority is to strengthen digital innovation in communication methods and forms. By actively adapting to digital communication trends and making good use of new carriers such as short videos, online literature and art, digital exhibitions, and immersive experiences, the attractiveness, interactivity, and sustainability of the international communication of fine traditional Chinese culture can be continuously enhanced.

Under this overall framework, the international communication of fine traditional Chinese culture is no longer merely a simple "introduction to the outside world" or "cultural display," but rather a systematic project deeply integrated into the broader undertaking of strengthening national international communication capacity and promoting mutual learning among civilizations. "One overarching guidance" clarifies the overall direction of the international communication of fine traditional Chinese culture; the "two supports" consolidate the basic conditions for content supply and platform-based communication; and the "three priorities" highlight the key tasks that need to be advanced in the present and in the period ahead. Only by further improving operational mechanisms and strengthening coordinated linkage on this basis can the overall effectiveness of the international communication of fine traditional Chinese culture be continuously enhanced.

3. Mechanism Construction and Coordinated Improvement for the International Communication of Fine Traditional Chinese Culture

On the basis of having basically clarified the goals and overall framework of the international communication of fine traditional Chinese culture, the key link in promoting its transition from conceptual design to practical implementation lies in how to build communication mechanisms that operate smoothly, connect coherently, and coordinate efficiently. The enhancement of the international communication of fine traditional Chinese culture cannot rely solely on stage-based efforts by a single actor, nor can it remain at the level of scattered content output and partial channel expansion. Instead, it must advance communication work from fragmented promotion to systematic operation, and from localized efforts to overall improvement, through mechanism construction and coordinated refinement^[3].

In terms of mechanism construction, priority should be given to improving the content supply mechanism, discourse transformation mechanism, platform support mechanism, and feedback evaluation mechanism. The content supply mechanism focuses on systematically sorting out and integrating resources such as traditional festivals, intangible cultural heritage skills, classical literature, Chinese aesthetics, ways of life, and traditional Chinese medicine around the spiritual symbols, value concepts, and representative cultural forms of Chinese civilization, so as to form a communication content system with a clear main line, prominent focal points, and distinct layers, thereby avoiding fragmentation, dispersion, and homogenization in content supply. The discourse transformation mechanism emphasizes, on the basis of upholding cultural subjectivity, transforming Chinese cultural discourse effectively into international communication discourse in light of overseas audiences' cultural backgrounds, cognitive habits, and modes of expression. It seeks to translate abstract ideas into concrete narratives and convert cultural connotations into communication content that is perceptible, understandable, and acceptable, thereby continuously enhancing the explanatory power and affinity of fine traditional Chinese culture. The platform support mechanism requires the coordination of various carriers, including traditional media, social media, short-video platforms, digital exhibitions, and offline cultural exchanges, so that different platforms may complement one another in terms of authoritative expression, visual presentation, emotional interaction, and experiential participation, thus building a three-dimensional and multi-level communication support system. The feedback evaluation mechanism lies in establishing an operational closed loop linking content production, communication delivery, audience feedback, and strategy adjustment, so as to promptly grasp communication effects across different countries, platforms, and audience groups, promote content optimization through feedback, improve communication methods through evaluation, and continuously enhance the precision, adaptability, and sustainability of the international communication of fine traditional Chinese culture.

In terms of coordinated improvement, on the one hand, it is necessary to strengthen linkage and cooperation among diverse actors. The international communication of fine traditional Chinese culture involves government departments, mainstream media, university think tanks, cultural institutions, enterprise platforms, overseas Chinese communities, and online content creators, among other actors. Different actors each possess their own strengths in policy guidance, academic interpretation, content production, platform operation, and people-to-people exchange. To avoid fragmentation and dispersion in communication, it is necessary to strengthen overall coordination and resource integration, and promote a division of labor that is clear and a working pattern that is collaborative in such areas as topic selection, content planning, brand building, channel expansion, and international cooperation. On the other hand, it is also necessary to strengthen the organic linkage among all links in the communication chain, promoting the connection between content supply and platform dissemination, between discourse transformation and audience reception, and between project implementation and effectiveness evaluation, so that the international communication of fine traditional Chinese culture may gradually form an operational system characterized by front-back connectivity, horizontal linkage, and dynamic optimization. At the same time, attention should also be paid to the coordinated allocation of communication resources, communication forces, and communication scenarios, enhancing the coupling and stability among various mechanisms and avoiding situations in which content, platforms, actors, and feedback become separated from one another.

Overall, mechanism construction focuses on solving the problem of "how to establish the operational foundation" for the international communication of fine traditional Chinese culture, while coordinated improvement focuses on solving the

problem of “how to enhance overall effectiveness.” Only by unifying mechanism construction with coordinated improvement can the overall framework be transformed into stable and effective operational support, thus laying a solid foundation for subsequent pathway design and practical advancement.

4. Pathway Design and Practical Advancement for the International Communication of Fine Traditional Chinese Culture

The effectiveness of the international communication of fine traditional Chinese culture depends not only on whether communication mechanisms are sound, but also on whether communication pathways are scientifically designed and whether practical advancement is effective. Facing new circumstances such as the increasing complexity of the international communication environment, differentiated audience demands, and evolving media ecology, the international communication of fine traditional Chinese culture must enhance the relevance of communication through pathway design and strengthen the sustainability of work through practical advancement, thereby promoting communication work from stage-based efforts to normalized advancement and from local breakthroughs to overall improvement ^[4].

In terms of pathway design, greater emphasis should be placed on combining overall planning with key breakthroughs. The international communication of fine traditional Chinese culture cannot remain at the level of scattered activities and temporary projects. Rather, it should undertake systematic planning around key countries, key regions, key platforms, and key audience groups, so as to form a communication layout with clear levels and distinct priorities. On this basis, priority breakthroughs may be made in content fields with relatively high recognizability and strong communication potential, such as traditional festivals, intangible cultural heritage projects, Chinese aesthetics, classical literature, ways of life, and traditional Chinese medicine. In doing so, a number of communication brands with demonstrative effects and sustained influence can be created, thereby promoting the international communication of fine traditional Chinese culture from isolated highlights to overall improvement.

Pathway design should also place greater emphasis on combining audience-specific communication with digital empowerment. Significant differences exist among countries, regions, and groups in cultural cognition, aesthetic preference, and media use. This means that the international communication of fine traditional Chinese culture cannot adopt a single model or a uniform mode of expression, but should instead adopt differentiated designs according to different audience characteristics. For younger audiences, visual, narrative, and interactive forms of expression should be strengthened; for academic audiences, greater emphasis should be placed on ideological interpretation and theoretical support; and for the general public, more attention should be paid to everyday expression, experiential communication, and emotional resonance. At the same time, active use should be made of new technologies such as short videos, digital exhibitions, virtual reality, and artificial intelligence to transform traditional cultural resources into visualized, interactive, and immersive products, thereby continuously enhancing the attractiveness and appeal of international communication.

Pathway design mainly addresses issues such as communication layout, content selection, and innovation in communication methods, thereby clarifying the direction of international communication. However, whether pathway design can truly be implemented effectively also depends on whether organizational implementation, resource allocation, and long-term guarantees can keep pace ^[5]. Therefore, on the basis of clarifying the direction of pathway design, it is still necessary to further strengthen practical advancement.

In terms of practical advancement, greater emphasis should be placed on combining overall coordination with step-by-step implementation. The international communication of fine traditional Chinese culture involves multiple links, including content production, platform construction, international cooperation, project implementation, and effectiveness evaluation. It is therefore necessary to strengthen top-level design and organizational coordination, forming a promotion mechanism with clear responsibilities, a rational division of labor, and orderly collaboration. Following the approach of “key breakthroughs, pilot-first implementation, and gradual expansion,” demonstration practices can first be carried out around content and platforms that already have a relatively solid foundation, broad audiences, and significant influence. After mature experience has been formed, it can then be gradually extended to more fields and regions, thus improving the operability and sustainability of communication practice.

Practical advancement should also place greater emphasis on combining talent support with institutional guarantees. High-quality international communication requires a composite talent team that understands both Chinese culture and the laws of international communication, as well as digital media technologies. Through university education, project-based practice, interdisciplinary cooperation, and international exchange, the capacity of relevant personnel in cultural interpretation, internationalized expression, and platform operation should be continuously enhanced. At the same time, project support, resource allocation, and effectiveness evaluation mechanisms should also be improved, incorporating communication scope, audience feedback, and enhanced identification into comprehensive consideration, so as to form a long-term mechanism in which practice promotes improvement and evaluation promotes enhancement, thereby providing stable support for the sustained advancement of the international communication of fine traditional Chinese culture.

Overall, pathway design for the international communication of fine traditional Chinese culture focuses on solving the problem of “how to communicate better,” while practical advancement focuses on solving the problem of “how to make communication deeper and more sustained.” Only by unifying pathway design with practical advancement can the reach, explanatory power, and power of identification of the international communication of fine traditional Chinese culture be continuously enhanced, thus better realizing the transformation from merely “being communicated abroad” to “achieving effective communication.”

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Generative AI-driven TouchDesigner Empowers Interactive Aesthetic Reconstruction and Creative Research of Digital Media Art

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Abstract: With the breakthrough development of generative AI technology, digital media art is undergoing a paradigm shift from “tool-assisted” to “intelligent symbiosis”. This study takes TouchDesigner, which is powered by generative AI in real time, as the technical base, and focuses on its interactive aesthetic reconstruction mechanism and creative path innovation in digital media art creation. Through case evidence and technical analysis, this paper reveals how the technology combination reconstructs the creative logic, aesthetic experience and value dimension of digital media art through the three core capabilities of dynamic content generation, multimodal interactive feedback, and real-time visual computing. This paper proposes a three-dimensional reconstruction model of “intelligence-interaction-aesthetics”, and verifies its innovative application in virtual production, interactive installation, immersive exhibition and other scenarios, providing theoretical support and practical paradigm for the intelligent transformation of digital media art.

Keywords: Generative AI; Digital Media Art; Interactive Aesthetics

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1. Introduction

Driven by artificial intelligence and digital technology, digital media art is ushering in unprecedented opportunities for change. Generative AI has achieved a paradigm shift from “pattern matching” to “semantic generation” through deep learning algorithms, and TouchDesigner, as a real-time visual interaction platform, has become a key hub connecting intelligent generation and real-time interaction with its node-based programming architecture and GPU acceleration capabilities. Based on this technical intersection, this study explores how generative AI real-time drives TouchDesigner to empower the interactive aesthetic reconstruction of digital media art and promote innovative breakthroughs in creative paradigms^[1].

1.1 Technological Breakthroughs and Artistic Applications of Generative AI

Technological breakthroughs and artistic applications of generative AI Generative AI is based on the Transformer architecture and realizes dynamic content generation through pre-trained large models. In the field of digital media art, its application has pushed through the boundaries of traditional creation.

Image Generation: Midjourney generates high-precision images through text descriptions, such as “Floating Castle in a Dream Forest,” improving creative efficiency by dozens of times. RunwayML realizes real-time text-to-video conversion and

supports early visualization of film and television creation.

Multimodal interaction: Combining speech recognition and affective computing, generative AI can respond to audience expressions and voice commands in real time, such as “Iteration Final Chapter” uses Leap Motion gesture recognition to drive game scene changes to achieve “contactless control”.

Style Transfer and Depth Map Generation: Disco Diffusion collaborates with MiDaS v2 to generate stylized scenes and extract depth information based on realistic photos, providing a data foundation for point cloud effect production.

2. TouchDesigner’s real-time interaction architecture and visual computing capabilities

TouchDesigner encapsulates complex algorithms into draggable TOX components through a modular design, with a core architecture including:

2.1 Three-layer processing engine

the performance layer is responsible for user interaction and visual feedback, the computing layer focuses on model inference and data processing, and the communication layer manages the real-time data exchange between the browser and the host^[2].

2.2 GPU-accelerated vision processing

Modulation via WebGL .Three-layer processing engine: the performance layer is responsible for user interaction and visual feedback, the computing layer focuses on model inference and data processing, and the communication layer manages the real-time data exchange between the browser and the host.

GPU-accelerated vision processing: Parallelize model inference through WebGL, and can stably run face tracking (60fps), gesture recognition (45fps), and pose estimation (30fps) on RTX 3060 graphics cards.

2.3 Cross-platform compatibility

Based on WebAssembly technology, the MediaPipe core library can run on the browser side with performance loss controlled within 15%, supporting cross-platform deployment from consumer hardware to professional workstations.

3. Three-dimensional model of interactive aesthetic reconstruction

This study proposes a three-dimensional reconstruction model of “intelligence-interaction-aesthetics” to reveal the aesthetic transformation under the synergy between generative AI and TouchDesigner:

3.1 Intelligent generation dimension:

AI breaks through the “experience dependence” of traditional creation and creates “unknown surprises” through the combination and transfer of human visual experience. For example, “Artificial Intuition” uses the Noise TOP feature to drive the “electrocardiogram” visual system, combined with neurons to symbolize the pulsation of consciousness to realize the concrete expression of abstract concepts^[3].

3.2 Interactive Feedback Dimension

Interactive aesthetics transform audiences from passive recipients to active participants. For example, “Walking to the Light” uses the camera to recognize the gesture of “holding the light”, triggering the change in the brightness of the sky in the cracks, making the audience become the “conspirators” of artistic creation.

3.3 Aesthetic experience dimension

virtuality, diversity and interactivity constitute the new aesthetic characteristics of digital media art. The virtual world created by generative AI transcends the limitations of reality, such as the “Digital Dunhuang” project of the Dunhuang Research Institute optimizes the colors and details of murals through AI to achieve an immersive cultural experience for global audiences.

4. Creative practice path innovation

Through the analysis of typical cases, this study refines the three paths of collaborative creation between generative AI and TouchDesigner:

4.1 Virtual production system

In the final chapter of the iteration, TouchDesigner communicates with the UE5 engine through the OSC protocol to drive level flowcharts and installation lighting changes in real time. After the AI-generated character animation is optimized by the

motion capture device, it is transmitted to TouchDesigner for stylization processing through the MQTT protocol, forming a closed-loop process of “generation-optimization-rendering”.

4.2 Interactive installation design

The MediaPipe TouchDesigner plug-in supports facial mesh tracking (468 points), gesture recognition (21 points) and posture estimation (33 points), providing data support for the “cluster consciousness evolution” of “Artificial Intuition”. Combined with the random movement of the particle system, it realizes dynamic visual narrative in three-dimensional space^[4].

4.3 Immersive Exhibition Experience

By generating depth maps and point cloud data through AI, TouchDesigner can construct real-time particle transformation effects for stylized scenes. For example, “Walking to the Light” uses depth map layering technology to extract foreground and color mapping the audience’s outline, creating an immersive experience of “meeting the contingency of light”.

5. Technical Challenges and Optimization Strategies

Despite the strong potential of generative AI and TouchDesigner, their large-scale application still faces performance bottlenecks and engineering challenges:

5.1 Latency Optimization

By using model distillation and asynchronous processing, the response time of GPT-3.5 Turbo can be reduced from 2.3s to 0.8s; employing Redis to cache conversation history ensures low-latency access .

5.2 Data Security and Compliance

Implementing differential privacy training and content safety API checks meets data protection regulations like GDPR and CCPA; using a dynamic prompt generation mechanism balances personalized responses with value alignment.

5.3 Cross-Software Collaboration

In “The Iteration End,” TouchDesigner serves as the central control platform, calling UE5 level data via OSC to drive device movements and lighting changes, demonstrating the feasibility of multi-software data transfer.

6. Future Trends and Value Dimensions

The deep integration of generative AI and TouchDesigner will propel digital media art towards a path of “intelligence, personalization, and immersion”:

6.1 Technical Integration Trends

Combining 5G and edge computing enables complex visual analysis in cloud-based collaboration; through parameter sharing and sparse activation techniques, trillion-parameter models can run on consumer-grade devices^[5].

6.2 Interdisciplinary Collaboration

Cross-disciplinary work in art, design, computer science, and psychology cultivates versatile creators with AI literacy. For example, Mars Era Education upgrades curricula to train “all-around AI designers.”

6.3 Ethics and Value Reconfiguration

In an era of technological explosion, balancing technological convenience with ethical dilemmas is necessary. “The Iteration End” explores the impact of ‘enemy-deployment’ technology on human identity, prompting deep reflection on tech ethics.

7. Conclusion

Generative AI-driven real-time TouchDesigner, through the three core capabilities of intelligent generation, real-time interaction, and visual computing, reconstructs the creative logic and aesthetic experience of digital media art. The “Intelligence-Interaction-Aesthetics” three-dimensional model proposed in this study provides a theoretical framework to understand the artistic value of this technological combination. In the future, as model miniaturization and real-time learning technologies develop, this technology combination will unleash greater potential in virtual production, interactive installations, immersive exhibitions, and more, driving digital media art toward greater intelligence, personalization, and immersion, ultimately achieving deep integration and value co-creation between technology and art in the new era.

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Construction of a Teaching Paradigm for “Comprehensive Ideological and Political Education” in Higher Vocational Engineering Departments under a Virtual-Real Integration Environment

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Abstract: Under the dual background of improving the quality of vocational education and the wide application of virtual and real integration technology, the “big ideological and political course” of higher vocational engineering department, as the key carrier to implement the fundamental task of establishing morality and cultivating people, still faces the practical difficulties such as the disconnection between ideological and political education and professional teaching, the lack of teachers’ quality and the poor adaptability of resources, which is difficult to adapt to the cognitive characteristics and training needs of engineering students. This paper uses literature research method and practical analysis method to systematically sort out the current situation of the integration of virtual and real integration technology and the “big ideological and political course” of higher vocational engineering department, and clarify the core crux of the current teaching dilemma. On this basis, following the principles of professional adaptation, virtual and actual coordination, and people-oriented education, the teaching paradigm of “three layers, two environments and one evaluation” is constructed, and its core concept, educational objectives and overall framework are clarified. The implementation path of resource construction, model innovation, and teacher improvement and supporting safeguard measures at the institutional, technical, and collaborative levels are proposed. The research results show that the paradigm can effectively break the barriers between ideological and political education and professional teaching, realize the coordinated promotion of value guidance, skill training and quality improvement, and provide a practical scheme for the high-quality development of “big ideological and political course” in higher vocational engineering department.

Keywords: The Fusion of Virtual and Real; Department of Higher Vocational Engineering; Big Ideological and Political Course; Teaching Paradigm; Technical Morality Symbiosis

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1. Introduction

Against the backdrop of the in-depth implementation of the “Action Plan for Improving the Quality and Cultivating Excellence in Vocational Education (2020-2023),” the construction of “comprehensive ideological and political education

courses” in higher vocational engineering departments, as the core position for cultivating high-quality technical and skilled personnel, has become a key measure for implementing the fundamental task of fostering virtue and cultivating talent and promoting the connotative development of vocational education ^[1,2]. Currently, virtual and real fusion technologies (covering cutting-edge applications such as virtual simulation and AR/VR) have gradually and deeply penetrated the entire teaching process of higher vocational engineering majors. This not only provides immersive, repeatable, and low-risk teaching scenarios for professional skills training, but also offers new technical support for “comprehensive ideological and political education courses” to break through the limitations of traditional teaching time and space and achieve a deep integration of theory and practice between ideological and political education and professional teaching ^[3]. However, practical research shows that the teaching of “comprehensive ideological and political education courses” in higher vocational engineering departments still faces many practical bottlenecks ^[4,5]. Problems such as the disconnect between ideological and political education and engineering professional teaching, and the rigid and monotonous teaching methods are particularly prominent, making it difficult to adapt to the cognitive characteristics of engineering students who emphasize practice, application, and concrete thinking. Based on this real dilemma, systematically carrying out research on the construction of the teaching paradigm of “comprehensive ideological and political education” in higher vocational engineering departments under the integrated virtual and real environment can not only enrich the practical path and theoretical system of “comprehensive ideological and political education” in higher vocational education, but also promote the synergistic effect of “skills transmission” and “value guidance” in engineering talent training, and help cultivate high-quality engineering and technical talents with both professional literacy and national sentiment. It has important theoretical value and practical guiding significance ^[6].

From an international research perspective, the application of virtual technology in vocational education has accumulated to a certain extent. Related findings mainly focus on core areas such as technology-enabled optimization of teaching scenarios and improvement of practical skills, emphasizing the use of virtual simulation technology to address the practical challenges of scarce practical scenarios, high operational risks, and high training costs in vocational education. However, due to fundamental differences in educational philosophies and value orientations between China and other countries, this research lacks a core orientation towards ideological and political education and differs significantly from the core needs of my country’s “comprehensive ideological and political education” and “cultivating morality and fostering talent as the fundamental principle,” making it difficult to directly apply to the teaching practice of “comprehensive ideological and political education” in higher vocational engineering departments in my country ^[7,8]. Domestic research on this topic largely focuses on the exploration of virtual-real integration practices in “comprehensive ideological and political education” in ordinary universities, emphasizing the innovation and optimization of classroom teaching methods, while specific research targeting higher vocational engineering departments is relatively scarce. Existing research is limited to the application of virtual technology and fails to closely integrate with the job characteristics and skills training objectives of vocational engineering majors. It has failed to construct a teaching paradigm that is systematic, targeted, and operable, and thus cannot effectively solve practical problems such as the lack of deep integration between ideological and political education and professional teaching in vocational engineering departments, the insufficient realization of the educational value of virtual and real technology, and the lack of adaptability to practical scenarios ^[9]. This study takes this as its starting point to make up for the shortcomings and deficiencies of existing research.

2. The Real-World Dilemmas of “Comprehensive Ideological and Political Education” in Higher Vocational Engineering Departments under a Virtual-Real Integration Environment

The widespread adoption of virtual and real-world integration technology in vocational engineering education has provided a significant opportunity for the high-quality development of “comprehensive ideological and political education courses.” However, the current teaching practice of “comprehensive ideological and political education courses” in vocational engineering departments still faces many practical difficulties, severely restricting the improvement of educational effectiveness. Among these, the insufficient synergy between ideological and political education and engineering professional

teaching is the core dilemma, with the two exhibiting a clear disconnect. In most teaching practices, virtual and real-world technology is often used solely for professional skills training, while the integration of ideological and political elements lacks systematicness and pertinence, failing to truly achieve the educational goal of “using skills to cultivate morality and using morality to enrich skills”^[10]. This results in ideological and political education becoming merely a formality, failing to resonate with students and effectively guiding them to internalize ideological and political concepts into their professional qualities. The shortcomings in the comprehensive quality of the teaching staff further exacerbate this dilemma. Some teachers lack both proficient application skills in virtual and real-world integration technology and insufficient ideological and political teaching skills, making it difficult to design teaching content that combines professionalism and ideological and political elements in conjunction with engineering professional scenarios, thus failing to fully leverage the educational value of virtual and real-world technology. At the same time, the homogenization and lack of adaptability of teaching resources are prominent issues. Existing virtual simulation ideological and political education resources are mostly general-purpose content, lacking exclusive resources that match the needs of engineering professional positions and the cultivation of professional qualities, thus failing to meet the cognitive and growth needs of engineering students. The lag in the teaching evaluation system is also not to be ignored. The current evaluation is still mainly based on theoretical assessment, and has failed to build a diversified and comprehensive evaluation system that adapts to the virtual and real integrated teaching model and takes into account ideological and political performance, skill level and professional qualities, making it difficult to fully reflect the teaching effectiveness and students’ growth.

3. Construction of a Teaching Paradigm for “Comprehensive Ideological and Political Education” in Higher Vocational Engineering Departments under a Virtual-Real Integration Environment

3.1 Paradigm Construction Principles

The construction of a virtual-real integrated teaching paradigm for the “Comprehensive Ideological and Political Education” in vocational engineering departments must be based on the characteristics of vocational engineering education and the educational requirements of the “Comprehensive Ideological and Political Education,” following scientific and reasonable construction principles to ensure the paradigm’s relevance and operability. Professional suitability is the primary prerequisite, requiring close alignment with the job requirements and skills training objectives of engineering majors. Ideological and political elements should be organically integrated into the engineering practice process and professional knowledge transmission, achieving a deep coupling between ideological and political education and professional teaching, and preventing the hollowing out and formalization of ideological and political education^[11]. The principle of virtual-real synergy is the core support, fully considering the immersive, repeatable, and low-risk advantages of virtual simulation scenarios with the practical and comprehensive characteristics of real engineering scenarios. This achieves a complementary and symbiotic relationship between virtual and real scenarios, effectively enhancing the effectiveness of ideological and political education through the synergistic effect of “practicing skills in virtual scenarios and cultivating morality in real scenarios.” The principle of putting people first is the fundamental guideline^[12]. We must always take moral education as the core, highlight the cultivation of professional qualities of engineering students, and integrate ideological and political elements such as craftsmanship, model worker spirit, and innovative spirit into the entire teaching process to achieve the organic unity of value guidance, skills training and quality improvement.

3.2 Core Concepts and Educational Goals

This study constructs a virtual-real integrated teaching paradigm with the core concept of “virtual-real integration and the symbiosis of skills and morality.” It breaks down the barriers between traditional ideological and political education and professional teaching, relying on virtual-real integration technology to build an integrated teaching scenario of “ideological and political education + professional knowledge.” This promotes the transformation of ideological and political education from “passive indoctrination” to “active understanding,” allowing students to subtly cultivate correct professional values, a sense of national responsibility, and a sense of patriotism while mastering engineering professional skills. Based on this core concept, a multi-level and comprehensive educational goal system is established: at the value level, it focuses on cultivating

national responsibility, craftsmanship, and a sense of duty, guiding students to closely integrate their personal career development with national engineering construction and industry development, and establishing the ideal and belief of “serving the country with skills”; at the ability level, it emphasizes the synergistic improvement of engineering practice skills, virtual-real technology application capabilities, and innovative thinking, adapting to the ability requirements of the engineering field for high-quality technical and skilled personnel; at the quality level, it strives to cultivate students’ rigorous, pragmatic, meticulous, and collaborative professional qualities, helping students achieve the organic unity of career growth and personal development^[13].

3.3 Overall Framework of the Paradigm

Combining the teaching characteristics of “comprehensive ideological and political education” in vocational engineering departments with the advantages of virtual-real integration technology, this study constructs a holistic teaching paradigm framework of “three layers, two scenarios, and one evaluation.” Each component permeates and synergizes with the others to ensure the effective achievement of educational goals. The “three layers,” as the core support of the paradigm, correspond to the value guidance layer, the skills training layer, and the quality enhancement layer. The value guidance layer focuses on the core requirements of ideological and political education, clarifying the value orientation of education; the skills training layer closely aligns with the skills objectives of engineering majors, solidifying students’ professional foundation; and the quality enhancement layer emphasizes the cultivation of professional qualities, improving students’ comprehensive qualities. These three layers form an organic whole of “value guidance, skills support, and quality assurance.” The “two scenarios,” as the core carriers of teaching implementation, include virtual simulation ideological and political education scenarios and real engineering ideological and political education scenarios. Virtual simulation scenarios are mainly used to simulate dangerous, complex, and difficult-to-repeat engineering scenarios, achieving immersive penetration of ideological and political elements; real engineering ideological and political education scenarios rely on enterprise job practice, engineering project training, and other carriers, allowing students to practice ideological and political requirements in real practice, achieving complementary symbiosis between virtual and real scenarios. “Evaluation” serves as a crucial guarantee for the implementation of the paradigm. It involves constructing a multi-dimensional and comprehensive evaluation system that takes into account both formative and summative evaluations. This system comprehensively covers students’ ideological and political performance, skill levels, and overall quality improvement. Through scientific evaluation, it drives improvements in teaching quality and ensures the paradigm’s effectiveness in nurturing students.

4. Implementation Path and Safeguard Measures for the Teaching Paradigm

4.1 Core Implementation Path

The effective implementation of teaching paradigms requires a scientifically feasible implementation path, combined with the actual teaching situation of vocational engineering departments, focusing on three key aspects: resources, models, and faculty. Regarding the construction of teaching resources, it is necessary to create a virtual-real integrated ideological and political education resource system adapted to the characteristics of engineering majors. This involves developing targeted virtual simulation ideological and political education cases based on core engineering courses, focusing on materials such as responsibility education in engineering safety regulations, patriotism education in major engineering construction, and innovative spirit education in engineering technology innovation. Simultaneously, it is crucial to systematically integrate ideological and political elements from real engineering cases, constructing a three-dimensional “virtual + real” ideological and political education resource library to effectively improve the adaptability and relevance of resources. In terms of innovative teaching models, it is essential to break through the limitations of traditional classroom teaching and construct an integrated teaching model of “virtual simulation exercises + real-world job practice + ideological and political thematic discussions.” Through virtual simulation scenarios, students can intuitively understand the connotations of ideological and political education; through real-world job practice, students can practice ideological and political requirements; and through ideological and political thematic discussions, students can deepen their value cognition, achieving “integration of learning, thinking, and application; unity of knowledge, belief, and action.” In terms of faculty development, we will strengthen the improvement of teachers’ comprehensive qualities, carry out special training on the integration of virtual and

real technologies with ideological and political education, improve teachers' technical application capabilities and ideological and political education level, and encourage teachers to conduct in-depth research in enterprises to explore ideological and political materials in engineering practice, so as to promote the transformation of teachers from "professional teachers" to "ideological and political + professional" compound teachers.

4.2 Supporting Safeguards

To ensure the smooth implementation and long-term operation of this teaching paradigm, a comprehensive and multi-layered support system needs to be constructed, providing strong support from three dimensions: institutional, technological, and collaborative. At the institutional level, a sound management system for the virtual-real integration of ideological and political education should be established, clarifying teaching requirements, assessment standards, and incentive mechanisms. Virtual-real integration ideological and political education should be incorporated into the teacher assessment and teaching evaluation system to fully stimulate teachers' enthusiasm and initiative, and promote the standardization and normalization of the teaching paradigm. At the technological level, investment in virtual-real integration technology and equipment should be increased, the construction of the virtual simulation teaching platform should be improved, and the platform's stability and usability should be optimized. Simultaneously, a professional technical service team should be established to provide comprehensive technical support for teaching implementation and promptly resolve various problems encountered by teachers in the application of technology. At the collaborative level, in-depth cooperation between schools and enterprises and industry associations should be strengthened. High-quality enterprise resources should be introduced to participate in ideological and political education, and enterprise technical backbones and industry model workers should be invited to the classroom to share their stories of ideological and political education and professional insights from the front lines of engineering, achieving collaborative education between schools and enterprises, further enhancing the relevance and effectiveness of teaching, and providing solid practical support for the implementation of the teaching paradigm.

5. Conclusion and Outlook

5.1 Research Conclusions

This paper focuses on the teaching dilemmas of "comprehensive ideological and political education" in vocational engineering departments under a virtual-real integration environment. Through systematic analysis and practical exploration, it constructs a teaching paradigm of "three layers, two contexts, and one evaluation," clarifying the core principles, core concepts, educational goals, and overall framework of the paradigm construction, and proposing corresponding implementation paths and safeguard measures. Research shows that this teaching paradigm can effectively break down the barriers between ideological and political education and engineering professional teaching, achieving the coordinated advancement of value guidance, skills training, and quality improvement through virtual-real integration technology. It effectively solves the current problems in the teaching of "comprehensive ideological and political education" in vocational engineering departments, such as insufficient coordination, monotonous forms, and poor resource adaptability. It provides a practical solution that can be learned from and promoted for the construction of "comprehensive ideological and political education" in vocational engineering majors, and has important practical significance for promoting the high-quality development of "comprehensive ideological and political education" in vocational engineering departments and improving the quality of technical and skilled personnel training.

5.2 Research Prospects

With the continuous iteration of virtual-real integration technology and the ongoing development of higher vocational education, the teaching paradigm of "comprehensive ideological and political education" in higher vocational engineering departments still needs continuous optimization and improvement. Future research can further explore the deep integration of cutting-edge technologies such as artificial intelligence and big data with the teaching paradigm, utilizing technological means to achieve precise delivery of teaching content and personalized guidance in the teaching process, thereby enhancing the level of intelligent teaching. Simultaneously, considering the specific characteristics of different engineering majors (such as civil engineering, mechanical engineering, and electrical engineering), the implementation details of the paradigm should be refined to enhance its professional adaptability. Furthermore, cross-institutional and cross-regional cooperation and

exchange can be strengthened to summarize and promote excellent practical experiences in virtual-real integration ideological and political education, thereby promoting the overall improvement of the teaching quality of “comprehensive ideological and political education” in higher vocational engineering departments and providing stronger support for the implementation of the fundamental task of cultivating morality and talent in vocational education.

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Conflict of Interests

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

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Labor Education Curriculum Design and Practice from an Interdisciplinary Perspective

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Abstract: The effective implementation of labor education in the new era urgently needs to break through the barriers of single disciplines and overcome practical difficulties such as “skill-oriented” and “formalistic” approaches. This paper takes the practical and spiritual attributes of labor education as its logical starting point, defines the core connotation of interdisciplinary labor education courses, and constructs a four-in-one curriculum framework of “goals-content-implementation-evaluation.” Using the interdisciplinary project “Rainwater Garden Chili Pepper Planting” as a case study, research shows that interdisciplinary labor education courses can effectively achieve the collaborative educational goals of “cultivating morality through labor, enhancing intelligence through labor, improving physical health through labor, and fostering aesthetic appreciation through labor.”

Keywords: Labor Education; Interdisciplinary; Curriculum Design; Five Educations Integration

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1. Introduction

Labor education is a key link in implementing the fundamental task of fostering virtue and cultivating people. The “Opinions on Comprehensively Strengthening Labor Education in Primary and Secondary Schools in the New Era” issued by the CPC Central Committee and the State Council in 2020 clearly proposed to “build an education system that comprehensively cultivates moral, intellectual, physical, aesthetic and labor education” and promote the deep integration of labor education with the teaching of various subjects ^[1]. The 2022 edition of the “Compulsory Education Curriculum Scheme and Curriculum Standards” establishes its core position in the basic education curriculum system ^[2].

Currently, although my country’s primary and secondary school labor education practice has made some progress, it still faces many bottlenecks: First, the implementation of the curriculum is limited by the boundaries of the subject, and it often presents the characteristics of “singularity” and “fragmentation”, failing to achieve organic integration with moral education, intellectual education, physical education and aesthetic education; Second, the teaching model is rigid, and some schools simply equate labor education with physical labor or skills training, neglecting the cultivation of labor values and the development of scientific thinking; Third, the imperfect collaboration mechanism between families, schools and communities, the weak teaching staff and the single evaluation system are problems that have prevented the full release of the educational value of labor education ^[3].

2. Theoretical Foundation and Core Content of Interdisciplinary Labor Education Curriculum

2.1 Theoretical Basis

In his theory of “learning by doing”, Dewey proposed that “education is life” and “education is growth”, emphasizing that education should be rooted in practice and that students should construct knowledge and develop abilities by personally participating in labor practice and solving practical problems^[4,5].

The concept of “five educations integration” advocated in China emphasizes that moral education, intellectual education, physical education, aesthetic education and labor education are not independent of each other, but rather an organic whole that permeates each other and works together to educate people^[6, 8]. As the link of “five educations integration”, labor education naturally has the practical foundation to connect with the other four educations.

2.2 Explanation of Connotation

Interdisciplinary labor education courses refer to a curriculum system that takes labor practice as the core carrier, aims to cultivate students' correct labor values, essential labor skills and comprehensive labor literacy, breaks through the boundaries of a single discipline, integrates knowledge, methods and thinking of multiple disciplines, and constructs a “labor + discipline” integrated curriculum system^[7].

2.3 Core Features

Based on the essential requirements of labor education and the integration logic of interdisciplinary courses, this paper extracts four major characteristics of interdisciplinary labor education courses: comprehensiveness of educational goals, relevance of course content, practicality of implementation process, and collaboration of educational subjects.

1. The comprehensiveness of educational goals.
2. Relevance of Course Content.
3. Practicality of the implementation process.
4. Collaboration among educational stakeholders.

3. Design Principles and Overall Framework of Interdisciplinary Labor Education Curriculum

3.1 Basic Principles of Curriculum Design

1. Cultivating Morality and Guiding Values.
2. Interdisciplinary integration and deep fusion.
3. Student-centered, tiered design.
4. Real-world scenarios, practice-oriented.
5. Principle of multi-party collaboration to ensure effectiveness.

3.2 Overall Framework of Curriculum Design

Based on the above principles, a four-in-one interdisciplinary labor education curriculum framework of “goals, content, implementation, and evaluation” is constructed to achieve the systematic and scientific nature of curriculum design. The core of the framework is “labor tasks,” and the outer layers are “curriculum goals,” “curriculum content,” “curriculum implementation,” and “curriculum evaluation,” which are interconnected and operate in a closed loop. “Integration of five aspects of education” runs through all four aspects, and “collaboration between home, school, and community” provides external support for the framework.

1. Course Objectives: Differentiated and categorized, focusing on core competencies.

The overall goal is set as “cultivating correct labor values, mastering essential labor skills, and developing comprehensive labor literacy”.

2. Course Content: Three main categories, integrating knowledge from multiple disciplines.

Based on the core classification of labor education and combined with the need for interdisciplinary integration, the course content is divided into three modules. Each module integrates the knowledge of the corresponding disciplines to form an

integrated content system.

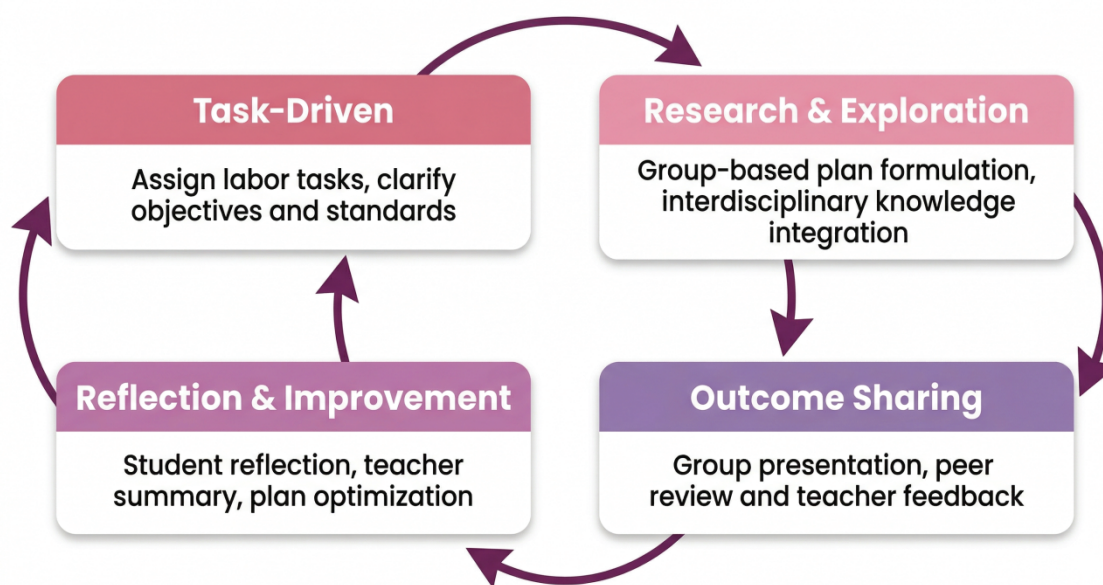
Table 1. Comparison of Interdisciplinary Labor Education Curriculum Content Modules and Subject Integration

Types of labor	Core content example	Interdisciplinary	Core competencies
Daily life labor	Campus plant maintenance, home cooking, clothing organization and storage	Chinese, Mathematics, Art, Biology	Work habits, aesthetic appreciation, and self-care ability
Productive Labor	Rain garden planting, handicraft creation, and ecological farm operation	Mathematics, Biology, Physics, Chemistry, Art	Scientific inquiry, innovative thinking, and labor skills
Service Labor	Community services for the elderly, campus public service campaigns, and rural revitalization research	Chinese Language and Literature, Morality and the Rule of Law, History, Geography	Social responsibility, communication skills, and patriotism

3. Course Implementation: Project-driven, four-stage closed-loop operation.

The interdisciplinary labor education curriculum is implemented with project-based learning as the core carrier, forming a closed-loop operation model of “task-driven - inquiry practice - results exchange - reflection and improvement”.

Figure 1. Flowchart of interdisciplinary labor education curriculum implementation



4. Course Evaluation: Multi-dimensional and comprehensive, with an emphasis on process-oriented motivation.

A comprehensive evaluation of interdisciplinary labor education courses is achieved by establishing a “three-dimensional, six-subject” evaluation system. The “three dimensions” refer to labor attitude, labor skills, and overall quality. Through methods such as portfolio assessments, labor points, achievement displays, and practice reports, a combination of formative and summative evaluations is achieved.

4. Practical Paths and Case Studies of Interdisciplinary Labor Education Courses

4.1 Core Practice Path

1. Develop interdisciplinary project platforms to achieve deep knowledge integration.
2. Deepen the integration of labor education into multiple scenarios and build a comprehensive education system.
3. Highlight the synergy of the “four aspects” to unleash the value of integrated education.
4. Strengthen teacher and resource support to solidify the foundation for curriculum implementation.

4.2 Case Study Analysis

1. Project Background

This project takes “Research on the Management Techniques of Pepper Seedling Cultivation and Transplanting Using Rain

Gardens” as an example . It is based on the “Campus Rain Garden” practice base in middle schools, is offered to first-year high school students, has a course cycle of 12 weeks, with 2 class hours per week, and adopts the implementation model of “interdisciplinary teaching team + group cooperation”.

2. Project Design and Implementation

With “chili pepper planting and management” as the core task of labor, knowledge from four major disciplines—mathematics, biology, science, and ethics and law—is integrated to construct a fusion model of “labor practice + scientific inquiry.” The specific implementation process is as follows.

3. Project Implementation Results

A total of 286 students participated in this project, resulting in 286 planting logs and 72 scientific research reports. The survival rate of the transplanted chili peppers reached 89%. Through the implementation of the project, students not only mastered the labor skills of chili pepper cultivation but also applied multidisciplinary knowledge to practice, achieving a comprehensive understanding of the subject matter. During group collaboration and inquiry, students’ teamwork, problem-solving abilities, and scientific inquiry literacy were significantly improved. Simultaneously, students experienced the hardships and joys of labor, established the concept that “labor creates value,” and their ecological awareness and sense of social responsibility were significantly enhanced.

5. Practical Results and Reflections

5.1 Practical Results

Students’ overall quality has significantly improved. The implementation of interdisciplinary labor education courses has effectively addressed the problem of traditional labor education’s emphasis on skills while neglecting overall quality. Through labor practice, students not only master basic skills in life, production, and service labor, but also enhance their comprehensive abilities in knowledge application, scientific inquiry, and teamwork, and establish correct labor values .

5.2 Reflections on Practice

Despite the achievements of interdisciplinary labor education courses, several issues remain to be addressed: Insufficient depth of interdisciplinary integration, with some interdisciplinary projects exhibiting only superficial integration; the connection between subject knowledge and labor tasks is not close enough, failing to achieve in-depth application of knowledge and synergistic development of thinking; Lagging teacher development, with some teachers lacking experience in interdisciplinary instructional design and guidance, insufficient participation of industry experts in course implementation, and a need to strengthen the development of a multi-skilled teaching staff; An imperfect evaluation system, with the operability of process-based evaluation needing improvement, unclear quantitative evaluation standards for labor literacy, and insufficient incentive effect of evaluation results; and uneven integration of off-campus resources, with differences in off-campus labor practice resources between urban and rural schools, where rural schools possess abundant agricultural production resources, while urban schools lack relatively scarce off-campus production and labor bases.

6. Conclusion

The design and practice of labor education courses from an interdisciplinary perspective is an inevitable trend in the innovative development of labor education in the new era. Practice shows that interdisciplinary labor education courses can effectively break through the barriers of a single discipline and achieve deep integration of labor education with subject teaching, class management, and social life ^[9]. In the future , it is necessary to continue to deepen the research and practice of interdisciplinary labor education courses, solve the bottleneck problems in teachers, evaluation, and resources, and continuously improve the curriculum system and implementation strategies so that labor education can truly take root.

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Conflict of Interests

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

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Cultural Heritage and Educational Innovation: A Study on the Integration of Traditional Music Culture in Vocal Music Education

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Abstract: Considering the current processes of globalization along with the fast development of information technologies, music education faces certain difficulties and challenges as well as opportunities. In this regard, this article studies the problem of the use of the traditional musical culture for the purposes of vocal music education by considering the relation between the vocal music art and culture through systematizing this relationship. At the same time, the research considers the problem of semiotic approach in vocal music education and reveals the features of cultural features of traditional vocal music art. The present work proposes a new model of the development of vocal music education based on the following key approaches such as the return to its cultural origin, traditional humanistic spirit, and consideration of multicultural views on life. Furthermore, the use of modern technologies in vocal music education is also discussed. Among other things, the integration of computer and multimedia technologies in vocal music teaching is considered. Consequently, the results of the research show that the use of the traditional musical culture in the field of vocal music art leads to greater success in vocal music education in terms of cultural and professional progress.

Keywords: Traditional Music Culture; Vocal Music Education; Cultural Heritage; Curriculum Reform; Educational Technology; Multicultural Education; Computer-Assisted Instruction

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1. Introduction

1.1 Research Background and Importance

The present trend of human civilization is marked by swift developments in science and technology, which have fastened the process of evolution in the world's economy. It becomes imperative to adopt a broader perspective on talent nurturing in comparison to what existed in the past, hence necessitating a new orientation in higher education ^[1]. The development of talent development in music has undergone a transformation from focusing too much on vocational education to nurturing holistic traits ^[2]. In other words, the existing paradigm of music education is no longer compatible with the demands for development in the music education sector ^[3].

Recently, in connection with the emergence of the quality education system, the reforms concerning vocal music education have been deepened at different levels. Various universities of higher education and institutions of pedagogical training have tried to implement vocal music reforms in their syllabi and pedagogic methodology ^[4]. At the same time, there is an

increasing scientific attention to different areas of study related to vocal music: art psychology of vocal music, vocal music aesthetics, and vocal music linguistics^[5]. However, modern vocal music education theory, based on one scientific approach involving the use of general educational principles, which are based on the summation of individual features of the art of vocal music, cannot create interconnections between various subjects^[6].

In modern science of education on vocal music, research applies the approach which consists in analyzing separate aspects of the art of vocal music in order to formulate universal educational rules, thus neglecting the relationship between the art of vocal music and other areas of knowledge and unable to provide scientific theory results possible due to scientific advancements in the appropriate branches of sciences, including humanities, social sciences, and natural sciences^[7]. The scope of theoretical consideration and viewpoint is quite limited in terms of philosophy of education^[8].

Moreover, the contemporary research framework regarding vocal music learning is monolithic, whereby the training process has no clear connection with the cultural aspects of the program curriculum. The same technique has been used in both content and methods; too much focus has been put on technical skills while little attention is devoted to fostering creativity. Such an imbalance limits the development of the cognitive and creative potential of the students in the field of vocal music^[9]. As a result, there is very little achievement in balancing technical skills and cognitive skills necessary for vocal music, such as understanding metaphorical meaning in poems used in vocal music pieces^[10].

1.2 Research Objectives

The main objective of this study is to explore how traditional music culture has been incorporated into vocal music education by examining its correlation with vocal music, both as an art form and culture, and evaluating its incorporation using modern research methods for education^[11]. Despite the uniqueness that exists between traditional and modern music education, the current study will focus on their comparison mainly in relation to cultural context, curricula design, teaching practices, and educational technology.

The present research is expected to meet the following objectives of research: To conduct a systematic study of the connection between vocal music art and culture using semiotics and cultural anthropology^[12]; To explore the cultural aspects of traditional vocal music art and their educational value in modern society^[13]; To develop new approaches and methods for curriculum reform in the field of vocal music education^[14]; To study the influence of modern pedagogical technologies on vocal music teaching^[15]; And to provide theoretical and practical grounds for nurturing versatile music talents^[16].

1.3 Data Source Description

Sources of literature and databases used for this paper were selected from several reliable academic databases focused on education. The time period of this literature review extends from 2020 to 2025, which makes this research relevant and current. Sources used for the collection of data include Web of Science, Scopus, CNKI, and numerous journals dealing with issues related to music education and culture. The literature includes articles about music education reforms, culture, curriculums, and educational technology^[17].

2. The Relationship between Vocal Music Art and Culture

2.1 Semiotics and Vocal Music Art

2.1.1 Significance of Introducing Symbolic Philosophy

During the twentieth century, as part of Western analytical philosophy, linguistics, and natural science, semiotics made a considerable advance towards the form of scientific discipline. The idea of “the symbol” became more and more important, and semiotics turned into one of the key objects of scientific research. Therefore, semiotics acquired importance as an essential element of modern philosophy and its ideological concepts^[18]. Ernst Cassirer, who was famous for his symbolic philosophical ideas, can be found among other world-famous philosophers of our times like Einstein, Russell, and Dewey in the collection of World Philosophers Library, considered to be “one of the most esteemed contemporary philosophers” and “a scholar of encyclopedic erudition of today’s intellectual world.”

In contrast to the linguistics theory of Ferdinand de Saussure and the semiotics of Charles Sanders Peirce, which are the pioneers of semiotics, the works of Ernst Cassirer and his protégé Susanne Langer have shown that there are strong elements of philosophy and culture involved in “pan-symbolic epistemology,” which demonstrate the cultural aspects of art^[5]. First,

they combine research on human beings and culture and the study of the nature of the symbols created by artists. According to Cassirer, man is a symbolic being that creates culture, and symbol-making distinguishes man from animals and links him with culture.

2.1.2 Cultural Enlightenment of Semiotics for Vocal Music Art

As a result of semiotic analysis of vocal music art, it becomes clear that vocal music art is a cultural element which, as any other sister arts and sciences, can be called a part of culture. The medium of vocal music art consists of symbols and can be described as emotional vocal system ^[9]. Basically, creative act in the sphere of vocal music activity is connected with creation of an artistic symbol in auditory terms.

As singing music involves the integration of lyrics and operas with the literary and theatrical arts, it becomes necessary that knowledge of the systems of signs used in adjacent arts should be essential for the creation of symbols in the world of singing music ^[1]. Here is always an intimate association between singing music and its related arts within the same society. The strongest base for creating singing music symbols can be created by all the different kinds of signs found in the human world.

2.2 Cultural Characteristics of Traditional Vocal Music Art

2.2.1 Historical Development of Chinese Vocal Music Art

The Chinese civilization has a very old history of more than five thousand years, characterized by an exceptionally advanced musical tradition. A great artistic and cultural heritage in connection with Chinese music has led to the formation of a unique vocal music tradition ^[13]. With respect to vocal music, the creation of culture and arts is linked to the development of language itself, as from the very beginnings of humankind, singing was a companion to the birth of language. The oldest example of folklore songs is The Love Song of Tu Shan Woman.

The development of the political structure was marked from the Qin dynasty to the Han dynasty. China saw the emergence of a feudal society and the integration of various cultures across several nations, which made the cultural composition richer in Han culture ^[7]. The area of vocal music and its arts saw much development. The establishment of Yuefu, an important Chinese music school, during the Han Dynasty through the efforts of Emperor Wu saw to it that “local customs were collected and musical notes harmonized.”

It is worth noting that political centralization and increased interaction between different ethnic groups during the Sui-Tang Dynasty contributed significantly towards the blending of various musical traditions existing then. The Silk Road served as an avenue through which musical traditions were transmitted from the East to the West. Songs that were created during the Sui and Tang eras later became refined and known as “Quzi” (tunes). Musical traditions of the Tang era have been documented in Dunhuang texts where there are 590 lyrics belonging to 80 tunes.

2.2.2 Cultural Levels and Their Influence on Vocal Music

Culture is a systematic structure involving a number of levels and dimensions. Ideas make up the key level. As for ideology, it also involves several important dimensions, namely value ideas and modes of thinking ^[7]. As in the case of world view, both value ideas and modes of thinking crystallize and integrate during practical activities of culture-making and, at the same time, are basic guidelines directing and limiting such activities. Chinese traditional culture can be considered as a whole structure involving a great many substructures. Chinese traditional culture after the period of the Qin and Han dynasties was characterized by distinctions of explicit culture and implicit culture. In the spring and autumn period and the warring states period, there appeared many different schools of intellectual life in artistic thoughts, such as Confucianism, Mohism, Legalism, School of Logicians (Dialecticians), and Yin-Yang thoughts. Later on, Confucianism became dominant due to Emperor Wu of Han’s decision to “exclude all other teachings and maintain Confucianism alone.” Thus, Confucian value idea “harmony” has been the prevailing value idea among many other value ideas in Chinese traditional culture.

3. Conceptions of New Vocal Music Education Models

3.1 New Concepts of Contemporary Music Education

3.1.1 Contemporary Music Anthropology Perspectives

With the consistent creation of innovative concepts, culture, and discoveries, modern society experiences the weakening of old research approaches used in all spheres of knowledge. The formation of numerous subdisciplines and cross-disciplines

in the sphere of international social sciences took place starting from the 1990s^[19]. Most music educators believe that music should be seen as an element of culture but not art itself, which means that “music in culture” is the approach that needs to be applied to the process of studying and understanding music^[17]. The idea became a basis for developing a music education concept in Germany since the 1970s.

3.1.2 Goals for the 21st Century

The “Goals 2000: Educate America Act,” passed by the Clinton administration in 1994, gave the field of art education the best assistance until then in the country. The assistance included music, visual arts, theater, and dance. Art was officially included in the list of “core subjects,” being marked number three out of the total six national goals of education^[4]. The other five “core subjects” were English, math, science, history, and geography. That was the year when the first National Standards of Arts Education in U.S. history were developed by the federal government’s direct participation in national arts organizations.

3.2 Returning to Mother Tongue Music Culture

3.2.1 Language as the Foundation of Culture

Language serves as the medium that carries and embodies culture and can therefore be viewed as an essential condition of culture. By mother tongue we mean the native language which is learned in early childhood through contact with people who share the same language. This gives rise to various expressions of cultural activity^[4]. In addition, language is also considered to be “relational” according to Ferdinand de Saussure, a renowned linguist from Switzerland. In other words, language is an invention of man. The mother tongue, therefore, bestows unique aesthetic charm upon the national musical culture of a country. At the same time, one notes that countries with diverse mother tongues have adopted different approaches to their music education systems^[16]. As discussed above, in 1995, at the Sixth National Conference for Music Education Reform, the theme of discussion was set as “Chinese mother tongue music education.”

3.2.2 Curriculum System Reform

At present, educational institutions in China have continued the teaching programs on music, following the structure of an educational system adopted from the Western model introduced during the May Fourth Movement, where the Western style of voice lessons is taught using a mechanistic teaching technique in vocal music^[18]. Therefore, it is fitting for the teaching of vocal music to adhere to the need to convey music using the Chinese language and culture, leading to the formation of a teaching program for vocal music that challenges the existing curriculum and methodologies based on Western music ontology.

3.3 Integration of Modern Educational Technology

3.3.1 Computer-Assisted Instruction Applications

The developments in science and technology in the modern-day society have an attractive impact on the field of education, continuously developing the technological aspects of education in music education^[20]. Music education through computers and computerized learning has been set as effective means in learning. In specific areas such as music theory teaching and technologically-driven teaching of music composition, computer technology has been seen to excel. An instance of this would be the Housewright Declaration of the United States which is considered an important document in music education in the 21st century.

Computer Assisted Instruction (CAI) is defined as the application of computers to assist instructional procedures or act as a means of instruction. Computer Assisted Instruction is not only an actual practice of computer usage but also a new teaching approach and instructional strategy^[6]. By virtue of its interactive nature, varied capabilities, personalized and flexible qualities, CAI improves the dissemination of information and individualized education while considering the concepts of transmission, practice and competence. This means that through the use of CAI, subjectiveness and arbitrariness that are evident in the conventional vocal music teaching approach of verbal communication and personal instruction will be avoided

3.3.2 Multimedia and Digital Technologies

However, in the last few years, some professional associations have been employing CAI methods to teach vocals music under particular circumstances. In order to gain practical knowledge and achieve expected results, some experiments and researches are carried out^[15]. For example, there is one method of investigating sound spectrums, where tests of audio spectra

are carried out through multimedia computer that can analyze spectrum of the singing voice.

When it comes to vocal training and learning for music, computer-recorded singing voices can help both teachers and students to observe various acoustic properties through function diagrams shown on a computer screen, thus making it possible to conduct numerous experiments with sound waves^[21]. As is mentioned above, this approach combines a systematic and rational scientific approach to music teaching with a subjective approach used before. It is necessary to note that much research needs to be done in this sphere; however, this approach, at least, has changed the old paradigm in which students preferred practical skills to theory.

4. Implementation Strategies and Recommendations

4.1 Curriculum Development Strategies

Below is an outline of how the incorporation of the cultural aspect of traditional musical practices can be made into vocal music education based on the above discussion. One way is to include the concept of dialects in musical performance in the curriculum of vocal music lessons to form a link between the two^[16]. Since China is characterized by large territory size, there is a great dialect variation within the country, and the impact of the dialect on vocal stylistics must not be overlooked. The second is to include a historical section in Chinese vocal music performance.

The third element would be to include an introduction to the history of global music cultures in the curriculum so as to give students a wider international perspective and to counter the fallacy of “world music being synonymous with Western music”^[18]. The fourth important aspect is to introduce music lessons that cater specifically to Chinese audiences, which is vital in aiding in the understanding of the unique melodic modes used in Chinese music. The fifth element is to include training in opera within vocal music lessons since the methods used in opera coincide with Chinese aesthetics.

4.2 Teacher Training and Professional Development

However, the successful incorporation of musical tradition in the vocal music teaching process largely depends upon the competence of the teacher. The preparation and further professional growth of teachers in this regard are therefore paramount^[17]. Training programs for vocal music teachers should be implemented by universities, including traditional vocal techniques classes, cultural studies seminars, and master performers’ workshops.

In addition to that, interdisciplinary cooperation is important in order to supplement the knowledge of the instructor. It should be noted that within the realm of teaching vocal music, it is important for the instructors to work together with specialists from various fields including musicology, anthropology, and linguistics.

4.3 Assessment and Evaluation Methods

Evaluation methods should be modified based on how well traditional music is incorporated into the learning process for singing lessons. It is important not only to assess the technical competence of learners but also to consider their knowledge about the culture, analysis of traditional music, and cultural awareness^[19]. Portfolio evaluation, performance evaluation, and reflective journals are suitable approaches for assessing the development of learners.

5. Conclusion

In addition, there are new challenges brought about by the potential paths to which the process of education reform will take around the world. Specifically, there are new demands for Chinese vocal music education that need to be addressed through the quick creation of an educational system possessing unique characteristics^[13]. This can be achieved through the incorporation of the cultural background of vocal music education by exploring human cultures and incorporating different disciplines from the fields of humanities and natural sciences into interdisciplinary teaching programs.

The combination of modern and innovative approaches to vocal music along with traditional music culture inherited by singers should be considered. There are obvious signs showing that if one gets involved into cultural heritage, he should make use of the idea of developing modern music Art culture which is distinguished by particular national characteristics and is quite alive^[22]. On the basis of practical knowledge, one can state that such a combination can open new ways to create talented vocalists. Cultural heritage along with innovations allows us to achieve the goal of vocal music education.

In summary, introducing the aspect of tradition into vocal music education is not simply about preserving cultural heritage but

provides an avenue for connecting the past with the future and also the local with the global aspects. It is the duty of music teachers to pass on the cultural heritage through new forms of teaching methodology.

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Theoretical Analysis of Gamified Music Application for Cultivating Intrinsic Motivation in Music Education

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Abstract: The present study explores the traditional music teaching method known as instrumental music teaching and discusses the drawbacks related to the repetitive nature of training and the lack of prompt feedback. Beginner students who learn how to play musical instruments like piano and flute usually have trouble overcoming their struggles while studying music, resulting in higher rates of music course dropouts. In order to solve this problem, the study creates a model for music teaching methodology, using the concept of game elements that comes from an extensive literature review. The theoretical background is based on the Self-Determination and Flow theories. There are four main dimensions in the model, including: 1) student learning profiles; 2) step-by-step resource allocation; 3) individual-based teaching process; 4) multidimensional evaluation process. The goal of the study is to create an effective approach to motivating learners intrinsically. Additionally, the study offers an outlook on the future development of collaboration between humans and machines in the field of music.

Keywords: Intrinsic Motivation; Music Education Gamification ;Teaching Flow; Theory Teaching Model

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1. Introduction

1.1 Background and Challenges of Music Education

Music education is a unique and complex field. Instrumental performance training is highly professional, requiring learners not only to combine motor skills with auditory perception, but also to incorporate artistic expressiveness into the technique. But there are obvious drawbacks in the traditional standardized teaching methods. For example, the uniform teaching model has become difficult to adapt to the diverse needs of contemporary students, who show great diversity in cognitive style and learning progress. The advancement of digital technology has brought new possibilities to overcome these limitations, and the education sector has begun to apply gamified design elements to music education. A number of empirical studies have shown that this is an effective intervention. Gamification design can significantly boost students' enthusiasm, and this approach can transform dull mechanical practice into meaningful artistic exploration activities.

1.2 Core Contradictions in Traditional Practice

An analysis of the practice methods of traditional Musical Instruments reveals that there are two fundamental contradictions that can undermine students' enthusiasm for learning and learning outcomes. The first contradiction is the polarization of associative motivation caused by mechanical repetition. Traditional training relies too much on scale and arpeggio practice, which is seriously lacking in the actual musical context. Therefore, prolonged meaningless repetition significantly reduces

students' motivation for autonomous learning^[1] and leads to a state of no motivation due to the lack of varied practice. As a result, students subjectively feel that their efforts have nothing to do with the actual musical outcome. Students with weak interest are prone to giving up halfway; The second contradiction is the serious lack of real-time feedback mechanisms. Traditional teaching is highly dependent on offline classes once a week, and students lack professional technical guidance during long periods of self-practice. Delayed feedback directly weakens students' sense of self-efficacy and leads them to repeat mistakes without realizing it. It is also prone to forming extremely difficult-to-correct incorrect muscle memory^[2].

1.3 Research Objectives

This study builds a framework of gamified music education theory in response to the core contradictions existing in traditional instrumental teaching, relying on digital technology to achieve four optimization goals: First, to transform mechanical practice into meaningful goal-oriented activities to stimulate students' intrinsic learning motivation; The second is to provide immediate and targeted feedback to help improve performance skills; The third is to build personalized learning paths that are tailored to individual differences in students' skill levels, interests, and learning styles; The fourth is to enhance learning efficiency through technology while retaining the humanistic essence at the core of music education. The framework combines self-determination theory with flow theory to form a teaching model supported by psychological theory, which can effectively address the technical training and learning motivation challenges currently faced by music education.

2. Literature Review

2.1 Advances in Personalized Teaching Research

Personalized learning has become a mainstream trend in educational research over the past decade, and adaptive systems for personalized learning have demonstrated remarkable effectiveness in the field of education^[3]. Intelligent systems also show great potential in music education. These systems can precisely adjust the teaching difficulty through underlying algorithms, and can intelligently match music types and adjust practice schedules. This mechanism successfully creates highly personalized learning experiences^[4]. Automatic chord recognition technology has made technological breakthroughs in recent years, and artificial intelligence means such as automatic music transcription have become increasingly mature. These cutting-edge technologies can effectively integrate dull technical training with students' real musical interests and effectively improve the disconnection between traditional instrumental teaching.

2.2 The Special Nature of Music Education

Learning music faces two challenges: a long cycle and great psychological stress^[1]. First of all, music learning is highly dependent on psychomotor skills and requires long-term and repeated practice. Problems such as long learning cycles, stage anxiety, and external pressure keep emerging, which increases the difficulty of instrumental learning. Secondly, music learning requires both technical precision and artistic expressiveness. Traditional teaching is difficult to balance the cultivation of both. A single basic skill training cannot support the emotional expression of music, and the lack of technical foundation will also limit the artistic performance of students. Finally, music has distinct social and cultural attributes, and its value is realized through cultural consensus and interpersonal interaction, which greatly increases the difficulty of designing personalized music teaching systems, requiring intelligent teaching models to adapt to individual learning differences while taking into account students' cooperation and communication as well as group music experience.

2.3 The Underlying Support of Self-Determination Theory and Flow Theory

Desi and Ryan put forward the famous self-determination theory, which holds that the maintenance of intrinsic motivation depends on the continuous satisfaction of three fundamental psychological needs: autonomy, competence, and relevance. Numerous studies in music education have confirmed that satisfying students' autonomous choice, ability experience, and social connection can effectively maintain the motivation to learn music. In technology-assisted learning Settings, providing meaningful choices can greatly satisfy students' autonomy^[5], and moderate system challenges and immediate feedback can significantly enhance learners' competence^[6]. The introduction of a social identity perspective is also indispensable, which helps to meet the learner's need for social relevance, and this emotional level of satisfaction is key to maintaining the motivation for continuous practice^[7,2].

Zickson-mihaly proposed the theory of flow. Flow states arise from the perfect dynamic balance of challenge difficulty and

individual skills. Research shows that meeting basic psychological needs helps trigger flow experiences in digital learning^[8], and in music teaching, optimizing the balance of challenge and skills can significantly increase classroom engagement^[9]. Interactive systems can actively stimulate the learner's flow state through algorithms, which can effectively regulate the positive relationship between technology application and learning efficiency^[10]. The deep integration of self-determination theory and flow theory is of great academic value, providing a solid foundation for gamified instructional design that takes into account both motivation stimulation and experience optimization^[11].

The two theories complement each other and are highly compatible, and the satisfaction of psychological needs can promote the generation of the state of flow. The integration of the two can provide design criteria for gamified instrumental music teaching: ensuring students' sense of achievement through appropriate task difficulty, satisfying students' autonomy needs through diverse learning, continuously motivating learning through progress feedback, and strengthening emotional connections through musical social interaction, thereby constructing a modern instrumental music teaching model that is both interesting and effective.

3. Systemic Problems in Traditional Music Performance Training

3.1 A Serious Disconnection between Theory and Practice

Traditional teaching strictly separates basic training from artistic practice, and for a long time separates basic skills practice from real musical experience. Students have long engaged in mechanical training such as scales and fingerings, but have difficulty establishing a connection between technical practice and musical performance and musical expression. From beginner, intermediate to advanced stages, traditional teaching has the drawback of emphasizing technical refinement and neglecting musical application and artistic expression. This disjointed learning model is very likely to weaken students' initial learning motivation and reduce their intrinsic enthusiasm for continuous practice.

3.2 Rigid and Monotonous Teaching Methods

Traditional instrumental teaching often adopts a rigid model where teachers demonstrate and students imitate and practice. Although it can help students master basic playing skills, it limits the space for students' independent exploration and innovation, making it difficult to achieve individualized teaching. Innovative methods such as gamified learning and mobile learning can break this single structure. The introduction of multi-dimensional interactive experiences can stimulate interest while ensuring the rigor of basic teaching, making up for the deficiencies of traditional teaching^[12].

3.3 Extreme Imbalance in Student Engagement

The combination of dull practice and lagging feedback leads to learned helplessness, a phenomenon that gradually causes students to lose motivation to learn and eventually drop out of instrumental learning. Although professional musicians can fully meet the psychological development needs, the music learning process itself is highly difficult, which greatly hinders the psychological needs of students during the learning process. Therefore, many potential learners encounter a bottleneck period before mastering sufficient skills, and they often give up music learning completely due to intense frustration^[1].

3.4 Result-oriented Evaluation of Alienation

In the traditional music teaching evaluation process, due to an excessive focus on final outcome assessments such as performances and competitions, the dynamic learning growth process of students is overlooked. This result-oriented evaluation model is prone to many problems: it makes students overly dependent on external learning motivation, one-sidedly pursue grades and rankings, and neglect understanding and aesthetic experience of music itself; There is a risk aversion mentality in fostering learning, and they are reluctant to explore music and express themselves creatively out of fear of negative evaluation; At the same time, the feedback from the summative assessment is monotonous and lagging, making it difficult to guide students to optimize their process-oriented abilities. Educators should incorporate gamification elements into the basic assessment system. Methods such as progress tracking and achievement unlocking can effectively shift attention from external outcomes to the internal learning process^[13] to make up for the shortcomings of the traditional outcome-based evaluation approach.

4. Construction of an Engaging Teaching Model based on theory of Mind

This study builds a four-dimensional gamified music teaching framework based on the aforementioned theory.

4.1 Draw a Precise Student Learning Profile

Precise personalized teaching must begin with a deep understanding of the learner. The system can divide students into three categories based on the assessment of the initial data: the first category is the robust students, who are well-suited for progressive challenges, while the system focuses on tracking learning progress and recognizing their achievements for the robust students; The second category of growth-oriented students, who have a solid foundation, requires the system to provide them with diverse musical styles and exploratory experiences; The third category of breakthrough students, who are skilled in technology, requires the system to provide them with creative tasks that can challenge their limits, and a deep learning-based path planning model can automate and dynamically complete this complex profiling evaluation process ^[14].

4.2 Establish a Stepwise Resource Push Mechanism

The basic-level module combines interactive tutorials with immediate audio-visual feedback, which can effectively reduce the cognitive load of beginners and build initial competence ^[15]. The advanced modules incorporate historical narratives and listening contrast tasks, which help deepen students' understanding of specific musical styles. The challenge module introduces virtual performance simulation and free arrangement projects, and reinforcement learning algorithms can dynamically adjust the resource difficulty of the score in this section ^[16].

4.3 Design Personalized Interaction Processes

Digital instruments and artificial intelligence technologies such as twin residual neural networks can build immediate feedback loops ^[17]. The system provides millisecond-level precision feedback on pitch and rhythm, and even calculates and feeds back subtle emotional dynamics, fundamentally eliminating the formation of incorrect playing habits, while using storytelling scenarios and progressive unlocking mechanisms to build meaningful play experiences. The addition of the social leaderboard transforms repetitive practice into intrinsic value-driven behavior, significantly improving students' daily practice habits ^[18].

4.4 Build a Multi-Dimensional Dynamic Evaluation System

Single-dimensional performance indicators have obvious limitations. Gamification teaching must rely on a multi-dimensional evaluation matrix ^[19], which covers four core data metrics. The system assesses students' perseverance through practice duration and regularity, and uses progress rate to measure individual longitudinal growth to make up for the lack of traditional technical evaluation by extracting indicators of emotional expression, and also requires comprehensive collaboration and creative engagement to reflect the indispensable social attributes of music.

5. The Role of Human Educators and Technological Limitations

5.1 Embodied Cognition and Human Guidance are Irreplaceable

Music cognition is essentially an embodied practice that involves deep interaction between the mind and the body and the environment ^[20,21]. There are huge perceptual blind spots in relying solely on digital technology. For example, AI systems can accurately determine the right and wrong of acoustic frequencies ^[8], but algorithms cannot guide physical ergonomic skills such as arm weight fall and breathing coordination, and machines cannot replace the emotional resonance and cultural insight provided by human mentors when overcoming stage anxiety.

5.2 Building a Hybrid Human-Machine Collaboration Model

Future music education should move towards a hybrid and collaborative approach. Digital systems should serve as the underlying support scaffolding, while algorithms are responsible for high-frequency regular skills assessment and practice progress tracking. The system can also handle the gamification of dull exercises, freeing human educators from the cumbersome mechanical correction, allowing teachers to focus all their energy on embodied physical instruction, and thus mentors can devote more time to deep artistic aesthetic inspiration and psychological emotional support.

5.3 Ethical Considerations of Gamification Technology

Gamification design must be wary of potential manipulation risks. Platform developers must not only avoid exploiting psychological weaknesses to overly pursue system data engagement, but also handle sensitive data privacy at the underlying logic level. Gamified instructional design can induce three types of problems: the first is manipulation risk, a game

mechanism that partially promotes participation, which is prone to exploiting learners' psychological weaknesses to induce engagement rather than driving learning based on intrinsic interests; The second is privacy risk. The teaching system's meticulous tracking of students' learning behavior can lead to data security and privacy leakage risks. The third is the risk of educational equity. If gamified intelligent teaching resources are only available in quality institutions, it will further widen the gap in educational resources and exacerbate educational injustice^[22].

6. Conclusion

The four-dimensional gamification framework proposed in this study systematically addresses the core pain points in traditional instrumental teaching. The model breaks the deadlock through the deep integration of technological empowerment and psychological mechanisms, and maintains intrinsic motivation in the teaching framework at the initial stage. This intervention approach completely breaks down the traditional barriers between technical training and artistic perception. Looking to the future, the multimodal assessment system, combined with artificial intelligence adaptive generation technology, will further enhance the dimension of music education, and through the introduction of virtual reality immersive social environments, it can also demonstrate broad educational prospects. Adhering to the people-oriented, human-machine collaborative educational philosophy is the key to the future development of the system, and the scientific and reasonable use of gamification technology will surely enable more learners to understand the deep essence of music in a fun exploration.

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An Exploration into the Transformation of University Talent Cultivation Models and Connotation Construction in the New Era

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Abstract: The new era has raised higher value expectations and more profound quality requirements for higher education. University talent cultivation is undergoing a comprehensive transformation from scale expansion to quality improvement, from knowledge-based to competency-based, and from one-way indoctrination to subjective construction. This transformation is by no means a mere change of methods, but a systematic reshaping involving educational philosophy, institutional frameworks, and cultural ecology. As the internal foundation of this transformation, connotation construction focuses on returning to the original essence of fostering virtue through education and the deep generation of a quality culture. This paper explores the logical path, core dimensions, connotation implications, coupling mechanisms, and practical dilemmas, revealing the dialectical relationship in which model transformation and connotation construction are mutually reinforcing and serve as two-way drivers for each other. On this basis, it proposes future practical approaches, offering a theoretical reference for deepening university educational reform in the new era.

Keywords: New Era; University Talent Cultivation; Model Transformation; Connotation Construction; Fostering Virtue through Education

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1. Introduction

Contemporary China is simultaneously undergoing the profound interweaving of the grand national rejuvenation strategy, once-in-a-century global changes, and the new technological revolution. The development of the Party and the people's cause requires successive generations of socialist builders and successors who are well-rounded in moral, intellectual, physical, aesthetic, and labor education. Facing this "unprecedented great undertaking" and coping with unprecedented risks and challenges, deepening the transformation of the talent cultivation model and striving to build a high-quality education system have become urgent requirements for serving the overall national strategy^[1]. In 2023, China's gross higher education enrollment rate reached 60.2%, establishing the world's largest higher education system, which is now advancing toward high-quality universalization^[2]. Its core proposition has shifted from "whether one can attend university" to "what kind of university one attends and what kind of education one receives." This shift signifies a fundamental displacement in society's expectations of universities: they are no longer merely required to output human resources equipped with specialized knowledge, but are more urgently expected to cultivate a new generation capable of leading the future, possessing sound

personalities, and shouldering great responsibilities. At the same time, the explosive growth of knowledge, the accelerating iteration of artificial intelligence, and the disruptive transformation of learning methods have plunged the traditional cultivation model characterized by one-way knowledge transmission into a deep crisis of legitimacy. Students' channels for acquiring information are unprecedentedly diverse, teachers' authority is no longer built upon a monopoly on knowledge, and if classrooms still rigidly adhere to lecturing, listening, memorizing, and testing, it becomes very difficult to activate the mind, cultivate character, and spark creativity.

Against this backdrop, the transformation of the talent cultivation model has become the core barrier to university reform, while connotation construction constitutes its value foundation and quality assurance. The two are not mutually separate task sequences, but rather two sides of the same process of change: if transformation lacks solid connotation support, it easily degenerates into a piling up of techniques or a renovation of slogans; if connotation lacks the carrier and activation of model innovation, it may remain stuck at the conceptual level, unable to be transformed into real educational effectiveness. This paper attempts a systematic theoretical exploration of the two, clarifying the logic and dimensions of transformation and the deep structure of connotation construction, discerning the coupling and interaction mechanism between them, and, based on reflection on practical dilemmas, proposing reconstruction paths, with the aim of providing rational understanding for the deep-level reform of the university talent cultivation system in the new era.

2. The Logical Path of Talent Cultivation Model Transformation

The transformation of the university talent cultivation model is not a sudden whim, but the inevitable result of the confluence of threefold logic: historical evolution, theoretical development, and practical reflection.

From the perspective of historical logic, higher education has gone through the liberal arts cultivation of a select few top talents in the elite stage, the mass training of applied professionals in the popularization stage, and is now moving toward the comprehensive literacy enhancement of all citizens in the universalization stage. In this historic leap, the cultivation model must shift from mere knowledge transmission to student-centered comprehensive quality development^[3]. The educational functions of universities are constantly differentiating and reorganizing, and tensions persist between knowledge transmission and character cultivation, general education and specialized training, social service and cultural inheritance. The student body in the universalization era is more diverse, and their developmental needs are no longer limited to obtaining a diploma or a specific skill, but rather pursue self-realization, social identity, and the holistic construction of life's meaning. This inevitably requires breaking through the past cultivation model characterized by standardization and homogenization, moving toward a more flexible, open, and personalized form of education.

From the perspective of theoretical logic, the development of cognitive science and learning theories continuously refreshes people's understanding of the educational process. Constructivism reveals that knowledge is not a passively received object but a product of the learner's active construction in context; holistic education theory emphasizes the overall participation of cognition, emotion, will, and body; theories of embodied cognition and situated learning point out that learning is deeply embedded in concrete practices and cultural contexts. These theoretical consensus fundamentally shake the traditional foundations of "teacher-centered, textbook-centered, and classroom-centered," prompting the center of gravity of education to shift from the performance of "teaching" to the generation of "learning," and from information transmission to the co-construction of meaning. Simultaneously, the laws governing education's internal and external relations also indicate that education must adapt to social development and promote the all-round development of individuals. The critical thinking, collaborative ability, cross-cultural understanding, and ethical sensitivity required by current society are very difficult to cultivate in a closed, linear, and shallow transmission model.

From the perspective of practical logic, the accumulated drawbacks of the traditional cultivation model are increasingly apparent. A cultivation system centered on knowledge delivery tends to lead to the suspension of student subjectivity, the weakening of higher-order thinking, and superficial value guidance; excessively rigid disciplinary divisions and standardized evaluation mechanisms suppress personality development and cross-disciplinary integration; the teacher-student relationship degenerates into a knowledge transaction, severely compressing the space for spiritual communication and personality inspiration. When society's demands for students' comprehensive qualities become increasingly multi-dimensional, while the

actual cultivation effectiveness falls short of expectations, the practical field inevitably generates an intrinsic impulse for self-transcendence, forcing a model transformation. Therefore, the transformation of the talent cultivation model can be seen as a collective effort for the return of educational subjectivity, a deep swing back from instrumental logic to humanistic logic, with its fundamental aim being the reconstruction of education's concern for the whole person.

3. The Core Dimensions of Talent Cultivation Model Transformation

The transformation of the talent cultivation model is not a piecemeal repair but a multi-dimensional reconstruction encompassing objectives, curriculum, teaching, organization, and evaluation, with each dimension nested within the others to form an organic whole.

First, the reshaping of cultivation objectives. Traditional cultivation objectives were often reduced to the mastery of knowledge points and the training of skills, fragmenting the wholeness of the person. The cultivation objectives of the new era must return to the fundamental task of “fostering virtue through education,” take the core socialist values as the guiding principle, and distill a core competency framework that combines patriotism and sense of belonging, a global vision, innovative spirit, and practical ability. This kind of objective is no longer a static list of specifications but a continuously generated ideal vision of personality, encompassing both deep cultural identity and ethical commitment, as well as general competencies like cross-disciplinary thinking, critical judgment, collaborative communication, and more. The elevation of objectives requires the cultivation process to shift from “processing” to “growing,” providing a value anchor for the subsequent transformation of other dimensions. This reshaping of objectives also requires us to integrate, in practice, the value guidance of “cultivating people through aesthetics and culture,” achieving deep-level shaping of students' values through the synergy of aesthetic education and ideological and political education ^[4].

Second, the reconstruction of the curriculum system. The curriculum is the carrier of cultivation objectives. The curriculum system under transformation must break down disciplinary barriers and departmental boundaries, constructing a modular structure of “integration of general and specialized education, cross-penetration.” General education must not degenerate into a patchwork of introductory courses serving as mere decoration; instead, it should be committed to intellectual enlightenment and cultural cultivation, guiding students to form a deep understanding of classic readings, value inquiries, and cutting-edge issues. Specialized education needs to eliminate outdated and redundant content, strengthen methodology transmission and problem orientation, and engage in high-level interaction with industrial practice and scientific research. Most importantly, curriculum-based ideological and political education, as an educational concept of value integration, should not be misinterpreted as a simple addition of political discourse. Instead, it must permeate all curriculum elements with educational values—like salt dissolving seamlessly into water—through the intrinsic spiritual dimension of knowledge, the humanistic care within disciplinary history, and the ethical considerations in professional practice, thereby achieving the organic unity of knowledge transmission, ability cultivation, and value guidance. Furthermore, utilizing big data and artificial intelligence technologies to promote precision in ideological and political education can provide more scientific effectiveness evaluation and personalized pathway references for implementing curriculum-based ideological and political education ^[5].

Third, the transformation of teaching paradigms. Teaching reform is the most direct manifestation of the model transformation. Traditional lecture-based teaching cannot meet the requirements of cultivating high-level abilities and must shift towards inquiry-based teaching centered on problems, experience-based teaching centered on projects, and interactive teaching centered on dialogue. Teachers' roles should change from knowledge authorities to learning designers and spiritual interlocutors, and classrooms should transform from monologue spaces into learning communities. Meanwhile, digital technology, as a “ubiquitous” variable, has profoundly reshaped the boundaries of learning. The integration of online and offline learning ecosystems makes autonomous learning and precise assistance possible, but it is necessary to be vigilant against the fragmentation and isolation brought about by technology. The true transformation of teaching paradigms does not lie in the dazzling equipment, but in the shift of the teacher-student relationship from asymmetrical domination to symbiosis among subjects, thereby achieving the integration of cognitive stimulation and spiritual impact.

Fourth, innovation in organizational forms. The rigid professional class and single departmental structure are no longer capable of meeting the demands of interdisciplinary cultivation and personalized growth. New grassroots educational

organizations are constantly emerging. Modern college systems emphasize coexistence between teachers and students, shared reading of classics, and integration of life, attempting to create a close academic and spiritual community beyond the disciplinary structure. Interdisciplinary platforms, future colleges, and industrial colleges, on the other hand, form flexible learning units based on major issues, providing students with a multi-disciplinary perspective and real-world experience. The essence of organizational innovation lies in breaking the excessive regulation of educational logic by administrative logic, allowing the system to once again serve the growth rhythm of individuals and build a flexible, open, and softly-bounded educational ecosystem.

Fifth, reform of the evaluation mechanism. Evaluation is the baton that controls the direction of change. Transformation requires a shift from the one-dimensional score evaluation dominated by terminal exams to a multi-dimensional, evidence-based developmental evaluation. A student growth portrait should be constructed, including academic performance, quality development, and behavioral records, and multiple evaluation subjects such as self-evaluation, peer evaluation, and social evaluation should be introduced to form a dynamic feedback and improvement loop. Special attention should be paid to the concept of value-added evaluation, focusing on students' efforts and growth amplitude from different starting points, and avoiding violent comparisons based on standardized scales, thereby releasing the growth potential of every student. Only in this way can evaluation be elevated from a tool for punishment and ranking to a beacon for promoting reflective growth.

4. The Essential Implication and Multi-Dimensional Unfolding of Connotation Construction

If model transformation is the visible face of educational reform, then connotation construction is its invisible skeleton and soul. Connotation construction is a continuous response to the fundamental question of "what is good education," and its essence points to the deep self-awareness of the university's mission to foster virtue through education and the intrinsic generation of a quality culture.

Conceptual connotation is the spiritual source of connotation construction. Amidst the clamor, the university must reconfirm its *raison d'être*: not merely a knowledge factory or a career springboard, but a spiritual temple for truth-seeking, cultural heritage, and personality cultivation. This requires reforging the "spirit of the idea" of what makes a university a university, balancing academic freedom with social responsibility, and internalizing the fostering of virtue through education as the value axis for all activities. If the guiding philosophy is vacillating or shallow, all technical improvements will be like duckweed without roots.

Institutional connotation is the rigid guarantee of connotation construction. It involves the improvement of the modern university governance system, requiring academic power and administrative power to be properly positioned and organically coordinated, fostering an institutional environment that stimulates the creative tension of teachers and students. When professional title evaluation favors research over teaching, talent titles proliferate excessively, and managerialism continuously erodes grassroots autonomous space, the system will be alienated into a force that dissolves the original aspiration of fostering virtue through education. To cultivate connotation, it is essential to strengthen the educational orientation of institutional supply, so that teachers can teach with peace of mind and students can study with tranquility, making rules a bulwark that protects, rather than depletes, educational ideals.

Resource connotation takes high-level faculty as the core fulcrum. The quality of the teaching staff directly determines the possible heights that talent cultivation can reach. Cultivating connotation means that faculty development must be placed as a strategic priority, with a comprehensive career-long support system established. Special emphasis should be placed on cultivating educational passion, teaching ability, and educational wisdom, fortifying the first line of defense in teacher ethics and conduct. Sound institutional supply should encourage the revival and vitality of grassroots teaching organizations (such as teaching and research offices and teaching teams), enabling them to become solid fortresses at the micro level that carry the mission of fostering virtue through education^[6]. Cultural connotation is the most enduring and resilient layer of connotation construction. Whether the air of the university is filled with the anxiety of short-term utilitarianism or the steadfastness of calm dedication, whether what flows between the podium and the seats is restless conformity or sincere exploration—these intangible cultural states profoundly influence educational effectiveness. Cultivating excellent academic

atmosphere and institutional culture is essentially about shaping a community character that takes scholarship as a vocation, reflection as a habit, and honor and disgrace as concerns. Cultivating people through culture means allowing the university spirit, permeating every blade of grass and every word and deed, to become a silent yet powerful educational force, enabling students to internalize it as their spiritual temperament through long-term immersion. This intrinsic quality cannot be rapidly produced, yet it endures the longest.

5. The Coupling and Interaction Mechanism between Model Transformation and Connotation Construction

There exists a profound coupling and interactive relationship between talent cultivation model transformation and connotation construction. The two form a dynamically evolving “double helix” structure, jointly propelling the spiraling ascent of educational quality.

Connotation construction provides value orientation and fundamental support for model transformation. The exploration of any model cannot suspend the value inquiry of “for what purpose we are transforming.” Without a firm educational philosophy, sound institutional guarantees, and a profound cultural soil, transformation can very easily slide into the pursuit of technical fads, falling into the hollow predicament of “new bottles for old wine” or even “new bottles with no wine.” For example, introducing a residential college system without corresponding mentor investment and spiritual community building, promoting curriculum restructuring without deep teacher understanding and institutional tolerance, or empowering education with technology without human warmth and ethical examination—the root cause of such formalistic transformations lies in the weak support of connotation. Connotation construction is precisely about injecting soul and laying a solid foundation for transformation, ensuring that every step of the change is oriented toward the person themselves.

Transformation practice, in turn, provides implementation carriers and feedback drivers for connotation construction. If advanced ideas remain confined to texts and slogans, not being transformed into perceivable, operable educational processes, they will ultimately wither. The transformation of the talent cultivation model is precisely the action field where conceptual connotations move toward reality. Through concrete practices such as goal reshaping, curriculum refinement, and teaching innovation, abstract connotation pursuits are given vivid representation. At the same time, the problems exposed, experiences accumulated, and reflections generated during the transformation process continuously feed back into the connotation system, prompting it to adjust, deepen, and self-transcend. Some universities, by reconstructing comprehensive evaluation systems for teaching contributions or integrating digital-intelligence technology into teaching quality management, have successfully realized a virtuous mutual feedback between institutional connotation and model transformation ^[6].

The co-evolution of the two requires a kind of systemic integration thinking. Universities must transcend departmental silos and self-interested logic, constructing a collaborative governance framework that spans teaching, research, human resources, student affairs, and other domains. Centered on the core proposition of “how to cultivate people,” they must form a holistic “all-member, whole-process, all-round” educational pattern with convergent goals and synchronized actions. Any approach that severs transformation from connotation, emphasizes hardware over software, or pursues isolated bright spots while neglecting the systemic ecology will find it difficult to achieve a fundamental improvement in educational quality. This requires universities to adopt a system design approach, break down departmental barriers, and construct a new multi-party collaborative education system such as “Grand General Education + Small General Education + Specialized Education” ^[7].

6. Conclusion

The transformation of the talent cultivation model and the connotation construction in universities in the new era is both a practical proposition answering the call of the times and a profound self-awareness returning to the true essence of education. The two are like the two wheels of a cart or the two wings of a bird; only by moving in coordination and exerting force in the same direction can educational quality be genuinely enhanced, enabling the university to become not only a place for knowledge transmission but also a forge for the spirit and a habitat for the soul. This undertaking is destined to have no endpoint. Only through continuous reflection and self-transcendence can universities truly shoulder the sacred responsibility of shaping the future and cultivate a new generation of well-rounded individuals capable of shouldering the great task of

national rejuvenation.

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Domestic and International Models of Industry-Education Integration and Cooperative Education Model: A Comparative and Applied Study Based on Literature Review and Student Experience Survey

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Abstract: Against the backdrop of deepening industry–education integration and the transformation of applied talent cultivation, this study investigates collaborative education models in business administration programs. By comparing representative international models—including Germany’s dual system, the U.S. cooperative education model, and Singapore’s teaching factory—with domestic practices, and analyzing questionnaire data from 300 students involved in school–enterprise cooperation projects, the study develops a framework covering cooperative foundation, value co-creation behavior, learning outcomes, and continuous participation intention. Results show that resource complementarity and support, collaborative design and participation depth, and interactional fairness and trust significantly enhance learning outcomes, while value co-creation behavior partially mediates these relationships. Learning outcomes further strengthen students’ intention to continue participating. Although students generally hold positive perceptions of collaborative education, collaborative design and participation depth remain relatively weak. Comparative analysis indicates that international models demonstrate advantages in enterprise involvement, process-oriented evaluation, and institutionalized collaboration. Accordingly, this study suggests strengthening project-chain integration, process-oriented evaluation, and institutionalized collaboration mechanisms to improve the quality and effectiveness of industry–education integration in business administration education.

Keywords: Industry-Education Integration; The Collaborative Education Model; Literature Comparison; Student Experience; Value Co-Creation; Business Administration

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1. Introduction

As higher education shifts from scale expansion to quality improvement and from knowledge transmission to competence development, the integration of industry and academia has evolved from a policy-advocated “key direction” to a “critical mechanism” in the cultivation of application-oriented talents (Khan et al. , 2025; Ferns et al. , 2025). For business administration majors in particular, the instructional objective extends beyond helping students master the conceptual frameworks of management, marketing, human resource management, and operations management; it also aims to enable

them, within real and complex organizational contexts, to develop comprehensive abilities to analyze problems, coordinate resources, communicate and negotiate, design solutions, and pursue continuous improvement. Such competencies are critical to students' employability, job adaptation, and career transition (Jackson, 2025; van der Baan et al. , 2024). These abilities are highly dependent on situational triggers and practical verification. Simply relying on classroom lectures, case discussions, and final exams often fails to fully cultivate them, as more authentic task design, evaluation centered on students' meaningful participation, and project-based or simulation-based learning proximal to real-world work scenarios are more effective in promoting students' skill demonstration, engagement experience, and job readiness (Quinlan et al. , 2025; Pickering et al., 2024; Naseer et al. , 2025). Therefore, effectively integrating industrial resources, job tasks, and course learning through school–enterprise cooperation to enable students to “learn by doing,” “learn through collaboration,” and “learn through reflection” has become a key issue in the educational reform of business administration programs (Ferns et al. , 2025; Khan et al. , 2025; van der Baan et al. , 2024).

Compared with earlier cooperation models that focused primarily on base construction, agreement signing, and internship placement, current industry-education integration places greater emphasis on cooperation depth, process quality, and outcome transformation (Vuoriainen et al. , 2025; Khan et al. , 2025; Ferns et al. , 2025). In practice, although some universities have adopted various forms of collaboration—such as industry colleges, order-based classes, co-developed courses, enterprise mentors in the classroom, and project-based teaching—the actual effectiveness of the collaborative education model does not always match the scale of cooperation. Some projects have invested a lot of resources, but the results often stay at the level of field visits and task execution. Although some enterprises actively participate in it, they mainly focus on lectures, recruitment and short-term guidance, and do not really integrate into curriculum design, project evaluation and learning feedback (Ferns et al. , 2025; Luk & Chan, 2024). Although some projects formally achieve multi-party participation, students lack sufficient subjectivity in goal setting, process negotiation, result correction, resulting in coexistence of cooperation but limited learning gains (Omland et al. , 2025; Nieminen et al. , 2025; Quinlan et al. , 2025). This shows that whether industry-education integration can truly be transformed into the advantage of talent cultivation depends not only on whether there is cooperation, but also on how cooperation is organized, how students participate, and how the cooperation conditions are transformed into learning outcomes (Vuoriainen et al. , 2025; Luk & Chan, 2024; Khan et al. , 2025).

At the research level, existing literature has extensively demonstrated the necessity, institutional foundation, and organizational forms of industry-education integration. However, there remains a lack of in-depth explanation regarding the micro-level mechanisms of the collaborative education model and talent cultivation (Khan et al. , 2025; Ferns et al. , 2025; Oliveira et al. , 2024). In business administration programs in particular, students' learning outcomes often manifest as multifaceted competencies—such as project comprehension, communication and collaboration, problem-solving, business judgment, and career adaptability. These outcomes do not arise automatically from resource investment; rather, they are gradually shaped through continuous interaction, collaborative practice, and relationship building (Jackson, 2025; D'Souza et al. , 2025; Omland et al. , 2025). The theory of value co-creation offers a powerful lens for explaining this process: it posits that value is not unilaterally predetermined by either schools or enterprises, but is instead cocreated through the integration of multiple actors' resources and the coordination of their actions (Vargo & Lusch, 2008; Payne et al. , 2008; Grönroos & Voima, 2013; Cruz et al. , 2024). Based on this, this paper identifies resource complementarity and support, collaborative design and depth of participation, and interactional fairness and trust as key antecedents of the collaborative education model, conceptualizes value co-creation behavior as the mediating mechanism that connects the cooperative foundation with learning outcomes, and further examines the influence of learning outcomes on the intention to continuously participate (Petrescu et al. , 2026; Zarandi et al. , 2024; Omland et al. , 2025). The study adopts a dual-path approach combining literature comparison and student experience surveys. On one hand, it conducts a structured comparison of typical industry-education integration models of the collaborative education model, both domestically and internationally, to identify key differences in their underlying mechanisms. On the other hand, based on questionnaire data from university students involved in school–enterprise cooperation projects, it empirically examines the causal relationships among cooperative foundation, value co-creation behavior, learning outcomes, and the intention to continuously participate. This paper seeks to answer

three questions: First, what are the similarities and differences in the structures and operational mechanisms of typical the collaborative education model models at home and abroad? Second, how do the key structural elements of the collaborative education model influence students' learning outcomes through value co-creation behavior? Third, what insights can the comparative findings offer for optimizing the localized application of business administration programs? The significance of this paper lies in integrating “model comparison—mechanism testing—application transformation” into a unified analytical framework, thereby providing a more robust theoretical and practical foundation for optimizing industry-education integration mechanisms within business administration programs.

2. Literature Review and Theoretical Foundation

2.1 Evolution of Research Perspectives and Existing Limitations

In terms of the research trajectory both domestically and internationally, studies on industry-education integration and the collaborative education model have generally evolved from policy argumentation and model analysis to research on process mechanisms (Khan et al. , 2025; Oliveira et al. , 2024; Vuoriainen et al. , 2025). Early research focused on demonstrating the necessity of school–enterprise cooperation for optimizing the structure of talent cultivation, alleviating the mismatch between supply and demand, and improving educational quality (Khan et al. , 2025). Subsequently, scholarly attention turned to comparing different institutional forms—such as industry colleges, the dual system, cooperative education, modern apprenticeship systems, and teaching factories (Ferns et al. , 2025; Vuoriainen et al. , 2025). In recent years, the focus has gradually shifted toward project processes, learning experiences, and competency outcomes (Luk & Chan, 2024; Ferns et al. , 2025). Overall, existing studies have sufficiently addressed the questions of “why promote industry-education integration” and “what forms of cooperation can be adopted.” However, there remains insufficient explanation regarding the mechanistic question of “how cooperation conditions translate into student gains during the project process” (Oliveira et al. , 2024; Luk & Chan, 2024; Vuoriainen et al. , 2025).

This deficiency is reflected in three main aspects. First, research has predominantly focused on system design and platform construction, with insufficient attention paid to the micro-level interactions occurring during project implementation. As a result, the collaborative education model tends to be interpreted as a static outcome—such as the signing of agreements, the establishment of bases, or the joint development of courses (Björck & Willermarck, 2025; Oliveira et al. , 2024). Second, a considerable portion of the research remains centered on schools or enterprises, rarely analyzing students' depth of participation, judgment logic, or behavioral responses from the perspective of their actual experiences. This makes it difficult to explain why there are significant variations in student gains across similar projects (Smith et al. , 2025; Jackson, 2025). Third, comparisons between domestic and international models often remain at the level of experience description, with insufficient effort devoted to extracting the effective mechanisms underlying different models. Consequently, a comparative framework capable of supporting the application and adaptation of these models to local contexts has yet to be developed (Jackson, 2025; Smith et al. , 2025).

2.2 The Contextual Characteristics and Theoretical Imperatives of Business Administration Programs

The educational goal of business administration programs is not simply skill training, but rather the shaping of multifaceted competencies to address real-world managerial problems (Jackson, 2025; Petrescu et al. , 2026). Whether in marketing—where students engage in customer insight, operations management—where they focus on process optimization, or human resource management—where they conduct job analysis and facilitate team collaboration, students need to develop the capacity for judgment and action within environments characterized by multiple interacting parties, incomplete information, and diverse goals (Jackson, 2025; Pickering et al. , 2024). Therefore, the integration of industry and academia in this discipline should not be understood merely as “increasing practice hours” or “introducing enterprise mentors”; rather, it should be understood as reconstructing the learning process itself through engagement with real tasks, real constraints, and real feedback (Quinlan et al. , 2025; Nieminen et al. , 2025). Only when students are embedded in project sequences that allow them to participate, express themselves, experiment, and revise can course knowledge be transformed into contextualized competencies and practical experience be consolidated into relatively stable professional capabilities (Pickering et al. , 2024; Petrescu et al. , 2026; Nieminen et al. , 2025). This also implies that the effectiveness of the collaborative

education model cannot be judged solely by the quantity of resources allocated or the diversity of cooperation forms. Instead, we need to examine three further questions: whether the resources provided by schools and enterprises are truly accessible, usable, and convertible for students (Smørvik & Vespestad, 2020; Petrescu et al. , 2026); whether students are involved in the entire process of goal setting, process negotiation, task execution, and outcome evaluation (Zarandi et al. , 2022; Omland et al. , 2025); and whether cooperative interactions are grounded in fair, transparent, and predictable relationships (To, 2025; Zarandi et al. , 2022). If the aforementioned conditions are absent, even if a cooperation project is formally established, students may remain merely performers and observers, making it difficult for them to achieve genuinely high-quality learning (Omland et al. , 2025; To, 2025). Therefore, research in the field of business administration requires an analytical framework capable of explaining the continuous transmission logic of “resources—participation—relationship—behavior—outcomes” (Smørvik & Vespestad, 2020; Petrescu et al. , 2026; Omland et al. , 2025).

2.3 Comparative Dimensions of Typical Collaborative Education Model Models: Domestic and International

From a comparative perspective, the lasting influence of typical international models—such as Germany’s dual system, America’s cooperative education, and Singapore’s teaching factory—stems not merely from the maturity of their cooperative forms, but more importantly, from the relatively stable collaborative mechanisms they have established throughout the entire process of talent cultivation (Mordhorst & Jenert, 2023; Lamancusa et al. , 2008; Quirós-Alpera et al. , 2025). Synthesizing relevant studies reveals that the differences between typical domestic and international models are primarily manifested in four dimensions. First, the structure of cooperation entities—specifically, whether enterprises function as peripheral supporters or as full-process collaborative partners (Ferns et al. , 2025; Vuoriainen et al. , 2025). Second, the depth of student participation—that is, whether students are genuinely involved in key stages such as goal setting, process negotiation, scheme revision, and outcome review (Lamancusa et al. , 2008; Quirós-Alpera et al. , 2025; Boud et al. , 2026). Third, the evaluation and feedback mechanism—namely, whether evaluation remains at the level of outcome acceptance or evolves into process-oriented feedback and learning correction (Luk & Chan, 2024; Boud et al. , 2026; Quirós-Alpera et al. , 2025). Fourth, the mode of institutionalized operation—whether the project relies on short-term cooperation and individual initiatives, or has established a relatively stable system encompassing curriculum, mentorship, projects, and evaluation (Mordhorst & Jenert, 2023; Ferns et al. , 2025; Vuoriainen et al. , 2025).

The aforementioned comparative dimensions hold particular significance for business administration programs (Jackson, 2025; Brodsky et al. , 2024). This major emphasizes cross-departmental collaboration, problem diagnosis, resource integration, and continuous improvement. Therefore, the effectiveness of the collaborative education model depends not on whether the forms of cooperation “appear diverse,” but on whether students can receive ongoing feedback within real tasks and participate in value generation (Billett, 2025; Timperley & Schick, 2025; Petrescu et al. , 2026). Building on the comparative analysis above, it is evident that the differences between domestic and international models lie not primarily in the presence or absence of cooperation forms, but rather in the depth of cooperation, the position of student participation, the evaluation loop, and the degree of institutionalization (Billett, 2025; Brodsky et al. , 2024; Timperley & Schick, 2025). Accordingly, this paper further introduces value co-creation theory to explain how conditions for the collaborative education model translate into students’ learning outcomes during the project process (Petrescu et al. , 2026).

2.4 Explanatory Power of Value Co-creation Theory and Research Hypotheses

Value co-creation theory offers a meso-level explanatory framework for this issue. The theory posits that value is not pre-produced by a single actor and passively accepted by others; rather, it is continuously generated through the integration of multiple actors’ resources, information exchange, collaborative practice, and relational embedding (Vargo & Lusch, 2008; Payne et al. , 2008). Introducing this theory into research on industry-education integration implies that universities, enterprises, and students should no longer be understood as a unidirectional chain of “universities teach—enterprises apply—students learn,” but rather as a collaborative system jointly engaged in the process of talent cultivation (Matthews & Dollinger, 2023; Muelder et al. , 2025; Stensaker & Matear, 2025). Within this system, resource complementarity and support are manifested through the effective provision of key elements such as curricula, mentorship, tasks, data, learning

spaces, and feedback (Payne et al. , 2008; To, 2025). Collaborative design and depth of participation are reflected in whether students shift from passive execution to joint design, joint decision-making, and joint improvement (Matthews & Dollinger, 2023; Nieminen et al. , 2025; Muelder et al. , 2025). Interactional fairness and trust are demonstrated by the transparency of rules, fairness of evaluation, clarity of responsibilities, and stability of relationships during project implementation (To, 2025; Stensaker & Matear, 2025; Muelder et al. , 2025). Together, these three elements constitute the cooperative foundation for the collaborative education model (Vargo & Lusch, 2008; Payne et al. , 2008; To, 2025).

However, the cooperative foundation does not automatically translate into learning outcomes. Whether this effect can be achieved depends on whether students engage in substantive value co-creation behaviors during the project—such as active communication, knowledge sharing, task collaboration, solution optimization, joint problem-solving, and outcome co-creation (Omland et al. , 2025; Petrescu et al. , 2026; Babalola, 2024). Value co-creation behavior acts as a critical bridge through which external institutional arrangements are internalized into students' learning processes. When students are able to participate deeply and receive consistent feedback, the resource and relational advantages inherent in cooperation are more likely to translate into knowledge acquisition, competence development, and career adaptability (To, 2025; Bao et al., 2023; D'Souza et al. , 2025). Conversely, even when resources are abundant, insufficient participation or weak trust may hinder the attainment of high-quality gains (Pinna et al. , 2023; Omland et al. , 2025). Based on this, the paper posits the following research propositions: resource complementarity and support, collaborative design and depth of participation, and interactional fairness and trust all positively influence multi-dimensional learning outcomes; these effects are partially mediated through value co-creation behavior; and multi-dimensional learning outcomes further enhance students' intention to continuously participate. Accordingly, this study formulates an overarching analytical framework—"cooperative foundation—value co-creation behavior—multi-dimensional learning outcomes—continuous participation intention"—and proceeds with subsequent empirical testing and model comparison (Petrescu et al. , 2026; Bao et al. , 2023; Pinna et al. , 2023).

3. Research Design

3.1 Research Approach and Methodology Path

This paper adopts a research design combining literature comparison and questionnaire survey. First, by reviewing representative models of industry-education integration and the collaborative education model in both domestic and international contexts—such as Germany's dual system, America's cooperative education, Singapore's teaching factory, as well as domestic industry colleges, co-developed courses, and project-based practices—a comparative analysis is conducted across four dimensions: the structure of cooperation entities, depth of student participation, evaluation and feedback mechanisms, and modes of institutionalized operation. This analysis aims to identify institutionally embedded experiences that can inform local adaptation (Hermann & Fauskanger, 2025; Fisher et al. , 2025).

Second, this study focuses on university students participating in school-enterprise cooperation projects, with particular attention to their authentic experiences and subjective perceptions throughout the collaborative education model process. Selecting students as the primary observational subjects is based on two considerations. On one hand, students are the direct participants in industry-education integration projects and the ultimate bearers of whether cooperation conditions translate into learning outcomes; their perceptions most accurately reflect the actual quality of project implementation (Brodsky et al. , 2024; Stensaker & Matear, 2025). On the other hand, competence development in business administration programs is inherently process-oriented and context-dependent. Examining the process solely from the perspectives of university administrators or enterprise mentors makes it difficult to fully capture variations in students' goal understanding, task commitment, interaction and collaboration, and achievement acquisition (Lin, 2024; Brodsky et al. , 2024). From December 2025 to February 2026, the questionnaire was distributed through a combination of online and offline channels, and a total of 300 valid questionnaires were collected. In order to ensure data quality, the screening project is designed around the real project participation experience. Then clean up the data according to the response integrity, completion time and response mode to minimize the interference of invalid responses to the analysis results.

3.2 Variable Measurement and Analysis Approach

The questionnaire consists of 25 items, using the Likter 5-point scale, of which 1 means “very disagree” and 5 means “very agree”. The scale includes six dimensions: resource complementarity and support, collaborative design and depth of participation, interactional fairness and trust, value co-creation behavior, multi-dimensional learning outcomes, and continuous participation intention. Among them, the first three dimensions correspond to the cooperative foundation for the collaborative education model. Value co-creation behavior reflects students’ active communication, knowledge sharing, task collaboration, and outcome co-creation during the project. Multi-dimensional learning outcomes capture students’ overall experiences in terms of knowledge acquisition, competence development, problem-solving, and career-related gains. Continuous participation intention examines students’ willingness to continue participating in similar projects in the future. The dimensions and corresponding items are presented in Table 1.

Table 1 Variable Dimensions and Item Settings

Dimension	Item Scope	Number of Items
Resource complementarity and support	Q1—Q4	4
Collaborative design and depth of participation	Q5—Q8	4
Interactional fairness and trust	Q9—Q12	4
Value co-creation behavior	Q13—Q17	5
Multidimensional learning outcomes	Q18—Q21	4
Continuous participation intention	Q22—Q25	4

3.3 Reliability, Validity, and Common Method Bias Testing

To ensure the stability and applicability of the measurement instruments, this paper conducts reliability and validity tests on the scale. The results show that Cronbach’s α coefficients for each dimension range from 0.884 to 0.927, all significantly above the 0.80 threshold, indicating high internal consistency of the scale (Cronbach, 1951). Furthermore, the KMO value is 0.919, and Bartlett’s test of sphericity is significant ($p < 0.001$), suggesting that the sample data are suitable for factor analysis (Kaiser, 1974). Additionally, the number of factors with eigenvalues greater than 1 is six, aligning with the hypothesized six-dimensional structure, which indicates that the scale possesses good construct validity. The relevant results are presented in Table 2. Furthermore, this study conducted Harman’s single-factor test to assess the potential risk of common method bias. The results show that the first factor accounts for 39.10% of the total variance, which did not exceed the generally accepted threshold of 40-50%. This did not exceed the generally recommended threshold, indicating that the common method deviation is unlikely to become a serious problem in this study (Podsakoff et al., 2003).

Table 2 Reliability and Validity Test Results

Dimension / Indicator	Result	Evaluation
Resource complementarity and support	0.891	Reliability acceptable
Collaborative design and depth of participation	0.887	Reliability acceptable
Interactional fairness and trust	0.889	Reliability acceptable
Value co-creation behavior	0.927	Reliability acceptable
Multidimensional learning outcomes	0.901	Reliability acceptable
Continuous participation intention	0.884	Reliability acceptable
KMO	0.919	Suitable for factor analysis
Bartlett’s test of sphericity (p)	0.000	Correlation matrix not an identity matrix
Number of factors with eigenvalue > 1	6.000	Consistent with six-dimensional structure
Sample size	300.000	Meets analytical requirements

Overall, this paper follows the research logic of “literature comparison - theoretical construction - variable measurement - statistical inspection - application transformation”: First, find out the key differences between typical models at domestic and abroad through comparative research. Second, an analysis framework based on the theory of value co-creation is built. Third,

test the relationship between variables through descriptive statistics, correlation analysis and intermediary effect test. Finally, based on the comparison results, the mechanism optimization path suitable for business administration programs is proposed. This design not only enhances the explanatory power of the research conclusions, but also provides an empirical basis for subsequent application suggestions.

4. Empirical Results

4.1 Descriptive Statistical Analysis

From the overall distribution, the mean scores of all six core dimensions exceed the scale midpoint of 3, indicating that have a positive overall evaluation of the current school-enterprise cooperation project.

Resource complementarity and support received the highest score ($M=3.980$, $SD=1.034$), indicating that most projects have established a foundational level of mentor allocation, practical opportunities, and task resources. The mean score for continuous participation intention is also relatively high ($M=3.958$, $SD=0.990$), suggesting that students are generally willing to continue participating in similar projects. However, collaborative design and depth of participation received the lowest scores ($M=3.892$, $SD=1.039$), indicating that there remains room for improvement in engaging students deeply in goal setting, process negotiation, and outcome revision within current projects. Descriptive statistics for each dimension are presented in Table 3.

Table 3 Descriptive Statistics for Each Dimension

Dimension	Mean	SD
Resource complementarity and support	3.980	1.034
Collaborative design and depth of participation	3.892	1.039
Interactional fairness and trust	3.929	1.039
Value co-creation behavior	3.921	1.055
Multi-dimensional learning outcomes	3.928	1.059
Continuous participation intention	3.958	0.990

4.2 Correlation Analysis

The correlation analysis results indicate significant positive correlations among all six dimensions. Resource complementarity and support is significantly positively correlated with multi-dimensional learning outcomes ($r=0.459$, $p<0.01$), and collaborative design and depth of participation exhibit a higher correlation coefficient with multi-dimensional learning outcomes ($r=0.476$, $p<0.01$).

This shows that students' participation in the key project stage is closely related to their learning gains. In addition, interaction fairness and trust are significantly related to value co-creation behavior ($r=0.451$, $p<0.01$), showing that transparent rules and stable relationships are important prerequisites for stimulating co-creation. In addition, multi-dimensional learning outcomes are significantly correlated with the willingness to continue to participate ($r=0.452$, $p<0.01$), which shows that tangible income provides an important basis for the willingness to continue to participate in the future. The results of the correlation analysis for each dimension are presented in Table 4.

Table 4 Correlation Matrix for Each Dimension

Variable	1	2	3	4	5	6
Resource complementarity and support	1					
Collaborative design and depth of participation	0.434**	1				
Interactional fairness and trust	0.347**	0.425**	1			
Value co-creation behavior	0.293**	0.419**	0.451**	1		
Multi-dimensional learning outcomes	0.459**	0.476**	0.427**	0.410**	1	
Continuous participation intention	0.400**	0.477**	0.466**	0.352**	0.452**	1

Note: ** indicates $p < .01$.

4.3 Further Analysis of Main Effects

The results indicate that resource complementarity and support, collaborative design and depth of participation, and interactional fairness and trust each exhibit a significant positive relationship with multi-dimensional learning outcomes. Furthermore, value co-creation behavior is not only significantly associated with multi-dimensional learning outcomes but also plays a significant mediating role in the process through which the cooperative foundation influences learning outcomes. This suggests that the effectiveness of the collaborative education model does not arise solely from the amount of resource investment, but is gradually shaped through the dynamic interaction of resource support, depth of participation, quality of relationships, and students' co-creation behaviors. The results of the main relationship tests are presented in Table 5.

Table 5 Summary of Main Relationship Tests

Path	Correlation Result	Mediation Effect	Conclusion	Interpretation
Resource complementarity and support → Multi-dimensional learning outcomes	Significantly positive ($r = .459^{**}$)	Significant indirect effect via value co-creation behavior	Supported	Greater resource support is associated with more pronounced learning gains
Collaborative design and depth of participation → Multi-dimensional learning outcomes	Significantly positive ($r = .476^{**}$)	Significant indirect effect via value co-creation behavior	Supported	Deeper student involvement in key project stages leads to better learning outcomes
Interactional fairness and trust → Multi-dimensional learning outcomes	Significantly positive ($r = .427^{**}$)	Significant indirect effect via value co-creation behavior	Supported	Fair, transparent, and stable interactions facilitate the formation of learning outcomes
Value co-creation behavior → Multi-dimensional learning outcomes	Significantly positive ($r = .410^{**}$)	exerts a significant positive effect on learning outcomes	Supported	Active communication, knowledge sharing, and outcome co-creation enhance learning gains
Multi-dimensional learning outcomes → Continuous participation intention	Significantly positive ($r = .452^{**}$)	Shown as significantly positive in supplementary tests	Supported	Stronger learning gains lead to higher willingness to continue participating

4.4 Mediation Analysis

Based on the correlation analysis, this paper further employs Model 4 of the PROCESS macro (Hayes, 2022) to test the mediating role of value co-creation behavior. Specifically, resource complementarity and support, collaborative design and depth of participation, and interactional fairness and trust were entered as independent variables, value co-creation behavior as the mediator, and multi-dimensional learning outcomes as the dependent variable. The 95% confidence interval for the indirect effect was estimated using 5,000 bootstrap samples. The results show that resource complementarity and support significantly and positively predict value co-creation behavior ($a=0.299$, $p < 0.001$). When both resource complementarity and support and value co-creation behavior were included in the model, value co-creation behavior still exerted a significant positive effect on multi-dimensional learning outcomes ($b=0.302$, $p < 0.001$), and the direct effect of resource complementarity and support remained significant ($c'=0.380$, $p < 0.001$). The indirect effect was 0.090, with a 95% bootstrap confidence interval of [0.045, 0.150], which did not include zero. This indicates that value co-creation behavior plays a partial mediating role in the relationship between resource complementarity and support and multi-dimensional learning outcomes.

Further analysis shows that collaborative design and depth of participation significantly and positively predicted value co-creation behavior ($a=0.426$, $p < 0.001$), with an indirect effect of 0.109 and a 95% bootstrap confidence interval of [0.057, 0.171]. Similarly, interactional fairness and trust demonstrated a significant positive effect on value co-creation behavior ($a=0.458$, $p < 0.001$), with an indirect effect of 0.125 and a 95% bootstrap confidence interval of [0.067, 0.198]. The above results indicate that the cooperative foundation not only directly enhances students' multi-dimensional learning outcomes but also further strengthens these gains through value co-creation behaviors—such as promoting knowledge sharing, task collaboration, and outcome co-creation. Additional analyses reveal that value co-creation behavior, via multi-dimensional learning outcomes, further influences continuous participation intention, with an indirect effect of 0.142 and a 95% bootstrap confidence interval

of [0.084,0.209], again excluding zero. Thus, students' willingness to continue participating in similar projects is largely grounded in the tangible growth and developmental gains they attain during the cooperative process.

5. Comparative Analysis and Applications of Domestic and International Models

5.1 A Structured Comparison of Domestic and International Models

Based on the literature comparison, this study makes a structured comparison of international models and domestic practices from the four dimensions: the structure of cooperation entities, depth of student participation, evaluation and feedback mechanisms, and modes of institutionalized operation. Overall, the common feature of German dualism, American cooperative school management, Singapore teaching factory and other models is that enterprises are not peripheral supporters, but partners, deeply embedded in the whole process of talent training. Although domestic universities have made a variety of explorations in industry colleges, order-based training, practice bases, cooperative development courses, project-based teaching, etc., there are still obvious gaps in the depth of cooperation, continuous operation, and evaluation cycles (Gong, 2024). The comparative findings are presented in Table 6.

Table 6 Comparative Framework of Typical the Collaborative Education Models: Domestic and International

Comparative Dimension	Typical International Models	Main Domestic Practices	Implications for Business Administration Programs
Structure of Co-operation Entities	Enterprises are deeply embedded in the entire process, including curriculum goal setting, task design, mentor guidance, and evaluation feedback, with clear delineation of responsibilities between universities and enterprises.	Diverse forms of cooperation exist, but in some projects, enterprises still focus primarily on resource provision or endoutcome acceptance, with insufficient process cogovernance.	Shift from a “universitied, enterprisecooperative” model to “university–enterprise–student cocreation” and enhance enterprises' fullprocess participation.
Depth of Student Participation	Students are routinely involved in key stages such as goal setting, process negotiation, periodic review, and outcome improvement, resulting in a complete participation chain.	Some projects remain at the level of task execution, with students having limited early involvement in goal setting and evaluation criteria.	Enhance students' agency in problem identification, solution optimization, and outcome revision; facilitate their transition from executors to cocreators.
Evaluation and Feedback Mechanism	Emphasis on processoriented evaluation, job competency mapping, and dualmentor feedback; evaluation serves both outcome judgment and learning correction.	Many projects still focus on summative assessment or outcome presentation, with insufficient recognition of communication, collaboration, problemsolving, and innovative contributions.	Establish project logs, stage-based feedback forms, and outcome review meetings to form a traceable and modifiable evaluation loop.
Mode of Institutionalized Operation	Stable articulation of curricula, projects, mentorship, and evaluation systems; cooperation is sustainable and replicable.	Some cooperation depends on project applications or individual initiatives, with insufficient mechanism consolidation and limited capacity for replication and diffusion.	Develop project libraries, case libraries, and mentor libraries, and improve incentive and benefitsharing arrangements to enhance mechanism stability.

In terms of the structure of cooperation entities, typical international models tend to integrate enterprises into key stages such as curriculum goal setting, task design, mentor guidance, and evaluation feedback (Ferns et al. , 2025). In contrast, many domestic projects still face challenges such as uneven depth of enterprise participation, insufficient stability of cooperative relationships, and collaborative mechanisms that require further improvement (Li et al. , 2024). For business administration programs, this implies that enterprises should not merely provide positions at the end of a project or conduct outcome validation; rather, they should assume the responsibilities of process co-governance and feedback correction throughout the entire project (Ferns et al. , 2025; Li et al. , 2024).

In terms of student participation and evaluation feedback, typical international models place greater emphasis on students'

full-process engagement and process-oriented evaluation (Ferns et al. , 2025; Luk & Chan, 2024). The empirical results of this study show that collaborative design and depth of participation received the lowest mean scores, yet they exhibit a significant positive relationship with learning outcomes and demonstrate stable effects within the mediation model. This finding suggests that the main weakness of domestic projects is not a severe shortage of resources, but rather that students have yet to fully transform from “executors” into “co-creators. “Concurrently, international models emphasize job competency mapping, workplace mentor/supervisor evaluations, self-reflection, and continuous feedback (Luk & Chan, 2024). Similarly, studies conducted in the Chinese context indicate that school–enterprise collaboration and quality culture significantly influence students’ perceived employability and developmental outcomes (Li et al. , 2024). This suggests that for domestic universities seeking to enhance the quality of the collaborative education model, the key lies not simply in increasing the number of cooperation projects, but rather in deepening the level of cooperation, strengthening evaluation loops, and advancing the degree of institutionalization (Li et al. , 2024; Luk & Chan, 2024).

5.2 Institutional Implications for the Collaborative Education Model in Domestic Universities

The comparison results show that the direction of optimizing the collaborative education model of domestic colleges and universities in the future is not simply to increase the number of cooperation projects, but to deepen the level of cooperation and enhance the completeness of the underlying mechanism (Curto-Reverte et al. , 2025; Li et al. , 2024). First, the project design logic should gradually change from the model of “university-led, enterprise cooperation, student participation” to the model of “university-enterprise-student co-creation” to ensure that students participate in goal understanding and task negotiation from the initial stage of the project (Bovill & Woolmer, 2019; Cruz et al. , 2024). Second, enterprise participation should be promoted from “resource investment” to “process co-governance”, so that enterprises can truly participate in key links such as curriculum design, task decomposition, stage feedback, and performance evaluation, not just provide positions. Third, the focus of evaluation in the collaborative education model should be shifted from outcomes to process tracking, thereby establishing a continuous learning correction mechanism through periodic feedback, problem review, and outcome iteration (Luk & Chan, 2024; Smith et al. , 2025).

More importantly, the empirical findings indicate that the effects of resource complementarity and support, collaborative design and depth of participation, and interactional fairness and trust on learning outcomes are not simply direct. Value co-creation behavior plays a significant partial mediating role in this process. This implies that when promoting industry-education integration, universities should not focus solely on the “coverage of cooperation” or the “number of cooperation agreements. “ Instead, greater attention should be paid to whether students genuinely engage in active communication, knowledge sharing, joint problem-solving, and outcome co-creation during the projects (Cruz et al. , 2024; Li et al. , 2024). In other words, the core of the collaborative education model lies not in whether a project exists, but in whether it can stimulate high-quality co-creation behavior. Whether this kind of co-creation behavior occurs depends on the exchangeability of resource supply, the accessibility of participation mechanisms and the predictability of interaction relationships (Bovill & Woolmer, 2019; Cruz et al. , 2024). Therefore, domestic universities need to shift from “focusing on formal construction” to “focusing on mechanism generation” to ensure that institutional design is transformed into specific project operation, so that students can perceive, participate and get practical returns (Li et al. , 2024; Smith et al. , 2025).

5.3 Practical Implications for Business Administration Programs

Based on the comparative and empirical findings above, this paper proposes three application suggestions. The first suggestion is to restructure the project chain to enhance task authenticity and deepen student embeddedness. Business administration programs can establish a project closed-loop centered on authentic enterprise problems, encompassing “problem identification—solution justification—execution and implementation—data analysis—outcome presentation. “ In this way, it integrates course teaching, enterprise tasks, competition training and practical assessment, so as to avoid the project staying at the level of field investigation or fragmented task participation (Naseer et al. , 2025; Ferns et al. , 2025). During the project initiation phase, it is essential to clearly define the decision-making and negotiation points in which students can participate, enabling them to understand the project goals, performance standards, and organizational constraints from the outset, thereby enhancing the quality of their participation (Ruskin & Bilous, 2020; Smith et al. , 2025).

The Second suggestion is to establish a closed-loop process evaluation system that embeds learning outcomes into project operation. Schools and enterprises can jointly formulate an evaluation framework suitable for business administration majors, and include the quality of task completion, communication and collaboration, problem solving, solution optimization, reflection and improvement, innovation contribution, etc. into continuous evaluation. Through methods such as dual-mentor consultations, stage-based feedback forms, project logs, and outcome review meetings, evaluation can function as a genuine mechanism for learning correction (Luk & Chan, 2024; Smith et al. , 2025). For students, the most beneficial factor is not a one-time score, but ongoing and targeted feedback received throughout the project (Luk & Chan, 2024). For teachers and enterprise mentors, evaluation should also serve as a crucial means of identifying co-creation behaviors and adjusting the forms of project support (Ruskin & Bilous, 2020; Luk & Chan, 2024).

The Third suggestion is to institutionalize collaborative mechanisms to enhance the sustainability and replicability of cooperation. Universities should establish project libraries, case libraries and tutor libraries, constantly accumulate enterprise tasks, course results and student project suggestions, and form reusable resources of the collaborative education model. At the same time, a clearer incentive mechanism should be formulated to give institutional recognition to enterprise tutors who continue to invest, instructors who undertake project transformation tasks, and students with excellent performance in project participation, so as to reduce cooperation over-reliance on personal enthusiasm (Curto-Reverte et al. , 2025; Li et al. , 2024). For business administration programs, the key to institutionalization lies in maintaining a sustained alignment between authentic enterprise needs and course competency goals, thereby ensuring that projects function not merely as short-term practical activities, but as stable mechanisms integrated throughout the talent cultivation process (Ferns et al. , 2025; Curto-Reverte et al. , 2025). In addition, it is necessary to explore collaborative incentive mechanisms between universities and enterprises in areas such as project outcomes, mentorship input, resource support, and talent cultivation effectiveness, thereby transforming the collaborative education model from short-term cooperative arrangements into a stable operational mechanism (Li et al. , 2024; Ruskin & Bilous, 2020).

6. Conclusion and Future Directions

This paper adopts a research method that combines literature comparison and student experience survey. Through the comparative analysis of the typical industry-education integration and the cooperative education model at home and abroad, a six-dimensional analysis framework of resource complementarity and support, collaborative design and participation depth, interaction fairness and trust, value co-creation behavior, multi-dimensional learning results, and willingness to continue to participate is built. The empirical investigation was conducted with university students participating in school–enterprise cooperation projects as the research subjects. The research findings are as follows: First, the sampled students generally hold a relatively positive evaluation of industry-education integration and the collaborative education model; however, collaborative design and depth of participation remain relatively weak. This indicates that while most current projects have established a foundation in resource provision, they still exhibit notable shortcomings in stimulating student agency. Second, resource complementarity and support, collaborative design and depth of participation, interactional fairness and trust, and value co-creation behavior are all significantly positively correlated with multi-dimensional learning outcomes, and exhibit stable effects within the mediation model. This suggests that the effectiveness of the collaborative education model stems from the joint action of multiple mechanisms. Third, value co-creation behavior plays a partial mediating role in the process through which the cooperative foundation influences learning outcomes, and multi-dimensional learning outcomes further affect continuous participation intention. This indicates that whether students are willing to invest long-term in industry-education integration projects fundamentally depends on whether they achieve genuine growth through the cooperation.

This paper offers both theoretical and practical contributions. Theoretically, it integrates “cooperative foundation—value co-creation behavior—learning outcomes—continuous participation intention” into a unified explanatory chain. Through literature comparison, it also supplements the structured dimensions for analyzing domestic and international models, thereby enhancing the meso-level explanatory power of the collaborative education model mechanisms within business administration programs (Omland et al. , 2025; Curto-Reverte et al. , 2025). Practically, the findings reveal that in promoting industry-education integration, domestic universities should shift their focus from “emphasizing form and quantity” to

“prioritizing process, mechanism, and transformation” (Ferns et al. , 2025; Luk & Chan, 2024; Li et al. , 2024). Despite the contribution, this research still has some limitations. First, the data mainly comes from students’ self-reports, and does not integrate the multi-source views of teachers and enterprise mentors. Second, it is difficult to capture the dynamic changes at different stages of the project using cross-sectional data. Third, the comparison of international models is mainly based on the synthesis of literature review and typical cases, and does not include the original transnational survey data. Future research can be combined with case interviews, vertical tracking and cross-regional comparisons to further explore the differences in collaborative education model mechanisms in the context of different types of institutions and projects. In the end, only by truly putting students at the center of co-creation can the integration of industry and education evolve from “cooperative arrangement” to “capacity generation mechanism” (Omland et al. , 2025; Li et al. , 2024).

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Conflict of Interests

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

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The Nexus of Curricular Reforms and Teacher Preparation: Assessing Pedagogical Content Knowledge and Instructional Alignment in Zimbabwe's Competence-Based Mathematics Framework

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Abstract: This study scrutinizes the congruence between pedagogical content knowledge and the competencies of pre-service primary teachers within the context of Zimbabwe's competence-based mathematics curriculum. Addressing the gap as to how adequately teacher training institutions prepare pre-service teachers for the requisite pedagogical content knowledge—compelling them towards critical pedagogy in mathematics teaching—an area concerning teachers, who as implementers of conceived reforms determine their success, was taken into account. The research underscores the need for adequately trained mathematics teachers embracing the contemporary Zimbabwean educational paradigm which moves away from purely content-driven curricula towards competence-based approaches. Mathematicians turned educators willing to think beyond some 'safety net' of content mastery face a syntactic maze demanding them to possess not just sound knowledge on mathematical concepts but also sophisticated strategic teaching techniques geared towards fostering learners' reasoning, problem-solving abilities, and their adeptness at applying learned material in real-life contexts. The study employed a mixed-methods research design comprised of structured questionnaires administered to 341 pre-service primary teachers as well as in-depth interviews with 30 participants, from whom qualitative data were withdrawn. Quantitative analyses stemming from the questionnaire data revealed gaps among pre-service teachers pertaining to levels of PCK which, in tandem with strengths across certain content areas while lacking significantly in others remained absent within effective use of technology and differentiated instruction integration contributed towards awarding these coexisting, paradoxical phenomena upon diverging pathways toward self-discovery. Results indicated that there is a gap between the concentration on active learning in the course and pre-service teachers' predominant use of passive traditional teaching techniques. Finally, this study showed that although pre-service teachers have some grasp of mathematical concepts, their pedagogical content knowledge (PCK) and instructional skills educational level does not meet the expectations of the competence-based mathematics curriculum in Zimbabwe. It calls for an urgent review of programs aimed at equipping teacher trainees with PCK to enable them to effectively teach in rigorous reformed curriculum contexts, including better focus on inquiry teaching, assessment for learning, and use of manipulatives and technologies.

Keywords: Pedagogical Content Knowledge; Pre-Service Primary Teachers; Competence-Based Curriculum; Mathematics Education; Teacher Education; Curriculum Reform; Teacher Preparation; Zimbabwe

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1. Introduction

Any educational system is fundamentally built on the effectiveness of its teachers, especially their pedagogical content knowledge (PCK). The blending of subject matter with relevant teaching strategies forms PCK, which helps in translating curriculum content into learning (Adipat et al., 2023). Pre-service educators are poised to become the mainstay of a country's education system. Hence, exploring the gaps between their PCK and skills and curricular expectations becomes important. It is also equally essential to study whether pre-service primary teachers can deliver instruction aligned with the Zimbabwean competence-based mathematics curriculum's core principles which emphasizes application and problem solving. This study explores this gap towards understanding the level of preparedness that primary school teacher trainees have in nurturing mathematical competencies among children in Zimbabwean primary schools.

On a global scale, teacher PCK and its relationship with curriculum changes has received attention from researchers. For example, Singapore is internationally recognized for its mastery of mathematics education as the teachers' colleges train them to deliver deep PCK tailored to national emphasis on modeling, problem solving, and conceptual understanding (Choy & Dindyal, 2024). Equally important is Finland's reputation for having a more progressive approach wherein educators are being trained to emphasize creative and critical thinking which aligns with the student-centered focus of the curriculum (Ridwan, 2024). Closer to home in Kenya and South Africa where there is an emerging interest in competence-based curricula, there have been some studies observing gaps between their pre-service training and teaching practice competencies required to successfully teach these curricula. Within Zimbabwe, the adoption of a competence-based curriculum raises concern about how well pre-service teacher education programs equip students with appropriate PCK and skills necessary for quality mathematics instruction.

With the adoption of a competence-based curriculum aimed at equipping learners with relevant 21st-century skills and knowledge, Zimbabwe undertook a notable educational reform. This revision places emphasis on comprehension and application of problem solving and critical thinking alongside the use of mathematics in real-world contexts. Nevertheless, the successful execution of this curriculum is greatly dependent on teachers' readiness, especially their skill to meet the curriculum goals through meaningful engaging lessons crafted around active learning paradigms. While some time has elapsed since the introduction of the new curriculum, one looks in vain for studies exploring its alignment with pre-service primary level teacher training pedagogy—curriculum taught at degree granting colleges—and pedagogical content knowledge and skills (Mufanechiya, Kanyopa and Mokhele-Makgalwa, 2024). There appears to be an evidence-based divergence between policy objectives pertaining to curricular reforms and actual classroom practices informed by these policy practices. Risiro (2021), for example, reported that a number of teachers were unable to adopt activity-based learning approaches due to lack of proper training and resources.

In addition, the preliminary observations conducted in primary grade levels indicate a persistent use of a teacher-centered approach within the teaching of mathematics, which may be detrimental to the cultivation of competencies (Sunzuma and Luneta, 2023). The aim of this study is to address the gap in understanding the degree and one pre-service teachers' PCK and competencies with respect to Zimbabwe's competence-based mathematics curriculum syllabus. This lack of understanding will likely undermine attempts to refine teacher education initiatives. Informed by the existing gap, this study has outlined the following objectives: 1) to measure the pedagogical content knowledge (PCK) of pre-service primary teachers in mathematics within the framework of Zimbabwe's competence-based curriculum. 2) To assess the pre-service primary teachers' competencies in applying relevant and effectively challenging teaching processes that foster problem-solving, critical thinking, and practical use of mathematics. 3) To assess emphases of pre-service teachers on their training gaps toward effective delivery of a competence-based education in comparison to other educational curricula. 4) To formulate suggestions aimed at Zimbabwean primary teacher education policies which relate more directly with curricular demands and thereby improve the teaching of mathematics in primary schools. Thus far, this study seeks to examine comprehensively how aligned PCK and skills of pre-service primary teachers are with Zimbabwe's advanced requirements for a competence-based mathematics curriculum.

2. Literature Review

Any curriculum implementation, especially one as sophisticated as Zimbabwe's competence-based mathematics curriculum, relies heavily on the readiness of its instructors. This review focuses on the critical alignment between the PCK and competencies of pre-service primary teachers with the requirements of the new curriculum. Understanding this gap is important to project outcomes in teacher education and inform school-based teacher education programs in relation to intended outcomes.

2.1 Defining Pedagogical Content Knowledge (PCK) in Mathematics

The definition of teaching efficacy shifted with the introduction of Pedagogical Content Knowledge (PCK) by Lee Shulman in 2013. Teaching effectiveness is not solely centered on subject matter knowledge or pedagogical techniques; rather, it involves an integration of both. To effectively teach mathematics (or any other subject for that matter), one needs to possess PCK, which goes beyond knowing the content to encompass instructional strategies tailored towards alleviating students' developmental hindrances (Shulman, 2015). This suggests that students should appreciate a great deal more than what is sophisticated in the learning process. Rather, it requires the ability to appropriately represent appealing and engaging ideas at different levels, along with a deep grasp on why these ideas matter for learners. Such understanding expands far beyond simply knowing what makes learners tick within their heads to appreciate how deep phenomena connects with mental models long after they learn that material.

Building upon Shulman's seminal contributions, Grossman and Fraefel editors (2024) have done a remarkable job of extending the boundaries of PCK by adding elements such as knowledge of curriculum and assessment. This is important in light of curriculum developments such as Zimbabwe's competence-based curriculum which is focused on the application of theory into practice (Sunzuma et al., 2025). A teacher with strong PCK would understand the mathematics not just as abstract concepts but how it was vertically and horizontally integrated within the educational curriculum framework, across grade levels, other subjects and how to assess students' grasp of key concepts aligned with curriculum expectations. It requires a sound grasp of the instructional outcomes, the metrics used for evaluation, and philosophy underpinning teaching captured within the curricular architecture. In addition, it requires adaptability in terms of modifying teaching styles to effectively deliver lessons and embrace all learners in their differing abilities. Aligning instruction and assessment with robust PCK makes one stand out among fellow educators.

The particular facets of PCK applicable to mathematics are intricate and demand a particular form of knowledge that goes beyond pedagogy. This includes the aspect of a teacher's knowledge—a sophisticated acquaintance with the framework of mathematical knowledge—enabling them to understand how various concepts intertwine and navigate students through their intellectual pathways (Ormond, 2021). Moreover, it includes identifying strategies for teaching which represent mathematical concepts through physical materials, drawings, contemporary technology, or even real life scenarios so as to foster learning appreciation among pupils (Difficulties) learners who decode information in diverse ways. A teacher endowed with great PRU can change Spanish to English freely and explain varied aspects effortlessly taught over different pupils' responses during lessons (Matitaputty et al., 2024). Sakaria, Maat and Matore (2023) note KCS and KCT as vital components associated with PCK in mathematics. KCS encompasses recognizing the pre-conceived notions students have as well as their misconceptions about certain mathematically defined ideas (Borke, 2021). Evaluating PCK requires special attention within professional training programs offered to instructors.

PCK in Mathematics can be evaluated using different tools and techniques like self-assessments, lesson plan critique for assessment integration, as well as classroom evaluation where teachers' instructional activities are systematically elaborate (Moh'd, Uwamahoro and Orodho, 2022). Advanced teaching strategies designed to develop PCK among pre-service teachers include courses tailored specifically to the pedagogy of mathematics through its teaching components, lesson study where instructors work together to plan, implement, observe, and critique lessons on teaching practice, and practical teaching placements accompanied by rigorous reflective frameworks so that pre-service teachers may grasp the connection between theory and practice while developing their PCK (Asvat, 2024). As has been established earlier in this chapter with the aid of a number of cited experts who contributed to the body of literature concerning PCK development it is a gradual process which

demands relentless thought and endeavor. It builds through teaching experience complemented by professional development activities such as collaboration with peers or engagement with scholarly work aimed at advancing one's understanding of PCK alongside enhancing instruction in mathematics.

2.2 Competence-Based Curriculum: Global Trends and Zimbabwe's Context

Competence-based education (CBE) is a transformative approach to teaching and learning that moves away from the traditional hours-based, content-driven, curriculum towards focusing on demonstration of mastery of specific skills and knowledge (Mwita, 2023). At its core, CBE stresses authentic assessment, self-directed pathways through personalized learning experiences, and outcome-based education with planned results that are frequently aligned with real-life scenarios (Catacutan et al., 2023). The focus stands in stark contrast to traditional models which center on rote memorization and standardized testing. This has led to widespread advocacy for the adoption of CBE. Countries such as Finland, Canada, and Australia have led the way by incorporating CBE into their educational frameworks, often utilizing strategies like flexible pacing, competency-based grading, and individualized learning plans tailored to diverse student needs and learning styles (Javed, 2025). These global cases provide important lessons on what national policy makers need to consider when contemplating the adoption of CBE within an entire educational system, as well as highlight the urgency for a shift in approach designed to equip students for the ever-changing demands of a 21st century workforce.

Zimbabwe's curriculum in mathematics integrates education with national development priorities by focusing on acquiring practical skills and relevant problem-solving capabilities. Notable elements of this curriculum include core competencies which students are to develop during their mathematical education, including critical thinking, communication and the application of mathematics to real-world situations (Mashingaidze, Mukaro and Chauraya, 2024). Within these frameworks, assessment criteria shift from conventional examinations to more authentic forms such as project assignments, portfolios, and performance-based tasks where students demonstrate the application of skills gained (Age, 2025). The strategies for teaching that have been suggested span active learning focused on student collaboration within problem-centered contexts to use of appropriate technological tools that stimulates learning and understanding of mathematics (Fadzil and Osman, 2025). An intensive review of other available curriculum documents highlights an intentional gap in the development of a mathematically literate population who will be able to participate meaningfully in the nation's socio-economic growth.

As promising as CBE is, its benefits come with complex challenges and opportunities related to its implementation. Moving away from standardized testing toward authentic assessments design calls for a complete overhaul in teacher-training programs concerning evaluative processes shaped at measuring student competencies. In addition, personalized learning pathways alongside flexible pacing systems demand a monumental shift in school culture, structure, and resources (Idowu, 2024). Moreover, ensuring equitable outcomes is especially important with regard to the systemic underlying issues of resource distribution and technology that can disproportionately widen competence gaps among students from varying socioeconomic backgrounds (Peer, 2024). That said, the successful overcoming of these obstacles stands to significantly improve student engagement as well as skill development for workforce demands while advancing some core principles of equity within education: more effective delivery systems and preparation for success in the 21st century.

2.3 Alignment of PCK and Competence-Based Mathematics Education

The alignment of pedagogical content knowledge (PCK) with the objectives of the curriculum remains one of the key sustaining elements to effectively integrate competence-based mathematics education (CBME). The nature of teaching within a CBME framework requires that educators have granular understanding of what specific competencies are expected at each level, and how to design rich learning experiences that cultivate these competencies (Gustafson et al., 2024). In addition, teachers must accurately assess progress in relation to the defined competencies. This transformation focuses on PCK that leads to stronger emphasis in formative assessment and differentiated instruction designed for real-time understanding.

With respect to evaluation, a focus on formative assessment invites new possibilities from teachers beyond predefined curriculums toward more responsive educational frameworks where dynamic understanding shifts shaped by ongoing assessment guide learning pathways (Yadav et al., 2025). Achieving this goal fundamentally alters the educator role from standing at the front to facilitate the application of critiqued mathematical skills tailored through active assessments.

Looking internationally at the implementation of competence-based curricula aids in understanding the best approaches and possible gaps that may exist in integrating PCK with curriculum objectives. Singaporean research underscores the need for teachers to comprehend how to foster deep conceptual understanding along with engaging problem-solving task design, as this is essential for effective teacher training (Toh and Chua, 2025). Investigations into the impact of teacher PCK on student performance in CBE have consistently shown that teachers possessing robust PCK are far better equipped to facilitate learner progression towards attaining competencies (Koh and Wang, 2024). These studies emphasize the importance of ongoing training focused on enhancing educators' grasping of defining competencies, assessment methods, and tailor instruction designed to address all levels of a diverse classroom population.

Nevertheless, a possible misalignment between pre-service teachers' PCK and the expectations of a CBME curriculum like the one used in Zimbabwe is something that needs to be addressed. These gaps may result from lack of content knowledge, lack of knowledge regarding the assessment of competencies, or challenges in crafting instructional activities aimed at particular competencies (Cabauatan Jr and Dacles, 2021). Suggested mitigation strategies include advancing targeted professional development addressing those gaps within teachers' PCK frameworks, mentorship programs pairing veteran teachers and novices to CBME, and the development of systematic curriculum materials for educators which promote teacher education focused on implementing competence-based teaching (Tsarkos, 2024). Actively addressing these mismatches with appropriate support would strengthen teachers' PCK to implement and sustain competence-based mathematics education as a cross-subject instruction framework.

2.4 Pre-Service Teacher Education and PCK Development in Mathematics

The teaching methodologies and syllabus offered in pre-service programs for mathematics teachers significantly influence their future educators' Pedagogical Content Knowledge (PCK). While some programs follow a conventional approach with an emphasis on 'content' knowledge, others attempt to foster innovative understanding of how students learn mathematics (Rehman, Huang and Mahmood, 2025). The ability of these teacher-training programs to adequately prepare their students for competence-based education depends on the integration of practical experience and theory – how well the pre-service teachers are trained/tested on the content as far learning outcomes is concerned, and what skill sets are in place to enable them encourage effective learning at all levels (Mpate, 2025). More effective practices revealed through research include constructivist approaches, problem-based learning or technology-focused methodologies aimed at developing PCK.

Practical experiences and mentor-ships are important for the formation of PCK because they allow pre-service teachers to use their theoretical knowledge in tangible class-room situations. The learners' context is equally important, as situated experience like teaching or doing an internship is crucial to gain an understanding of the art of teaching (Bay 2021). Mentorship helps everyone, but specifically aids pre-service teachers in gaining access to guides who are seasoned professionals with ample skills for offering feedback and modeling ways of effective teaching. These structured mentorships form a strong coherence with competence oriented pedagogical goals which gives pre service teachers an upper hand towards teaching learning diversity within classrooms, innovative pedagogical techniques and addressing the varied learning levels presented by different students in one classroom (Nesje and Lejonberg 2022). Attention needs to be given on how practical experiences are framed so that they include reflective thinking, collaboration, and improvement through iteration, seamless design loops driven by analysis, and refinement cycles based on self-assessment.

Assessment as well as feedback are critical components of pre-service teacher education in relation to developing PCK, both in shaping it and recognizing the need for improvement. Various approaches such as self and peer assessments, lesson plan evaluations, and classroom observations can be leveraged to assess PCK (Yadav et al., 2025). Feedback guides reflection for action, with its effectiveness calling on specificity, timeliness, and the provision of clear next steps. Pre-service teachers should aim to refine their practices based on reflective thinking influenced by effective feedback. Data-driven formative assessment mechanisms beset with technology offer promising avenues for providing tailored support through pre-defined metrics enabling pre-service teachers to monitor their performance while identifying recurring themes that warrant closer inspection within their practice (Huijin & Eunjeong, 2023). Moreover, encompassing peers alongside instructors and clinicians into collaborative assessment design may drive collective responsibility aimed at rigorously preparing proficient

mathematics teachers through embedded continuous improvement cycles.

2.5 Challenges and Opportunities for Zimbabwe's Context

The ongoing resource deficits and infrastructural inadequacies within Zimbabwe's education system pose considerable obstacles to the effective teaching of mathematics and the development of Pedagogical Content Knowledge (PCK) in pre-service teachers. Limited access to technology, overcrowded classrooms, inadequate classroom resources such as textbooks and manipulatives, along with a lack of trained specialists negatively impact quality mathematics instruction (Graham, 2023). Moreover, rural schools are particularly vulnerable to these constraints because qualified teachers often have little to no access to basic goods essential for teaching or critical to their occupation, which exacerbates the already insufficient levels of quality mathematics education available (Mncube, 2023). The limited range of appropriate educational materials combined with a lack of training on how best to use the provided materials makes it harder for pre-service teachers to develop strategies and a sound understanding of the mathematical concepts that are crucial for successful PCK development (Olawale, 2024). Addressing any one of these challenges within this framework calls for more inventive approaches including utilizing locally available materials or incorporating technology where it is possible alongside providing funding and advancing infrastructure development.

The considerations of culture and society are equally important with respect to mathematics education in Zimbabwe. Attitudes emanating from cultural systems typically impose certain traditional constraints with regard to the teaching and learning of mathematics. For example, mathematics is generally viewed as a complex or very abstract discipline, which tends to be the case when students are exposed predominantly to rote learning strategies. This perception leads to a lack of commitment amongst learners (Emelda, Mubemba and Thelma, 2024). Moreover, some traditional cultural views may shape attitudes towards the subject which are not encouraging especially towards women where it has been suggested that societal expectations are designed towards lower participation and achievement in STEM (Msambwa et al., 2024). On the positive side, community engagement can greatly enhance the learning of mathematics. For instance, organizing parents and community members into structured numeracy workshops or problem-solving sessions enhances their perceived value towards mathematics which aids in creating a supportive atmosphere for learning (Tytler, Anderson and Williams, 2023). These factors reveal that sociology and culture provide greater understanding in addressing equity issues within curriculum frameworks focused on all learners.

To advance Pedagogical Content Knowledge (PCK) development among pre-service primary teachers in Zimbabwe within the existing limitations, a number of recommendations are vital. As pointed out by Sujatha and Vinayakan (2023), curriculum design must focus on practical relevance by integrating mathematical concepts with students' daily lives and cultural heritages. Also, teacher education logistics have to include active learning modalities like collaborative problem-solving, lesson study, and microteaching that enable reflection-focused hands-on experiences for pre-service teachers to deepen their PCK (Kehinde, Foluso and Dupe 2024). Assessment efficacy should include use portfolio frameworks with performance tasks and situated assessments that illustrate students' comprehension of mathematical principles along with their application skills across varied contexts. Lastly, equitable allocation of resources must ensure access disparities controlled vis-a-vis access to technology and professional development materials for all educators irrespective of geographical location or school setting. Grounded on the principles of equity, access, and quality alongside these recommendations strengthens preparedness amongst all educators to meaningfully deliver a competence-based mathematics curriculum while equipping learners with confident maths skills shaped them as successful learners during foundational years of schooling.

2.6 Theoretical Framework

Many theoretical perspectives already exist that help examine the alignment of Pedagogical Content Knowledge (PCK) and competencies of pre-service primary teachers with Zimbabwe's competence-based mathematics curriculum. To begin with, Shulman's PCK framework is critical to assess the scope of a teacher's subject matter knowledge in relation to his or her pedagogical knowledge. It captures the fact that teaching mathematics at any level requires more than just the bare content; it demands knowing how learners understand—or fail to understand—the subject and how best the content can be presented and modified to suit different learning styles. This framework supports inquiry into how prospective teachers are acquiring

their capacity to transform mathematics knowledge into forms that are accessible and applicable to their students, bearing in mind the Zimbabwean syllabus in which functional and practical skills dominate.

Second, learning theory constructivism as developed by Piaget and Vygotsky offers insight into how pre-service teachers facilitate mathematics teaching and learning as an active process of meaning-making. This framework indicates that learners develop understanding of the mathematical concepts through engagement with their environment and peers. Thus, it becomes critical in determining whether or not pre-service teachers have the competencies needed to create appropriate instructional contexts where learners grapple actively with challenging mathematical problems instead of being recipients of information passively. Understanding this situation requires an examination of teacher's activities, methods used, and group work techniques employed – problem-solving – to determine the level at which pre-service teachers have been prepared to design activities' aimed at developing learners understanding toward the mathematical concepts articulated in the competences-based curriculum of Zimbabwe.

Ultimately, Bandura's social cognitive theory sheds light on the evolution of self-efficacy and its influences on pre-service teachers' implementation of the competence-based curriculum. This theory suggests that the belief an individual holds regarding their ability to perform a specific task has considerable bearing on motivation, effort, and persistence. In terms of mathematics education, pre-service teachers with high self-efficacy are more likely to adopt new teaching models, visit obstacles head-on, and foster positive learning environments for their students. Therefore, this framework allows researchers to investigate how pre-service teachers' self-efficacy calibrates against their PCK skills in relation to Zimbabwe's mathematics curriculum—examining where gap theories may exist to intervene and aid in boosting teaching confidence and effectiveness.

3. Research Methodology

This study aims to examine the congruence of Pedagogical Content Knowledge (PCK) and associated competencies of pre-service primary teachers with the expectations of Zimbabwe's competence-based curriculum in mathematics. Given that the curriculum seeks to develop and assess problem-solving, critical thinking skills, and application of mathematics in everyday situations, it is important to evaluate whether PCK is adequately provided by teacher preparation programs. In this part, I describe the methods that were used including: research strategy and design; philosophy, sampling techniques and instruments used; pilot study testing; analysis done with collected data; measures taken concerning reliability and validity; as well as ethical aspects regarding the study.

3.1 Research Approach

This study employed a mixed-methods research approach. As described by Shan (2022), mixed methods encompass the collection, analysis and integration of qualitative and quantitative data within a single study or multiple interrelated studies. This approach was chosen in order to understand more fully the complex interplay between pre-service teachers' pedagogical content knowledge (PCK) and the demands of the competence-based curriculum. Quantitative measurement of PCK through structured questionnaires enabled us to gauge PCK levels among a larger sample of pre-service teachers. The qualitative data from interviews contextualized and deepened our understanding regarding the challenges pre-service teachers faced, thus enriching and expanding the quantitative data. The rationale for this approach aligns with the pragmatic paradigm as discussed by Dawadi, Shrestha and Giri (2021), which focuses on the implications of conducting research. One of the purposes of the study was to improve teacher education programs in Zimbabwe which necessitated both qualitative and quantitative approaches.

3.2 Research Design

The study utilizes a convergent parallel mixed-methods design which is a subtype of mixed-methods design where both qualitative and quantitative data are collected and analyzed separately before being integrated or merged in the interpretation stage (Bhairawa et al., 2022). Within this framework, qualitative and quantitative data are treated with equal significance. The quantitative component gathered through questionnaires, yielded a statistical snapshot of preservice teachers' PCK. At the same time, qualitative data garnered through interviews illuminated the intricate challenges and opportunities pertaining to the implementation of the competence-based curriculum in more nuanced detail. This is an appropriate design because

it provides multiple ways of validating and triangulating findings thereby enhancing claimed rigor and credibility for understanding the phenomenon under investigation. In this regard, therefore, achieving the objectives aligned with identifying areas of convergence as well as divergence offered robust insights into pre-service teachers collaboratively revealing alignment (or misalignment) derivatively framed between their PCK and curriculum requisites quantified through mixed results encapsulated qualitatively juxtaposed against quantitatively interpreted outcomes.

3.3 Research Strategy

The selected research methodology is a combination of surveys and case studies all tied together with a mixed-methods approach. The survey method collected quantitative data from a large group of pre-service teachers which makes the data more reliable and the results could be generalized (Johannesson et al., 2021). A structured questionnaire which was sent to the participants made it possible for every one of them to respond to identical questions, making it easier to intercompare answers and distinguish uniform responses through comparison analysis. Simultaneously, a case study strategy was applied for the qualitative part which entailed interviewing a small number of pre-service teachers in detail. This case study contributed towards evidence on broad contextual inquiry that was also purposefully quantitative in nature (Hancock, Algozzine and Lim, 2021). These two strategies combined within the mixed-methods framework provided an extensive understanding of the research problem at hand. For this study, the philosophy of research that applies is pragmatism.

3.4 Research Philosophy

Focusing on the work of Shook (2023), we can describe pragmatism as paying attention to the practical outcomes of the research and why a particular method is chosen. This approach works in practice because it does not impose a rigid binary choice between positivism and interpretivism; rather, it considers what is most useful within a given framework (Gillespie, Glăveanu and de Saint Laurent, 2024). In this case, mixed-methods research design is justified from a pragmatic perspective. It incorporates both quantitative and qualitative data to deepen understanding of the situation at hand and make more informed decisions—actionable insight. The focus here is on generating knowledge aimed toward actionable insights intended for designing teacher education programs or realigning pre-service teachers' pedagogical content knowledge with the demands of teaching the competence-based curriculum in mathematics.

3.5 Sampling/Sampling Techniques/Population of the Study

The study's sample frame includes all pre-service primary teachers training in the established teaching colleges of Zimbabwe, particularly those who are completing their practical's and about to transition into the primary teaching workforce. This is important because these are the educators that would be in charge of actualizing the competence-based mathematics primary curriculum which is structured for learners at the foundational level. Considering the practical difficulties associated with surveying all pre-service teachers from every college in Zimbabwe, a representative sample becomes necessary. The choice of sampling technique is influenced by several criteria such as desired precision level, available resources, and population characteristics, among others. A combination of stratified random sampling and cluster sampling could provide an effective approach. As described earlier, stratification entails dividing a given population into subgroups (strata) using academic relevant and identifiable factors such as the nature of the teacher training college (government, church private), geographical region of the college, or specific major within primary education. This captures diverse training contexts and student backgrounds. Random selection of colleges within each stratum forms clusters.

Consequently, individual pre-service teachers from the chosen colleges would be randomly selected to take part in the study.

As a starting point, we can use Cochran's sample size formula where the population is limited. This approach takes into account the precision margin of error, confidence level, and variance of the population. The formula is:

$$n = (N * Z^2 * p * (1-p)) / (e^2 * (N-1) + Z^2 * p * (1-p))$$

Where:

n = required sample size

N = population size (the estimated number of pre-service primary teachers in Zimbabwe)

Z = Z-score that corresponds with the level of confidence desired e.g. 1.96 for 95%

p = proportion estimate that has the attribute being measured; usually set to 0.5 if unknown as this elevates sample size

requirements.

e = margin of error, simply put, how far off results are permissible (0.05 for a 5% margin)

For easier calculation let us take N to be 3000 which is an estimation of preschool primary school teachers in Zimbabwe. Aiming for the usual target (95%) places Z at 1.96 and giving a five percent margin on equal 0.05(e). For these calculations using $p=0.5$, we will perform it based off previous settings:

$$n = (3000 * 1.96^2 * 0.5 * (1-0.5)) / (0.05^2 * (3000-1) + 1.96^2 * 0.5 * (1-0.5))$$

$$n = (3000 * 3.8416 * 0.25) / (0.0025 * 2999 + 3.8416 * 0.25)$$

$$n = 2881.2 / (7.4975 + 0.9604)$$

$$n = 2881.2 / 8.4579 \approx 340, 6$$

Based on this reasoning, the precise estimation and confidence requirements suggest that a sample of around pre-service primary teachers is optimal at approximately we expect to achieve after rounding off to a clean number while acknowledging these assumptions. Collecting data from this carefully calculated sample will make it possible to comprehensively evaluate the relationship between PCK and pedagogical skills possessed by these future educators with respect to their suitability for Zimbabwe's competence-based mathematics curriculum reconstruction by stratified random sampling coupled with cluster sampling methods.

For the qualitative part, in this case interviews, I used purposive sampling selecting an audience that was highly focused such as mathematic educators which resulted in selecting thirty individuals who were perceived as knowledgeable or experts who offer critical response. These students were chosen because of their strong academic performance and interested studying in teaching willing to participate through whether they want or need data collection conducted on them tends towards math education courses did mathematics related subjects .

3.6 Research Instruments

Structured questionnaires and semi-structured interviews are the two primary instruments that were applied in this research. In this case, the questionnaire collected quantitative information regarding pre-service teachers' pedagogical content knowledge (PCK) concerning mathematics. The questionnaire took the form of multiple-choice questions alongside some Likert-scale items as well as open-ended questions. These questions sought to evaluate their understanding of key mathematical concepts, relevant instructional methods, and blending both teaching and learning principles. The Shulman (2015) PCK framework alongside Zimbabwe's competence-based curriculum for mathematics offered guiding literature which informed the construction of the questionnaire.

The focus of the semi-structured interview was aimed at gathering qualitative information that concern experience, perceptions, and experienced challenges by pre-service teachers towards teaching mathematics under a competence-based curriculum. Such interview guidelines featured open-ended questions so respondents could freely expand on their answers while giving more depth to their accounts. Topics from within this focus included understanding components of the curriculum; employing appropriate strategies; assessing learner performance; identifying factors contributing to their strength or weaknesses across these competencies.

3.7 Pilot Study

Prior to the principal data collection, a preliminary study was held with a small group of pre-service teachers who did not conform to the main sample. This study aimed to evaluate the clarity, validity, and reliability of the research instruments. Moreover, it sought to uncover any possible issues with the data collection processes (Kunselman, 2024). In response to feedback provided by pilot study participants, both the questionnaire and interview protocol underwent modifications in order to enhance relevancy and precision. Furthermore, identifying logistical issues and refining data collection processes were other objectives which were fulfilled through pilot studies.

3.8 Data Analysis

Quantitative information extracted from questionnaires was assessed using both descriptive and inferential statistics. Means, standard deviations, frequencies, and other forms of descriptive statistics summarized the data in order to depict sample characteristics. To evaluate inter-group differences among pre-service teachers as well as determine relationships between some associated variables within the groups, some inferential statistics such as t-tests and ANOVA were employed. These statistical analyses were conducted using SPSS software designed for social sciences. The qualitative data obtained from the

interviews were analyzed through thematic analysis which is a method of identifying and analyzing patterns (themes) within qualitative data (Lochmiller, 2021). The steps of thematic analysis include: (1) transcribing the interviews; (2) reading and re-reading the transcripts to become familiar with the data; (3) generating initial codes; (4) searching for themes; (5) reviewing and refining the themes; and (6) defining and naming the themes. To assist with coding and analyzing interview data, ATLAS.ti qualitative data analysis software was employed.

3.9 Reliability and Validity

As for quantitative data, certain strategies were implemented to ensure accuracy and trustworthiness. Derived from relevant theoretical models, a reliable framework was crafted that underwent validation in a pilot study. The internal consistency reliability of this framework was measured using Cronbach's alpha coefficient. An alpha value exceeding 0.7 would affirm reliability suggesting that all items within the questionnaire pertained to one shared concept or construct.

To maintain the credibility and consistency of the qualitative data, methods such as triangulation, member checking, and peer debriefing were used. As stated by Vu (2021), triangulation consisted of corroborating the results with various data sources like interviews and documents. In participant verification or member checking, participants were shown the preliminary conclusions so that they could confirm whether those results reflected their reality. Other researchers provided feedback through peer debriefing, which subsequently highlighted possible biases related to the study.

3.10 Ethical Considerations

Ethical factors were taken into account throughout every stage of the research. Ethical clearance from relevant institutional review boards was gained before beginning data collection. All participants granted informed consent whereby they fully understood the purpose of the research, its processes, and their ability to withdraw at any point during it. The identities of participants were protected by pseudonyms alongside secure storage of sensitive information ensuring confidentiality and anonymity was upheld. Potential risks to participants' well-being were minimized alongside protective measures in place considering balanced against benefits derived from conducted researched sessions followed by immediate aftermath intervention analyses via sessions studying drawn conclusions during gathered info intervals addressing holistic ethics abiding BERA guidelines established for such instructional scientific undertakings

4. Presentation of Data, Analysis and Discussion

The purpose of this study was to explore the alignment of pedagogical content knowledge and skills among pre-service primary teachers with Zimbabwe's competence-based mathematics curriculum using a mixed-methods approach. This study analysed the distributed questionnaires whilst merging them with the qualitative output and aligning with the literature review vis a vis theoretical frameworks.

4.1 Questionnaire Response Rate

The investigation consisted of the administration of three hundred and forty one structured questionnaires and thirty interviews, each of which was finished by all respondents and participants. This results in a response rate of 100%, which is excellent since it ensures that every respondent is represented in the sample. The statistical breakdown of the questionnaire responses is shown down below in table 1.

Table 1 Questionnaire Responses Statistical Breakdown

Distributed Questionnaires	Returned Questionnaires	Intended Interviews	Interviews Conducted	Response Rate
150	150	30	30	100%

Source: Researcher's Construct (2025)

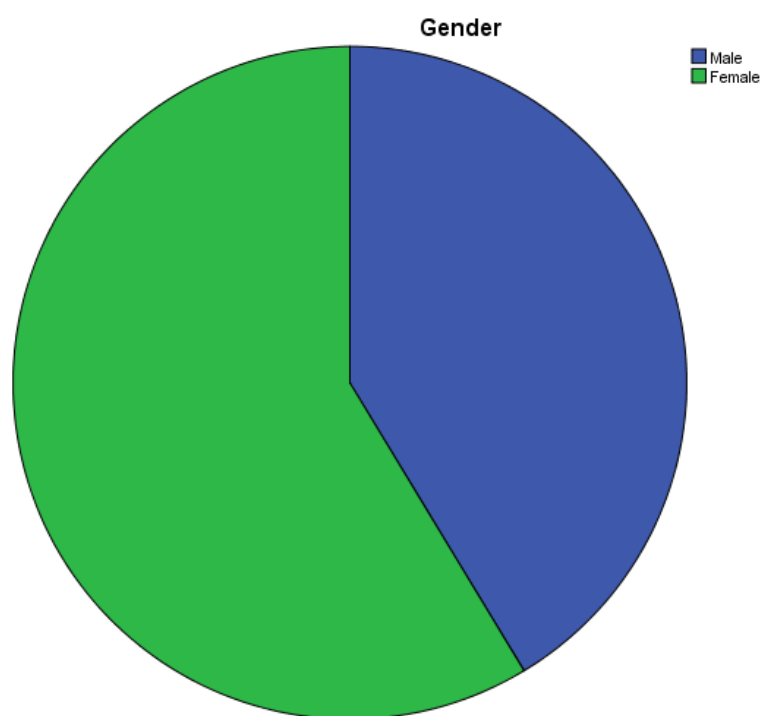
Before presenting the trade data, it is important to outline the demographic profile of the participants who were interviewed qualitatively in the preceding table in order to give context which is key to appreciating the range of views that shaped the qualitative analysis. Table 1 presents the demographic data.

4.1.1 Gender

The study comprised a sample of 341 pre-service primary teachers from whom females constituted the majority (58.7%) with

200 participants, while males represented 41.3% with 141 participants. This disparity of one gender to another mirrors an overarching pattern within the teaching profession, especially in primary education where there is a predominance of female teachers when compared to their male colleagues (Ferreira, Silva and Gomes, 2025). The disproportionate share of women noted in this study supports findings which indicate that the early childhood and primary teaching continues to be stand dominated by women, likely because of cultural norms and occupational pathways informed by gender stereotypes (Scholes and McDonald, 2022). This specific case or example reveals interest pedagogy directly within context and deploy relevant content knowledge are skills integrated Zimbabwe's competence-based mathematics curriculum; hence analyzing the impact of gender becomes integral considering social norms may navigate preference tailored towards subject matter impact one's teaching style effectiveness relative to curriculum delivery engagement (Lee and Boo, 2022). Therefore, understanding how pre-service teachers' examined gender influenced preparedness concerning professional development strategies designed targeted tailored towards deepening their exposure competence advanced mathematics instruction strongly enhances rigor relevance proportional academics strategic deliberate interventions confront realities aimed professional frameworks supportive structures addressing gaps noticed gaps constrained targeting focused determined-sharp limited educational prospects offered exacting purpose.

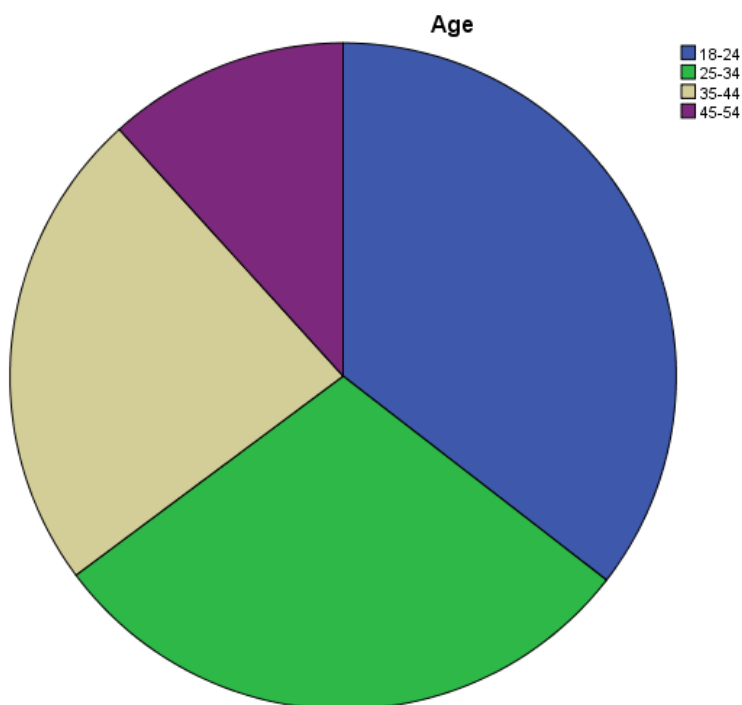
Figure 1 Gender



4.1.2 Age

A considerable proportion (35.5%) is accounted for by the 18-24 age group, which consists of individuals likely coming straight from secondary education and entering teacher training programs immediately. The sample also includes the 25-34 year olds, who make up 29.3%, suggesting they may be students with some work experience or those who have previously studied in a different field before entering teaching. Individuals aged 35-44 years in pre-service training account for 23.5%. This suggests a portion of people who are possibly looking to change careers or pursue further professional qualifications much later into their working life. Finally, within the age range of 45-54 years, we find 11.7% of the sample which may consist of people with other extensive prior experience or those returning to school to refine their teaching skills formally. This blend of younger teachers and older professionals adds tremendous value as it ensures that there is diversity in age which could enhance teaching methods while pre-service teachers enrich classroom instruction on pedagogical approaches and content knowledge. As noted by Tan et al., (2021), teachers' pedagogical content knowledge hinges on their experiences and knowledge, thus spanning multiple decades creates opportunities for adaptable robust teaching strengths within the cohort.

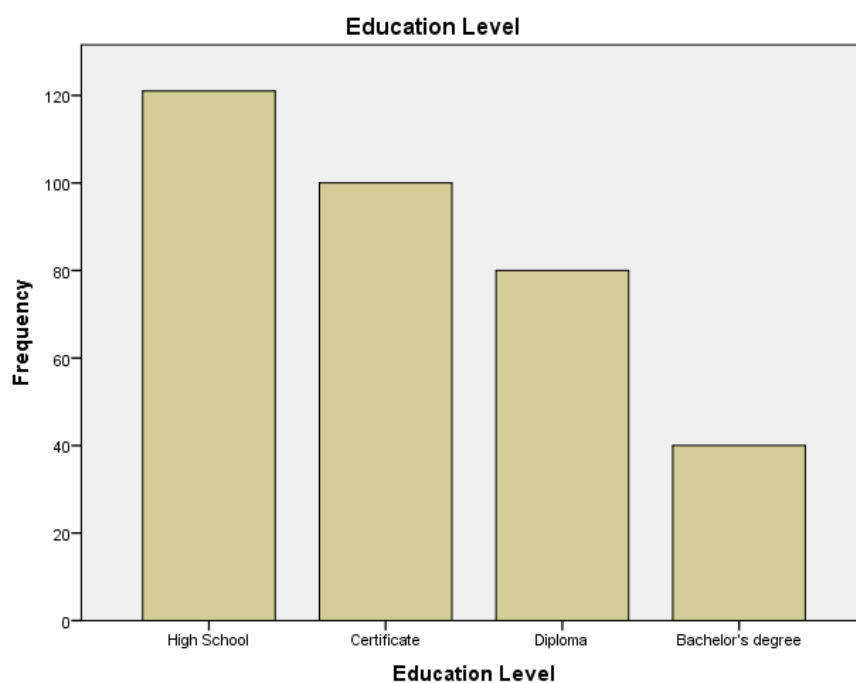
Figure 2 Age



4.1.3 Education Level

The earlier mentioned factors are of great importance as they indicate the probable influences on Pedagogical Content Knowledge (PCK), due to varying educational experiences, along with Zimbabwe's competence-based mathematics curriculum. A sizeable proportion 35.5% holds only secondary schooling which, is suggestive of a lack of formal pedagogical training in mathematics instruction at higher levels. Approximately 29.3% seems to hold a certificate which suggests some basic teacher training and its focus on mathematics education is uncertain. Additionally, 23.5% having a diploma makes sense as this represents a greater duration of pre-service teacher training along with enhanced exposure to better teaching methodologies and relevant mathematical content as compared to those holding only certificates.

Figure 3 Education Level

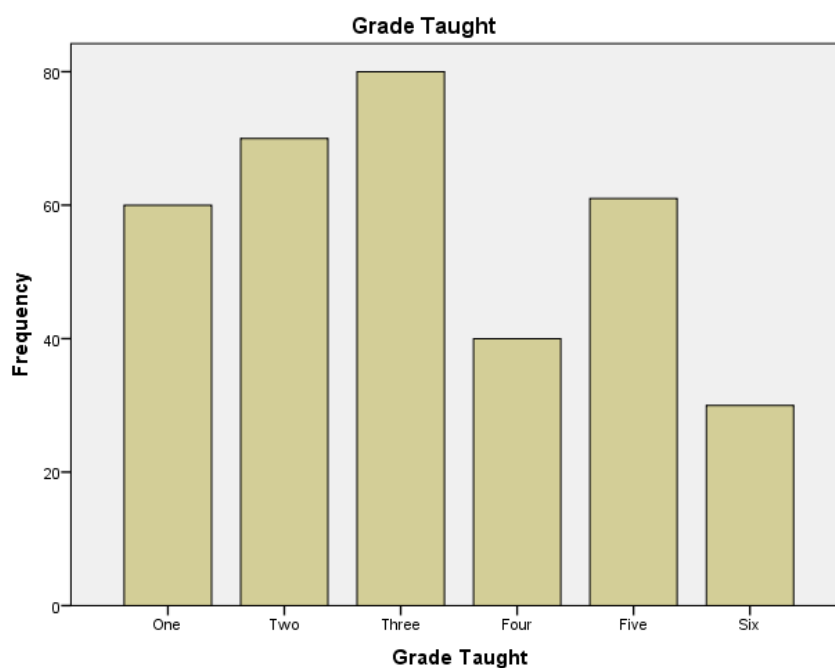


Lastly, the fact that only 11.7% of pre-service teachers hold a Bachelor's degree is indicative of limited subject matter knowledge and pedagogical understanding (Catacutan et al., 2023). Moreover, this infusion raises concerns about the readiness of pre-service instructors with regard to curriculum implementation since greater exposure to formal education generally translates to enhanced content mastery and teaching proficiency (Li, Liu and Su, 2022). Given the low figure of trained pre-service teachers who have bachelor degrees, suggests there is urgent need for further appropriate action directly aimed at addressing professional gaps in PCK/ Competence-Based Curriculum Skills across all levels in light of Zimbabwe's competence-based mathematics curriculum.

4.1.4 Grade Taught

Significantly, Grade Three was the modal grade taught, occurring in 23.5% of the sample ($n = 80$). This was followed by Grade Two with 20.5% ($n=70$) and Grade Five with 17.9% ($n=61$). Grade One had a frequency just below this at 17.6%, while Grade Four comprised 11.7% ($n=40$), and Grade Six was least represented with 8.8% ($n=30$). This distribution indicates that the pre-service teachers in the sample have different levels of exposure to primary mathematics teaching. The stronger representation of Grades Two and Three suggest that there is more focus during training on mathematical skills taught at these levels, as per Zimbabwe's Competence-Based Curriculum which aims at developing a solid foundational understanding in early primary years as early as possible. However, the lower representation of Grade Six is striking, as it raises issues related to how well prepared pre-service teachers are for more advanced content and teaching methods concerning upper primary Mathematics; this needs further study related to their Pedagogical Content Knowledge (PCK) and PCK skills.

Figure 4 Grade Taught

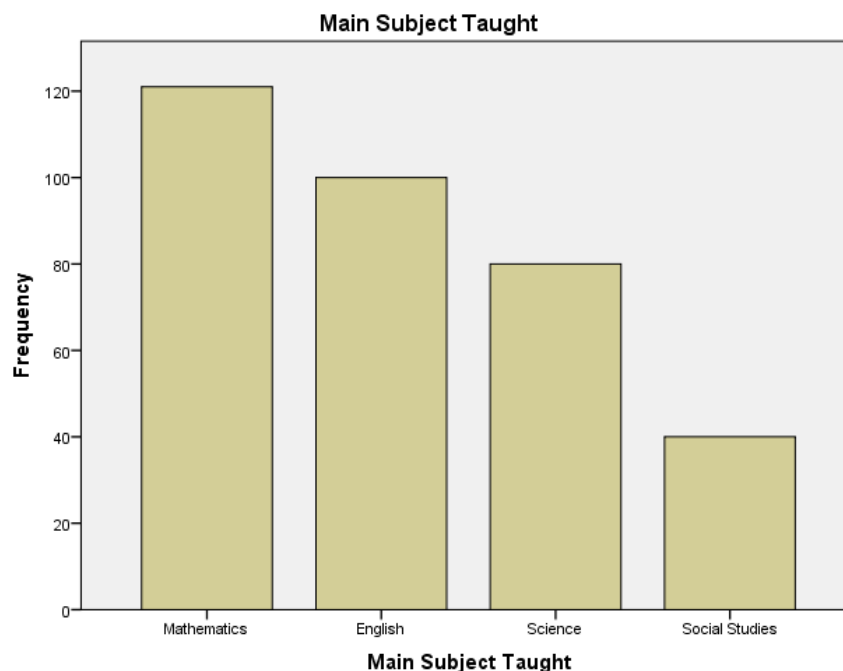


4.1.5 Main Subject

Analyzing the PCK and teaching competencies of pre-service primary school teachers in Zimbabwe about the mathematics curriculum shows diversity, with mathematics being the most frequently taught subject among 35.5% of respondents, while English was 29.3%, Science 23.5%, and Social Studies 11.7%. This could indicate that either more focus is placed on teaching mathematics in the colleges, or there are more pre-service teachers who intend to teach mathematics than other subjects. The work Mönch and Markic did in 2022 proved how important PCK is when they stated that teachers must know how to explain a subject so students can understand it. Since mathematics is the most commonly taught subject by the pre-service teachers, it is essential that their mathematical pedagogical content knowledge (PCK) is strong, especially considering its alignment with Zimbabwe's competence-based curriculum which emphasizes practical and problem-solving skills. The differences in the percentages across the subjects highlight and reinforce the requirement for customized training that fulfills

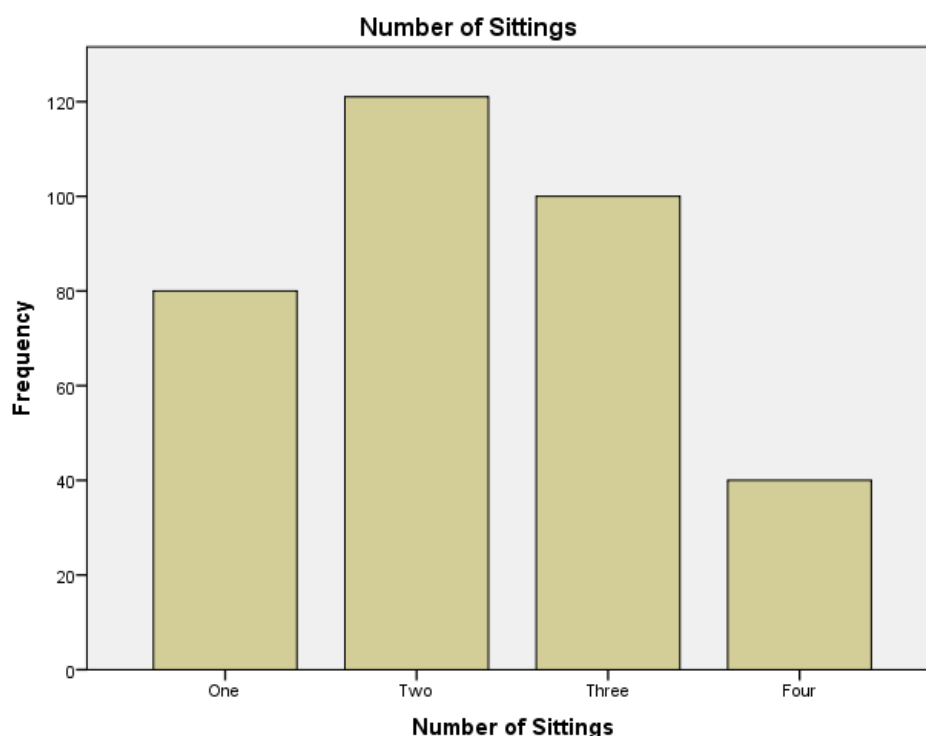
the PCK needs of every discipline, as mentioned by Vettriselvan et al. (2025). To optimally equip pre-service teachers from all subject areas, it is important to enhance their capability to utilize their content knowledge through appropriate teaching methods which improves learners' performance throughout instruction aligned with the objectives emphasizing competencies.

Figure 5 Main Subject



4.1.6 Number of Sitzings

Figure 6 Number of Sitzings



Analysis of the data indicates that a notable proportion, 35.5% ($n=121$), had attempted the mathematics examination on two occasions suggesting some level of familiarity with the assessment processes. Also notable is that 29.3% ($n=100$) had attempts at three sittings, potentially indicating efforts to improve and meet certain benchmarks. Conversely, 23.5% ($n=80$) only had one attempt which raises questions regarding their previous exposure to mathematics assessment. An even smaller

segment, 11.7% (n=40), sat for the test four times which may reveal some ongoing struggle to meet needed thresholds. These results highlight important differences in mathematical knowledge, prior examination experience and training among pre-service teachers which poses challenges for instructional alignment combining pedagogical content knowledge and skills centered on Zimbabwe's competence-based curriculum for Mathematics (Olawale, 2024). The findings also underscore gaps in curriculum expectations designed for prior learning frameworks demonstrating differentiated instruction tailored to pre-service teacher training in Mathematics aimed at refining instructional frameworks design aligned to elements suited to the varying needs and prior experiences of pre-service teachers.

4.2 Normality Tests

Normality tests including Kolmogorov-Smirnov and Shapiro-Wilk tests show that none of the main factors of interest – Age, Pedagogical Content Knowledge (PCK), Teaching Strategies Skills, Training Adequacy Perceptions, Teacher Education Recommendations – were normally distributed within the sample of pre-service primary teachers. For all variables assessed in this model both tests produced significant results ($p < .001$) suggesting non-normality. The Kolmogorov-Smirnov statistic ranged from .217 to .438 and Shapiro-Wilk from .571 to .845 adding further evidence for non-normality. These findings corroborate those observed in educational research whereby subjective assessments such as perceptions and recommendations tend to diverge from central tendency metrics owing to systematic bias induced by various contextual influences (Cook, Watson and Webb, 2024). It is particularly interesting that Pedagogical Content Knowledge and Teaching Strategies Skills are not normally distributed, perhaps indicating the extent to which pre-service teachers' prior experiences and learning styles informed their skills development relative to the benchmarks set out by a competence-based curriculum. In parallel, individual expectations based on prescriptive mindsets are likely contributing to non-normally distributed perceptions of training adequacy.

Table 2 Tests of Normality

	Kolmogorov-Smirnov ^a			Shapiro-Wilk		
	Statistic	Df	Sig.	Statistic	Df	Sig.
Age	.217	341	.000	.845	341	.000
Pedagogical Content Knowledge	.438	341	.000	.571	341	.000
Teaching Strategies Skills	.303	341	.000	.693	341	.000
Training Adequacy Perceptions	.318	341	.000	.585	341	.000
Teacher Education Recommendations	.252	341	.000	.828	341	.000

a. Lilliefors Significance Correction

4.3 Reliability Test

Table 3 Reliability Test

Table 3 shows the overall Cronbach's Alpha coefficient.

Reliability Statistics		
Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.855	.855	4

As presented in Table 3, the overall Cronbach's Alpha coefficient was found to be .855. This indicates a high level of internal consistency among the 10 items comprising the instrument. Furthermore, the Cronbach's Alpha Based on Standardized Items was also .855, suggesting that standardizing the items did not significantly alter the reliability. These results confirm that the instrument reliably measures the intended construct, ensuring the validity and trustworthiness of subsequent analyses and interpretations regarding the alignment of PCK and skills with the curriculum.

4.4 Descriptive Analysis

The study sought to explore the alignment of pedagogical content knowledge and skills among pre-service primary teachers

with Zimbabwe's competence-based mathematics curriculum. A number of objectives were closely scrutinized which included: 1) to assess the level of pedagogical content knowledge (PCK) of pre-service primary teachers in mathematics concerning the core concepts of Zimbabwe's competence-based curriculum. 2) To evaluate the skills of pre-service primary teachers in utilizing effective teaching strategies that promote problem-solving, critical thinking, and practical application of mathematical concepts. 3) To explore the perceptions of pre-service teachers regarding the adequacy of their training in preparing them to implement the competence-based mathematics curriculum effectively. 4) To recommend strategies for improving teacher education programs to better align with the demands of the curriculum and enhance the quality of mathematics education in Zimbabwean primary schools. These were analysed below using quantitative and qualitative methods of analysis.

4.4.1 Pedagogical Content Knowledge (PCK) of Core Mathematical Concepts

Table 4 Pedagogical Content Knowledge (PCK) of Core Mathematical Concepts

Descriptive Statistics					
	N	Minimum	Maximum	Mean	Std. Deviation
Pedagogical Content Knowledge	341	1	4	1.51	.535
Pedagogical Content Knowledge	341	1	4	1.52	.534
Pedagogical Content Knowledge	341	1	2	1.50	.501
Pedagogical Content Knowledge	341	1	5	1.55	.610
Valid N (listwise)	341				

The claim that instructors have adequate Pedagogical Content Knowledge (PCK) of fundamental concepts in mathematics is coupled with a need to view it through the prism of qualitative comments and descriptive statistics. While the data paints an optimistic picture as mean scores approaches 1.5 on a scale, as yet undefined, the straddling standard deviations (.535, .534, .501, and .610) indicate some level of perception toward knowledge strength amongst this collection of 341 individuals. This lends credence to Wang and Zhan's (2023) argument about PCK not being a singular construct but rather a multi-dimensional fusion of content knowledge and teaching strategies which can be personalized or customized."

More specifically, the data indicates a moderate agreement for all four statements relating to PCK. The convergence on the four statements as depicted by the means reinforces a positive self-evaluation of understanding foundational concepts and articulating them in diverse ways, addressing misconceptions and connecting mathematics to everyday life in Zimbabwean settings. Nevertheless, those scores while quantitative suggest an overarching narrative that require deeper contextual exploration. To illustrate, agreeing with the statement "I can connect real-life situations with mathematical concepts" could pertain to standard textbook frameworks rather than actual interactions envisioned in relation to their students' contexts.

In addition, the educators' responses to the research question provide essential qualitative perspectives that either corroborate or dispute the quantitative results. For instance, if a significant proportion of participants fails to explain how they would teach fractions in relation to everyday life in Zimbabwean contexts, this poses a challenge to the uniformly high self-reported PCK reported in the descriptive statistics. Quotations from participants expressing their difficulty in subconscious relevance identification anger within real-life applicability or voicing resource limitation grievances amplify the dissonance between perceived and actual PCK. These posed constraints, including limited access to culturally applicable examples or relevant manipulatives, have also been pointed out by other scholars (Tuithof et al., 2023) who argue that PCK is situated and highly context-dependent. Thus, while descriptive statistics offer illuminating insights on basic patterns and relationships of data collected during initial reconnaissance inquiries—and therefore are highly valuable—an investigation integrated with richly textured qualitative findings provides depth that surpasses prescriptive flat narratives around educators' core understanding of fundamental mathematical concepts.

4.4.2 Skills in Implementing Effective Teaching Strategies

Table 5 Skills in Implementing Effective Teaching Strategies

Descriptive Statistics					
	N	Minimum	Maximum	Mean	Std. Deviation
Teaching Strategies Skills	341	1	4	1.51	.535
Teaching Strategies Skills	341	1	4	1.54	.566
Teaching Strategies Skills	341	1	5	1.52	.551
Teaching Strategies Skills	341	1	5	1.52	.551
Valid N (listwise)	341				

The findings indicate a significant under-evaluation by respondents concerning their effectiveness in teaching mathematics problem-solving and critical thinking skills. With $n=341$, the answers to the four items averaged between 1.51 and 1.54, with standard deviations of .535 to .566. These figures suggest that, on average, practitioners in this study believed that they only modestly “agreed” with statements concerning their competence in fostering problem-solving skills, adapting to various learners/teaching skills, measuring learning outcomes curriculum-based assessments and creating multi-layered assessments. These results seem to contradict the expectations of a competence-based curriculum because as one of the participants commented while answering: “It emphasizes critical thinking skills.” This illustrates a discrepancy wherein the curriculum expects promotion of very strong critical thinking skills while teachers express minimal confidence in teaching such levels critically.

Understanding this disparity further emerges from qualitative data where teachers described the activities that they would employ. To illustrate, one educator suggested a mathematically framed activity that aimed to foster critical thinking skills: “I would give them a cost-benefit analysis for a school event’s budgeting which involves evaluating the costs, justifying needs versus wants, and making decisions.” This indicates an appreciation of constructivism in learning theory which posits that students actively build their knowledge through meaningful engagement with tasks. The quantitatively assessed data suggests that there is lower achievement in taking action on these skills and in one’s perceived ability to do so, which strays from this powerful theory. Another teacher explained their evaluation technique saying “I would evaluate how these skills were developed through observational assessment focusing on problem solving, explanation of reasoning within his decision-making process, and analyzing the budget proposal drawn at the end.” This quotation illustrates Shulman’s PCK framework as it shows understanding of the adaptation of mathematics into teaching practice reflecting assessment principles allied with higher order thinking.

Once more, however, the means suggest lacking confidence translates to there existing an imbalance between knowing and doing. This may derive from limited opportunities for professional development that integrate practice into classroom settings, such as applying Bandura’s social cognitive theory, which emphasizes learning through observation and modeling. The teachers may have the motivation alongside the theoretical understanding, but often perceive themselves as lacking the skill or experience required to enact palpable teaching strategies that promote critical thinking in their primary learners. Exploring the rationale behind these self-assessments would further identify areas of support and training pinpointing motivation, making targeted interventions more effective.

4.4.3 Perceptions of Training Adequacy

The effectiveness of a teacher’s confidence and preparedness hinges on the specific teacher training received prior because it integrates different perspectives related to available curricula. Guided by Shulman’s (1986) PCK, constructivist learning theory, and Bandura (1977) social cognitive theory, this study aims at Zimbabwean primary school teachers’ perceptions of their training adequacy concerning the competence-based mathematics curriculum (CBC). We posit alongside many scholars that effective teacher training should not solely provide adequate theoretical frameworks, instead it should simultaneously

enhance practical skills and confidence facilitating implementation. Participants expressed a positive perception regarding training adequacy based on generated descriptive statistics ($N = 341$).

Certainly, educators had a uniform affirmative response regarding the efficacy of the training programs toward their implementation of the competence-based mathematics curriculum (Mean = 4.41, SD = 0.712). This indicates that at some level, the training programs are proficient in meeting teachers' knowledge demands. This positive perception also carried over to their confidence regarding resource and material utilization for the curriculum (Mean = 4.36, SD = 0.821), which further signifies familiarity and competence that Bandura's self-efficacy theory would predict. Teachers perceived all offered training sessions as giving adequate chances to practice teaching mathematics using a competence-based approach (Mean = 4.40, SD = 0.759). This echoes constructivist learning theories which advocate for active involvement in knowledge construction through doing rather than mere passive receiving of information. The perception where primary schooling instructors believed strongly that the training programs provided reasonable attention to relevant issues and prospects concerning primary school mathematics instruction in Zimbabwe also reinforces this picture (Mean = 4.40, SD = 0.711).

The qualitative feedback indicates specific strengths and possible improvements for training programs, which starkly contrasts with the positive perception captured by the quantitative data. Teachers recalled valuing lessons that had an applied component, particularly observation of classes already in progress. One participant described, "I remember watching senior teachers teach. It helped me with ideas." Another participant said, "Practicing and seeing how the lessons are done was very helpful." These statements relate to what Shulman (1986) discusses regarding a fusion of content knowledge and pedagogy. The focus on practical components pertains to the constructivist theory of learning, which values learning through active engagement with material.

Regardless of the positive perceptions, certain educators pointed out deficiencies in their preparation. A few of the teachers commented that the training offered was not sufficient for covering all aspects of the new curriculum. One teacher mentioned, "We need to know more about what we are going to teach." This shortfall may adversely affect a teacher's PCK and their capacity to design appropriate and impactful learning opportunities within their classes. To conclude, the results capture the predominant favorable perceptions held by teachers regarding training adequacy alongside gaps that remain unresolved.

Table 6 Perceptions of Training Adequacy

Descriptive Statistics					
	N	Minimum	Maximum	Mean	Std. Deviation
Training Adequacy Perceptions	341	1	5	4.41	.712
Training Adequacy Perceptions	341	1	5	4.36	.821
Training Adequacy Perceptions	341	1	5	4.40	.759
Training Adequacy Perceptions	341	1	5	4.40	.711
Valid N (listwise)	341				

4.4.4 Recommendations for Improving Teacher Education

The collected data indicates that substantial changes are required within teacher education programs to equip educators with skills necessary for the effective implementation of competence-based mathematics curricula. I believe there is a need to reform teacher education towards more hands-on differentiated teaching, practice-based instruction, clinical apprenticeship models, guided practice, prospective reflection, and continual professional growth activities. This position can be strongly justified through the quantitative and qualitative research data collected from educators alongside Shulman's PCK (Pedagogical Content Knowledge) constructivism and Bandura's social cognitive theory. Many authors stress the prevalence of theoretical knowledge in literature, while this research presents an alarming lack of practical application alongside a surplus of theoretical frameworks revealing a disconnect requiring revision in models of today's teacher education systems.

The picture painted by the descriptive statistics is intuitive: there was general agreement among respondents regarding the

need for further refinement. With a sample size of 341 participants, the mean responses for all four recommendations were between 4.33 to 4.36 out of 5 which indicates consensus. In particular, the supporting statement that called for practical applications of mathematics achieved a mean score of 4.33 (SD = .866). This resonates strongly with the advice provided by participants, as one teacher noted, “New teachers need to see mathematics in action, not just in textbooks. Show them how to connect abstract ideas to real world problems.” This statement aligns well with constructivist learning theory which argues that knowledge is constructed by learners through participation and hands-on experiences.

The need for training on differentiated instruction received strong support with a mean of 4.35 and SD of .797 (Teaching Certificate). This finding underscores the appropriateness and alignment with the diverse learning needs of students in contemporary classrooms. Participants elaborated further on this necessity, proposing something like, “Teach them [new teachers] strategies that will allow them to reach all learners no matter their background or how they prefer to learn. Differentiation is key!” The quote illustrates Shulman’s PCK Model: PCK reflects an educator’s capability to modify and understand different pedagogical techniques according to the learners’ diversity and differences.

The suggestion to increase observational learning opportunities also showed strong agreement (Mean = 4.36, SD = .821). It aligns perfectly with Bandura’s social cognitive theory that emphasizes modeling and observation in learning. As participants pointed out, “Pairing new teachers with experienced mentors who are successfully using the competence-based curriculum. Let them observe, ask questions, and learn from the best.” The last recommendation highlights the continuing professional development and support measures as critical (Mean = 4.35, SD = .800) reinforces learning as a lifelong process integrally tied to both Bandura and PCK. One teacher expressed concern saying, “Don’t throw them in the deep end and expect them to swim. Provide ongoing support, workshops, and resources to help them grow and improve.”

Table 6 Recommendations for Improving Teacher Education

Descriptive Statistics					
	N	Minimum	Maximum	Mean	Std. Deviation
Teacher Education Recommendations	341	1	5	4.33	.866
Teacher Education Recommendations	341	1	5	4.35	.797
Teacher Education Recommendations	341	1	5	4.36	.821
Teacher Education Recommendations	341	1	5	4.35	.800
Valid N (listwise)	341				

4.4.5 Anova T-tests

Shulman argued pedagogy within the context of the subject content (PCK) while constructivist learning theory alongside Bandura’s social learning theory lend credence toward my belief that pre-service primary school teachers possess some understanding of TSS but lack robust Pedagogical Content Knowledge does require strong refinement to meet Zimbabwe’s progressive competence based multi-dimensional mathematics curriculum demands

The results from the one-sample t-test demonstrated significant positive mean differences for both PCK ($t(340) = 185.245$, $p < .001$, Mean Difference = 6.07918) and TSS ($t(340) = 115.544$, $p < .001$, Mean Difference = 6.09091), suggesting that a baseline level of competence surpasses a hypothetical null value. However, what is critical is not the mere presence of these skills but their profundity, flexibility, and contextual suitability within Zimbabwe’s educational framework. In the context of these findings, it is important to note prior research on the relevance of PCK and TSS in teaching effectiveness (Reynolds and Park, 2021), while contrasting them with those studies documenting a vast chasm between teacher knowledge and practice in real classroom settings (Kriz et al., 2021). Thus, the overarching challenge remains to transcend this baseline competence and cultivate in pre-service teachers an integration of subject matter content, pedagogy, instructional design, and student learning processes, curriculum implementation at various levels of sophistication grounded in systematic frameworks aimed

at nurturing authentic mathematical understanding among learners. This necessitates a move toward focused, context-based training structured around learning through reflection and collaboration as well as guided pre-service teaching whereby the trainees develop their understanding of effective mathematics teaching informed by constructivist principles and social cognitive theory.

Table 7 Anova T-tests

One-Sample Test

	Test Value = 0					
	t	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
Pedagogical Content Knowledge	185.245	340	.000	6.07918	6.0146	6.1437
Teaching Strategies Skills	115.544	340	.000	6.09091	5.9872	6.1946

4.4.6 Anova T-tests

The one-sample t-test with a null hypothesis of zero provides an insight into the alignment of pedagogical content knowledge (PCK) and skills of pre-service primary teachers concerning Zimbabwe's competence-based mathematics curriculum. There are notable differences among pre-service teachers' self-reported perceptions of training sufficiency ($t = 207.193$, $df = 340$, $p < .001$, Mean Difference = 17.56891) and their educational expectations ($t = 153.371$, $df = 340$, $p < .001$, Mean Difference = 17.39589) as compared to a theoretical point of zero alignment suggesting no difference on the premise. These results imply awareness rather than complete disassociation from reality indicating suggest perception of training adequacy alongside assumption that PCK being offered was well designed yet not sufficient enough to fulfill the his or her expectations alluding to needing further refinement so as to satisfy the new competency demands underline envisioning a robust constructivist approach towards education. This supports constructivist learning theories where it is posited that pre-service teachers are trying to make sense of effective teaching through their training experiences in mathematics instruction influenced via training observation as advanced by Bandura's social cognitive theory.

Even though the information indicates an overwhelmingly positive perception, it is important to investigate if such perception transforms into effective practice in the classroom. According to Shulman's PCK, which stands for pedagogical content knowledge, there exists a vivid interplay of subject matter knowledge, pedagogical knowledge, and contextual knowledge. This paradigm demonstrates that having a strong appreciation of training adequacy does not mean one will be able teach mathematical subjects in an insightful way where learners internalize foundational concepts. Thus further research is needed on how pre-service teachers apply their training into practical teaching competencies and what particular aspects of PCK need bolstering in order to address the disparity between perceived training and unrivaled classroom effectiveness.

Table 8 Anova T-tests

One-Sample Test

	Test Value = 0					
	t	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
Training Adequacy Perceptions	207.193	340	.000	17.56891	17.4021	17.7357
Teacher Education Recommendations	153.371	340	.000	17.39589	17.1728	17.6190

4.4.7 Correlations

Table 9 Correlations

		Correlations			
		Pedagogical Content Knowledge	Teaching Strategies Skills	Training Adequacy Perceptions	Teacher Education Recommendations
Pedagogical Content Knowledge	Pearson Correlation	1	.222**	.058	.029
	Sig. (2-tailed)		.000	.287	.600
	N	341	341	341	341
Teaching Strategies Skills	Pearson Correlation	.222**	1	.024	.083
	Sig. (2-tailed)	.000		.661	.125
	N	341	341	341	341
Training Adequacy Perceptions	Pearson Correlation	.058	.024	1	.268**
	Sig. (2-tailed)	.287	.661		.000
	N	341	341	341	341
Teacher Education Recommendations	Pearson Correlation	.029	.083	.268**	1
	Sig. (2-tailed)	.600	.125	.000	
	N	341	341	341	341

** . Correlation is significant at the 0.01 level (2-tailed).

The effectiveness of any issued curriculum depends on its teachers' readiness. This is especially the case for Zimbabwe's newly adopted competence-based mathematics curriculum which requires not only knowledge of mathematical concepts but also mastery of how to teach in a way that fosters deep learning. When investigating the Pedagogical Content Knowledge (PCK) and teaching practices of primary pre-service teachers in relation to the new curriculum, I argue that although pre-service teachers possess some understanding of PCK, its actual application stems largely from perceptions about available training and consequently their suggestions concerning the designed training programs for prospective educators. The stance I have taken is corroborated by correlational evidence from my research as well as literature concerning Shulman's PCK framework, constructivist theory of learning, and Bandura's social cognitive theory, while also noting ways in which my findings deviate from conventional wisdom.

Based on my research, I found that there exists a statistically significant positive correlation ($r = .222$, $p < .01$) between pedagogical content knowledge and teaching strategies skills. This means that for pre-service teachers who understand how to teach mathematics concepts, they are trained to use effective teaching strategies with some degree of likelihood. Shulman's foundational work on PCK supports this as he integrates subject matter knowledge with pedagogical knowledge (Shulman, 1986). For Shulman, PCK is not merely knowing mathematics and knowing how to teach; it is about how certain topics can be made accessible to learners based on what they already know and the misconceptions they may hold.

The positive correlation indicates that at least pre-service teachers willing to deepen their understanding of PCK will gain more ability in applying it within their actual teaching. In addition, this correlates well with the constructivist learning theory which advocates the active involvement of learners in creating their own understanding through experiences and interactions. Teachers possessing deep PCK are positioned best to enable learners to conduct constructive processes by designing appropriate learning experiences.

The shortcomings of the correlation also raise some issues. It indicates that having PCK does not mean a teacher is effective in practice. Perhaps there are other competencies, such as self-efficacy or classroom management, that strategically mediate the PCK-teaching skills relationship. This reinforces what other studies have shown regarding the difficulty of applying

knowledge in practice (MacMahon, Leggett and Carroll, 2022). Put differently, knowledge of concepts' underlying principles certainly helps, but success during implementation in a primary school setting—characterized by its fluidity and complex interactivity—remains far from certain. Curiously, the relationship between perceived training adequacy with both pedagogical content knowledge ($r = .058$, $p > .05$) and teaching strategies skills ($r = .024$, $p > .05$) are well within the bounds of being irrelevant. This indicates that a pre-service teacher's perception regarding how adequate a provided training program was does not have verifiable impact on PCK or teaching skills. However, it is worth noting that there is a significant positive correlation with training adequacy perceptions and teacher education recommendations ($r = .268$, $p < .01$). This suggests that pre-service educators tend to hold positive views about the recommendations they make when they regard their training as adequate. At this point in my research is where I aim to build upon foundational theory. One would assume that stronger training correlates directly with enhanced levels of PCK and teaching skills achieved. Rather, data points toward an alternate narrative where perception surrounding training adequacy influences a pre-service teacher's perception of the program more so than their actual level of PCK or demonstrable skills.

This underscores the importance of pre-service teachers' subjective realities and invites speculation with regard to Bandura (1977) and social cognitive theory—namely, self-efficacy. Pre-service teachers who believe they are prepared tend to be more confident in their teaching and willing to try new approaches, even if their PCK is not significantly higher than average. On the opposite end, those who feel unprepared likely possess a wealth of knowledge that they do not have the confidence to put into practice. This agrees with research showing that educator self-efficacy explains student outcomes (Lauermann and ten Hagen, 2021).

In addition, the significant correlation between perceptions of training adequacy and recommendations for teacher education reveals that pre-service teachers may supply considered recommendations based on what they found useful within their education. This is an important aspect of teacher education program responsiveness to ensure continuous improvement cycles in meeting the needs of future educators based on feedback from prospective candidates. While perceived adequacy might not directly improve PCK metrics, it can strengthen goodwill which invites attempts at constructive change—for everyone's benefit.

5. Conclusion and Recommendations

In this regard, the investigation discloses an alarming gap concerning the pre-service primary teachers' pedagogical content knowledge (PCK) in relation to Zimbabwe's competence based mathematics curriculum. It appears that most pre-service teachers tend to have a very basic grasp of mathematical concepts; however, their ability to teach and foster competence and understanding at the primary school level is lacking significantly. The study indicates a number of inconsistencies with regards to lesson planning, assessment, and selection and use of appropriate teaching materials. The absence of integration among relevant content knowledge and teaching strategies deeply impedes the implementation of the curriculum that emphasizes practical work, problem-solving, critical thinking skills, and value driven learning. These findings create demand for immediate action within the teacher education system aimed at strengthening pre-service teachers' PCK by equipping them with adequate competencies required for effective teaching within a complex framework of competence based mathematics syllabus.

In view of these findings, a number of strategies are critical to addressing the disparity between pre-service teacher training and the demands posed by the Zimbabwean mathematics curriculum. To start with, educator programs must focus on developing PCK through authentic, practical teaching experiences including lesson study, micro-teaching, and extensive practicum placements in diverse classrooms that include participant and guided reflective teaching with professional mentorship. In addition, constructivist pedagogy should be reinforced so that content knowledge courses are taught in direct relation to appropriate instructional methods and practices. It is necessary to deepen the engagement and relevance of mathematics for learners by applying problem-based approaches as well as learning through innovative technology-assisted tools. Moreover, the evaluation of pre-service teachers' PCK competencies should shift from exclusively written examinations towards a mixed approach which integrates performance evaluations based on lesson planning and instruction that includes differentiation, formative assessment strategy implementation aligned with a competence-based curriculum

framework. Lastly, teachers should be provided with opportunities for professional self-renewal and updating their PCK to engage in collaborative environments where both pre-service and in-service teachers work together towards a common goal of solving best practices related to the changing face of mathematics education in Zimbabwe.

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Research Instruments

Appendix A: Questionnaire

This questionnaire is structured around four key areas, each corresponding to a core objective concerning pre-service teachers and the competence-based curriculum. The results of such an assessment can be instrumental in informing adjustments to teacher education programs, ultimately contributing to a more effective implementation of the mathematics curriculum in Zimbabwean primary schools.

Demographic Information: (TICK WHERE APPLICABLE)

Question	Response Options
Gender	Male / Female / Other
Age	
Teacher Training Institution	(List of Relevant Institutions)
Year of Study	1st Year / 2nd Year / 3rd Year / 4th Year
Prior Education Level (before teacher training)	O' Level / A' Level / Diploma / Other

The following sections detail the core areas of investigation, each presented in a table format with a Likert scale for responses. The scale is as follows:

·1 = Strongly Disagree

·2 = Disagree

·3 = Neutral

·4 = Agree

·5 = Strongly Agree

Section 1: Pedagogical Content Knowledge (PCK) of Core Mathematical Concepts

Statement	1	2	3	4	5
I possess a strong understanding of the core mathematical concepts outlined in the competence-based curriculum.					
I can effectively explain mathematical concepts in multiple ways to cater to diverse learning styles.					
I am confident in my ability to identify and address common misconceptions students may have about mathematics.					
I can connect mathematical concepts to real-life situations and examples relevant to Zimbabwean contexts.					

Section 2: Skills in Implementing Effective Teaching Strategies

Statement	1	2	3	4	5
I am proficient in using teaching strategies that promote problem-solving skills among primary school students.					
I can effectively facilitate activities that encourage critical thinking and analytical skills in mathematics.					
I am skilled in adapting teaching approaches to suit the varying learning needs within a classroom.					
I can design and implement assessments that accurately measure students' understanding and application of mathematical concepts.					

Section 3: Perceptions of Training Adequacy

Statement	1	2	3	4	5
My teacher training program has adequately prepared me to implement the competence-based mathematics curriculum.					
I feel confident in my ability to effectively utilize the resources and materials provided for the curriculum.					
The training I received provided sufficient opportunities to practice teaching mathematics using the competence-based approach.					
I believe my teacher training program adequately addressed the challenges and opportunities associated with teaching mathematics in Zimbabwean primary schools.					

Section 4: Recommendations for Improving Teacher Education

Statement	1	2	3	4	5
Teacher education programs should place greater emphasis on practical application of mathematical concepts.					
More training is needed on how to differentiate instruction to meet the diverse learning needs of students in mathematics.					
Teacher education programs should include more opportunities for pre-service teachers to observe and learn from experienced teachers who are effectively implementing the competence-based curriculum.					
Ongoing professional development and support are crucial for teachers to effectively implement the competence-based mathematics curriculum.					

Appendix B: Interview Guide

1. Can you describe a specific mathematical concept in the primary curriculum and explain how you would teach it in a way that encourages students to apply their knowledge to real-world problem-solving scenarios?
2. What challenges do you anticipate in implementing this approach, and how would you address them?
3. The competence-based curriculum emphasizes critical thinking skills. Can you provide an example of a mathematical activity or lesson you would use to promote critical thinking in your primary students?
4. How would you assess their development of these skills?
5. Reflecting on your training, what aspects of the teacher education program do you believe have best prepared you for teaching mathematics using a competence-based approach?
6. What aspects, if any, do you feel were lacking or could be improved? Please provide specific examples.
7. Imagine you are tasked with training newly qualified teachers on how to effectively implement the competence-based mathematics curriculum. What advice or strategies would you share with them based on your own experiences and understanding? What resources would you recommend?

Teacher-Scaffolded Reconfiguration of AI Feedback Literacy in Business English Writing

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Abstract: The integration of generative artificial intelligence (AI) into writing instruction has fundamentally reconfigured feedback practices in higher education. This change is particularly obvious in Business English writing since it is highly dependent on context, norms and phramatic constraints. While existing research has largely emphasized technological affordances and efficiency gains of AI-assisted feedback, it often overlooks the epistemic limits of AI and the pedagogical mechanisms necessary for its effective use.

This paper develops a teacher-scaffolded framework of AI feedback literacy in Business English writing. Drawing on feedback literacy theory and sociocultural scaffolding theory, it believes that AI feedback literacy is not a single technical ability, but a multi-dimensional evaluation capacity, including epistemic literacy, pragmatic literacy, and strategic literacy. At the same time, teacher scaffolding is regarded as a key mediating mechanism to guide learners to critically use AI feedback instead of accepting it as an absolute authority.

In addition, a process model is proposed featuring a recursive sequence of epistemic positioning, critical mediation, and pragmatic adaptation. By reconceptualizing the relationship among teachers, learners, and AI, this paper extends feedback literacy theory in the AI environment and provides a theoretical basis for future empirical investigation in professional discourse.

Keywords: AI Feedback Literacy; Business English Writing; Teacher Scaffolding; Feedback Literacy; Writing Pedagogy

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1. Introduction

The rapid development of generative artificial intelligence (AI) has brought about major changes to the way of writing and teaching. AI can generate fluent and coherent text, which is increasingly integrated into the educational scene, and reshapes the way learners create, modify and evaluate written texts. This change poses a challenge to the traditional writing teaching model, which has long been based on a relatively stable relationship between teachers and learners.

In the traditional model, feedback is mainly regarded as evaluation information provided by teachers and mediated by people. Under this structure, teachers are both language authorities and teaching interpreters; while learners need to internalize feedback and apply it to the modification process. However, the emergence of artificial intelligence has broken this pattern

and officially entered the feedback ecosystem. Writing activities are now carried out in a triadic system composed of teachers, learners and AI, and the evaluation of authority is no longer completely human-centered.

This transformation has a particularly far-reaching impact on Business English writing. In this field, the success of communication depends not only on the accuracy of the language, but also on the interpersonal positioning and pragmatic appropriateness. Business writing genres such as emails, reports, proposals and negotiation information are essentially associated with the institutional and professional context. Their effectiveness depends on whether the language used is consistent with audience expectations, personal relationships and organizational goals. Therefore, the quality of writing cannot be attributed only to linguistic correctness.

Despite there is increasing attention on AI-assisted writing, most of the existing literature is still focused on the technical level, such as grammar error correction, fluency improvement and efficiency improvement. Specifically, the current research has not fully theoreticalized how learners can interpret, evaluate and strategically respond to algorithm-generated suggestions when facing context-sensitive writing tasks.

This absence points to a deeper conceptual gap. Although there are fundamental differences in epistemic grounding, AI feedback is often regarded as functionally equivalent to human feedback. Different from teacher feedback which considers subject knowledge, teaching intentions and situational awareness, AI feedback is based on the language modeling rather than real communication intentions. Therefore, its language fluency may cover up its limitations in pragmatic judgment and situational sensitivity.

Under this background, this paper argues that in Business English writing, whether AI can exert its pedagogical value depends on how learners respond to AI feedback and how teachers mediate in this process. In other words, AI feedback literacy is not the ability naturally formed by learners in the process of using AI, but is gradually cultivated in the guidance of teachers and continuous learning.

Accordingly, this paper addresses the following issues:

1. What structural restrictions prevent AI feedback from functioning as independent teaching resources in Business English writing?
2. How does teacher scaffolding mediate the development of AI feedback literacy?

To address these questions, the paper proposes a conceptual framework based on feedback literacy theory and sociocultural perspectives on scaffolding. It positions teacher scaffolding is not only an additional teaching aid, but also a key mechanism to help learners form judgment and evaluation ability in the AI-assisted writing environment.

2. Theoretical Foundations and Conceptual Positioning

The following section outlines the theoretical foundations of this study and clarifies the key concepts, mainly focusing on feedback literacy and scaffolding in AI-mediated writing environments.

2.1 From Feedback Literacy to AI Feedback Literacy

In the past decade, the research on feedback has undergone a profound conceptual change. Early research mainly regarded feedback as a kind of information transmission, in which teachers pass information to students for the purpose of correcting mistakes and improving the learning outcome. In this transmission-oriented model, the effectiveness of feedback depends on whether it is clear, accurate and timely enough.

However, recently, the academic community has challenged this linear understanding and began to emphasize that feedback is actually a socialized process actively constructed by learners. In this transformation, feedback literacy has become the core theoretical concept. It refers to the knowledge, ability and mentality that learners must have in order to understand feedback, evaluate its relevance, and improve learning accordingly (Carless & Boud, 2018; Carless & Winstone, 2020; Molloy et al., 2020). A major contribution of this perspective is that it redefines the role of learners, who are no longer passive containers for receiving feedback, but active participants (Mamad, 2022). Feedback itself essentially depends on whether learners can use it critically and efficiently.

However, the emergence of generative AI has brought new cognitive challenges, which go beyond the scope of the existing definition of feedback literacy. Unlike human feedback, AI feedback is generated based on statistical language models,

not based on disciplinary logic or teaching intentions. Although the feedback given by AI is grammatically smooth and structurally coherent, it lacks purpose, sense of responsibility and situational awareness in the human sense (Bearman et al., 2023). This essential difference has theoretical significance. AI feedback on the seemingly reliable appearance may mislead learners to overly believe in its authority (Gerlich, 2025). Especially in Business English writing, the effectiveness of communication depends highly on the interpretation of specific situations, and therefore, this misalignment between AI and reality is particularly serious.

In order to solve this problem, this paper develops the concept of AI feedback literacy, which can be understood as a kind of evaluation ability with context sensitivity. Learners should not only understand the feedback given by AI, but also need to judge and make reasonable revision decisions considering the purpose of writing, whether it is appropriate for pragmatics and professional norms.

AI feedback literacy mainly includes three interrelated aspects. The first is epistemic literacy. Learners should understand that AI feedback is not authoritative. Its output is based on the result of probability calculation, not professional judgment based on specific context. The second is pragmatic literacy, which means that learners need to judge whether the modification suggestions given by AI meet the specific communication purpose. The third is strategic literacy, which refers to how learners take the initiative to interact with AI, including how to propose prompts, how to compare different versions of output, and how to decide whether to adopt, modify or reject AI's suggestions. These three aspects together expand the traditional concept of feedback literacy, so that it not only focuses on the feedback itself, but also emphasizes learners' understanding of the AI system and the ability to actively use it in the automated feedback environment.

2.2 Reinterpreting Scaffolding in AI-mediated Writing Environments

Based on Vygotsky's socio-cultural framework, scaffolding is a temporary and targeted help, usually provided by more experienced people, that can enable learners to complete tasks within their zone of proximal development, and gradually internalize these abilities in the process (Vygotsky, 1978; Wood et al., 1976; van de Pol et al., 2010). In writing pedagogy, the teacher tends to employ eliciting, inferential questioning, hints and correctional feedback to scaffold student writing (Harran et al., 2026).

However, in an AI-mediated writing environment, the concept of scaffolding needs to be reconsidered theoretically. The artificial intelligence system itself can act as a technical support by providing instant language suggestions, alternative formulas and iterative feedback loops. Nevertheless, this kind of technical scaffolding is fundamentally different from human scaffolding on the basis of epistemology. Although artificial intelligence can write in different language expressions, it always fails to evaluate whether these expressions are appropriate with teaching objectives, subject norms or specific communication situations (Bender et al., 2021). Therefore, in the educational environment, AI does not have the ability to explain and evaluate the learning process like teachers, and cannot really play the teaching guidance role played by human support.

This limitation, on the contrary, further highlights the importance of teacher scaffolding. Artificial intelligence does not replace the role of teachers, but changes the role of teachers. In the AI-assisted writing environment, teacher scaffolding, as an intermediary mechanism, affects how learners understand and use the AI feedback.

Specifically, the teacher's bracket has three main functions. The first is epistemic positioning, which is to help learners understand that AI is just a tool to generate results, not an authoritative evaluator. The second is critical mediation, that is, guiding learners to judge whether AI feedback is appropriate according to the specific context and writing purpose, instead of accepting it directly. The third is pragmatic adaptation, which refers to help learners turn their judgments into specific modification decisions. From this perspective, teacher scaffolding is not merely instructional assistance but a mechanism for developing evaluative agency in technologically mediated writing environments. At the same time, teachers need to conceptualize these platforms as scaffolds in the writing process rather than as autonomous writing agents (Huang, 2026).

3. Structural Constraints of AI Feedback in Business English Writing

Because Business English writing is deeply rooted in the professional practice of social positioning, effective feedback requires not only language correction, but also explanatory judgment based on institutional and interpersonal reality. These structural constraints show that AI feedback must be supplemented by teacher scaffolding, which provides the necessary

contextual mediation for meaningful evaluation and revision. The following sections examine these constraints in detail from epistemic and pragmatic perspectives.

3.1 Business English Writing as Socially Situated Professional Discourse

Business English writing is essentially a kind of professional communication embedded in specific social and professional situations. In this kind of writing, language is not used in isolation. It is always closely related to organizational operation, interpersonal consultation and communication strategies. In work scenarios, written text is not just a tool for conveying information. It is also an important way for enterprises to shape their own image, coordinate interpersonal relationships and achieve professional goals. Therefore, the evaluative criteria of such writing extend beyond grammatical accuracy to include pragmatic appropriateness, rhetorical effectiveness, and contextual alignment.

From a systemic-functional perspective, the meaning of Business English writing is not determined by the language form itself, but by language selection and specific situations. The purpose of writing, the audience and the organizational background will all affect how language is used. Because of this, the same expression may produce different effects in different scenes. For example, in negotiation, reporting, complaint handling or persuasion communication, the same sentence may convey a completely different pragmatic meaning. This shows that Business English writing not only pursues correct language form, but more importantly, follows the communication norms in specific situations.

In addition, professional communication in the business environment is usually affected by many implicit communication rules, such as the degree of politeness, indirectness, degree of explicitness, and interpersonal positioning. Although these rules are often not clearly written, they directly affect the smooth progress of communication. To truly master these rules, it is not enough to have language knowledge, but also to have sensitivity to the context and an understanding of professional culture and social norms.

3.2 Epistemic and Pragmatic Limitations of AI Feedback in Business English writing

Although generative AI performs well in identifying surface language mistakes, there are still fundamental limitations in its ability to evaluate the quality of writing in Business English contexts.

A major problem is that language correctness is not the same as pragmatic appropriateness. AI feedback mainly comes from the probability analysis of a large number of language patterns, not based on real communication intentions. Therefore, it is more inclined to pay attention to language itself. However, in Business English writing, effective communication is not always the clearer the better. In many cases, the effect of expression depends on the appropriate implicit, consideration of interpersonal relationships, and the directness of expression according to different situations. Linguistic improvement at the surface level may therefore produce unintended pragmatic distortion at the discourse level. In other words, the language has improved, but the interpersonal meaning and context effects that were originally wanted to convey may have been weakened. This problem is especially obvious in business communication. In these cases, writers usually deliberately use more euphemistic or indirect expressions to maintain good interpersonal relationships or leave some space for subsequent communication. However, the AI feedback may often understand these expressions as not clear enough, so it is recommended to change the sentences to be more direct and clear ones, which may weaken the original communication effect.

Another cognitive problem is that people tend to overestimate the authority of AI feedback. The suggestions given by AI are usually fluent, coherent and seemingly professional. Thus, it is easy to mistakenly believe that these suggestions must be reliable and correct. If learners lack critical thinking, they may overly rely on AI's suggestions and regard it as a standard answer, instead of actively thinking about whether these modifications are really appropriate. This kind of uncritical acceptance is especially risky in Business English writing, because a tiny language adjustment may change the tone of the sentence, the way of interpersonal expression, and even affect the overall communication effect.

Overall, these limitations show that AI feedback cannot independently play an evaluation role in Business English writing. Whether it can really give full play to the teaching value still depends on the learner's understanding and judgment.

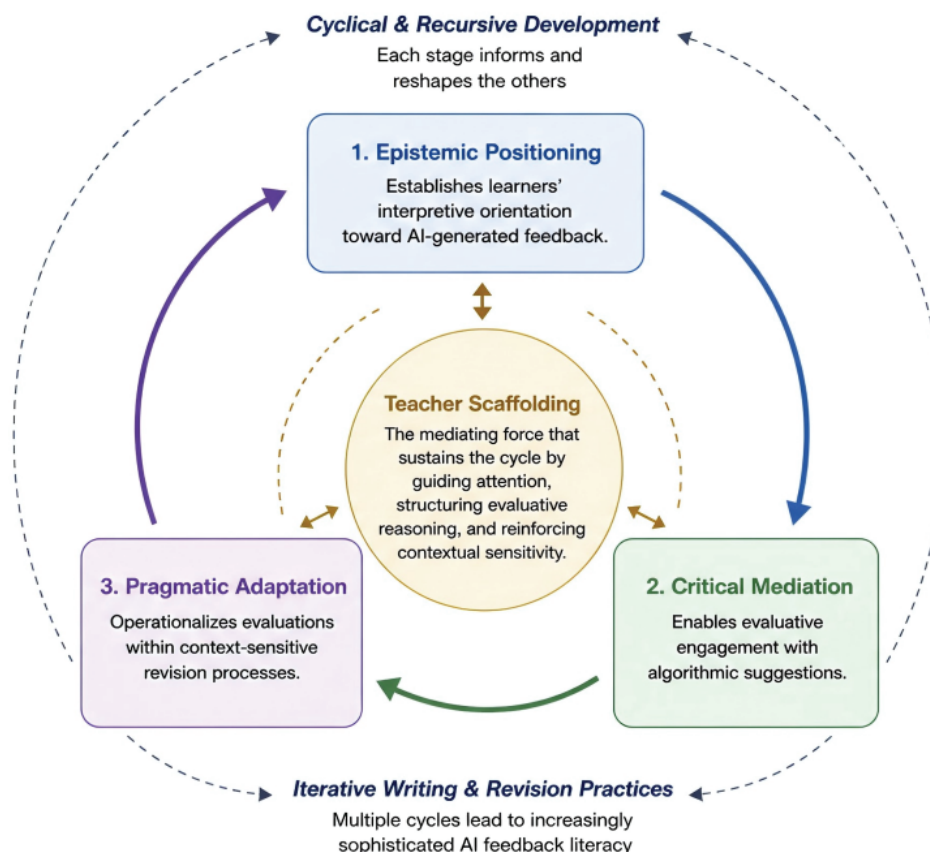
4. Teacher-Scaffolded Model of AI Feedback Literacy Development

This paper proposes a teacher-scaffolded model of AI feedback literacy in Business English writing, which contains three interrelated dimensions including epistemic positioning, critical mediation, and pragmatic adaptation (see Figure 1). These

three dimensions describe the growth path of learners, from first understanding the modification suggestions given by AI, to learning to judge whether these suggestions are reliable and suitable, and finally making appropriate modifications in combination with the actual writing scenario.

This process is not a linear sequence, but a recursive process. Each stage affects and strengthens other stages. Throughout the process, the teacher's guidance always plays a guiding role to help students understand, judge and revise. In general, the model regards AI feedback literacy as a dynamic and process-oriented ability, which needs to constantly interact with AI feedback in writing practice before it can be gradually cultivated.

Figure 1: Teacher-scaffolded model of AI feedback literacy



4.1 Epistemic Positioning in AI-mediated Feedback Environments

In Business English writing, the cultivation of AI feedback literacy should first let learners form a correct epistemic positioning, namely cognitive positioning, for the feedback generated by AI. This positioning is simply how learners understand and view the evaluation content given by AI, including its nature, scope of application and credibility.

In the traditional feedback environment, learners usually consider teacher feedback to be authoritative because it is based on professional knowledge and teaching goals. In contrast, the feedback generated by AI breaks the original authoritative structure. Although the language advised by AI is fluent, it is not based on clear teaching intentions or professional judgments. This change may cause cognitive confusion that learners tend to equate language fluency with evaluating effectiveness.

In Business English writing, the consequences of this confusion are particularly obvious, because pragmatic appropriateness cannot be judged by superficial language forms alone. Therefore, learners need to establish a judgment framework to distinguish whether the language is reasonable and whether the expression is appropriate in a specific situation, so as to use AI feedback more accurately.

Therefore, the teacher's guidance plays an important role in building this cognitive framework. Through guided comparative analysis, situational interpretation and reflective questioning of AI output, teachers help learners realize that the feedback generated by AI is probabilistic, rather than absolute authority. This change of attitude allows learners to regard AI feedback as a reference resource rather than a final conclusion. Therefore, epistemic positioning is the basic condition for subsequent

critical evaluation. It determines whether learners treat AI feedback critically or accept it completely without thinking.

4.2 Critical Mediation of AI-generated Feedback

After establishing epistemic positioning, learners enter a stage that can be called critical mediation of AI feedback. This process means that when learners use AI to obtain feedback, they need to understand and judge the various modification suggestions given by AI, and combine specific text content and writing scenarios to decide whether these suggestions are appropriate. In a writing environment with the participation of AI, learners are often given many different modified versions, which may differ in language expression, style selection and structural complexity. In the face of multiple choices, learners cannot simply copy any of them, but must make evaluative judgments. Therefore, critical adjustment has become the core link in the cultivation of AI feedback literacy.

The teacher's scaffolding builds this adjustment process in three aspects. Learners are guided to assess the linguistic coherence of AI suggestions, to compare alternative formulations with their original textual choices, and to evaluate the contextual appropriateness of proposed revisions in relation to communicative purpose and audience expectations. Through these comparisons and analysis, learners no longer only accept the surface language modification, but need to pay attention to the rhetorical effect and pragmatic effect behind the expression. In Business English writing, this kind of context judgment is particularly important, because the communication effect often depends on subtle adjustments such as tone, directness, interpersonal expression, etc. Therefore, the guidance of teachers is important, which can help learners realize that clearer language expression is not necessarily equal to effective communication. It can be seen that critical adjustment is a core mechanism. Through it, learners transform the external AI feedback into evaluative knowledge that has been internalized and processed by themselves.

4.3 Pragmatic Adaptation in Revision Decision-Making

The last stage of AI feedback literacy cultivation is pragmatic adaptation, which refers to the process of learners transforming evaluation and judgment into modified decision-making to suit the specific context in the writing task. In Business English writing, this stage is particularly complicated, because modification should not only pursue language clarity, but also take into account the requirements of polite expression, strategic euphemism and workplace scenario norms. Therefore, learners' response to AI feedback is not simply adopted or rejected, but a process of continuous adjustment. For instance, suggestions are adopted directly, or modified according to the context, or even completely abandoned when inappropriate. These different choices reflect the judgment ability of learners at different levels.

The teacher scaffolding is still essential at this stage. It can help learners clearly understand the basis for making their revision decisions. By guiding learners to think about reader expectations, communication purposes and discourse norms, teachers assist them to clearly modify the reasons and transform implicit judgments into explicit analysis. It can be seen that pragmatic adaptation is the key link in the reflection of AI feedback literacy in the writing results. Learners here show the ability to integrate language, pragmatic and scene factors into complete modification strategies.

4.4 A Recursive Model of AI Feedback Literacy Development

In summary, these three dimensions together constitute a cyclical and progressive development mechanism, and AI feedback literacy in the Business English writing is gradually formed under this mechanism. Epistemic positioning establishes learners' attitude towards AI-generated feedback; critical mediation enables them to think critically about these algorithmic suggestions; pragmatic adaptation transforms these evaluations into actual modification behaviors that adapt to the context.

This mechanism is not a linear development, but a cyclical advancement. In the process of repeated writing and revision, each stage continues to influence and reshape other stages. The teacher's scaffolding plays a key intermediary role in guiding learners' concerns, helping them form more organized judgments, and strengthening their sensitivity to the context, so as to maintain the operation of this circular mechanism.

From a theoretical point of view, the model redefines AI feedback literacy. It is no longer regarded as a fixed set of skills, but a constantly developing evaluation ability. Under the framework of the higher education assessment system, this redefinition shifts the focus from product-oriented to process-oriented, that is, emphasizing whether learners can critically understand and effectively use AI feedback in professional writing scenarios.

5. Discussion of Teacher-Scaffolded AI Feedback in Business English Writing

Integrating generative artificial intelligence into Business English writing teaching is not limited to improving text quality. More fundamentally, it reshapes the understanding, support and evaluation of the development of writing ability in higher education. In the AI-assisted writing environment, learning increasingly relies on learners' ability to interpret, evaluate and strategically use multiple AI feedback sources. This change requires us to re-examine the evaluation method, the role of teachers, and the conditions needed to cultivate students' independent evaluation ability from the teaching level.

5.1 Process-Oriented Reconfiguration of Assessment

The emergence of generative artificial intelligence makes writing teaching in higher education, especially Business English writing teaching, have to reconsider the way learners' learning outcomes are evaluated. Traditional evaluation mainly focuses on the quality of the final text, such as grammatical accuracy, vocabulary complexity and structural coherence. However, in the case of AI participation in writing, the superficial quality of the final text can no longer truly reflect the ability of learners, because high-quality text may be generated by AI assistance, and behind the written text, there may be a more in-depth thinking and revision process. This disconnect between the results and the learning process brings a fundamental challenge to the evaluation effectiveness of writing teaching.

In order to address this challenge, Business English writing evaluation must be redefined as a process-oriented evaluation system, focusing on the process of learners' handling of feedback, rather than just focusing on the final text performance.

In this revised evaluation logic, three dimensions are particularly important. First, the feedback interpretation becomes the content that can be evaluated. This includes evaluating whether learners can explain, argue and critically reflect on the feedback generated by AI, rather than just passively accepting or directly applying it. The evaluation focuses on whether learners can clearly explain the reasons for adopting or rejecting a feedback in combination with the purpose of communication. Second, modifying decision-making has become a key indicator of evaluation ability. The evaluation of this dimension focuses on how learners handle feedback from different channels, including AI suggestions, teacher comments and peer review, and prioritizes this information during the revision process. The evaluation focuses on the rationality of decision-making, rather than mechanically completing the modification. Third, context adaptation has become the core of evaluating advanced writing ability. In Business English writing, the ability to adjust the text according to readers' expectations, industrial norms and communication purposes is an important part of professional literacy. Therefore, the evaluation must examine the degree to which learners integrate pragmatic factors into the modification strategy.

In summary, these dimensions show that the evaluation in the AI-assisted writing environment should shift from a product-centered to a process-oriented evaluation model. This change is consistent with the overall trend of higher education evaluation, that is, the emphasis on learning-centered and process-oriented formative evaluation.

5.2 Pedagogical Tensions and Theoretical Implications

Although artificial intelligence has potential value in teaching, its integration into Business English writing teaching has also brought a series of contradictions.

One of the core contradictions is the risk of dependence. Although the original intention of AI feedback and teacher support is to help learners improve their ability, it may also lead to learners gradually over-reliance on these external evaluation sources. In this way, learners' opportunities for independent judgment will be reduced, which is not conducive to the development of their inherent evaluation ability.

The second contradiction is related to the restructuring of teachers' authority. In traditional writing teaching, teachers are the main authoritative sources of language and rhetoric. However, AI poses a challenge to this role after entering the classroom, because AI can provide immediate and seemingly authoritative feedback on superficial language problems. This transformation did not abolish the role of teachers, but reshaped their role. Teachers are increasingly becoming intermediaries of subject knowledge, responsible for giving contextual meaning to feedback, not just correcting language errors. This reconstruction requires teachers to change their teaching identity. Their professional ability is no longer mainly reflected in providing definite language modification schemes, but more reflected in guiding learners to interpret and evaluate multiple feedback sources, including AI output, and apply them to specific situations.

The third contradiction is about the cognitive opacity of the AI system. Unlike human feedback based on clear reasoning and teaching intentions, AI feedback comes from a complex and inexplicable statistical calculation process. This lack of transparency makes it difficult for learners to truly understand the generation logic of AI suggestions, which in turn increases the difficulty of critical judgment. In the absence of a clear explanation, learners often need to use external support to build moderate trust and questioning, so as to use AI feedback more reasonably.

These contradictions together highlight the core paradox of artificial intelligence integration into writing teaching: on the one hand, AI improves the accessibility and modification efficiency of feedback, and on the other hand, it brings new challenges such as dependence problems, authority restructuring and insufficient cognitive transparency. To deal with this paradox, it is necessary to change the focus of teaching to cultivating learners' AI feedback literacy, rather than just improving their writing performance. From the theoretical level, these contradictions further reinforce the core point of this article: AI feedback literacy cannot be formed naturally only through contact technology, but also requires structured teaching intervention based on teacher support.

6. Conclusion

This paper has developed a conceptual framework for understanding AI feedback literacy in Business English writing within a teacher-scaffolded pedagogical environment. It has argued that while generative artificial intelligence significantly expands access to feedback, its pedagogical effectiveness is constrained by structural limitations related to contextual sensitivity, pragmatic interpretation, and disciplinary specificity.

The core contribution of this paper is to redefine teacher scaffolding as a mediating mechanism. Teachers have become an important role in guiding learners' cognitive positioning, evaluation, reasoning and pragmatic judgment. At the same time, the research has also promoted the theory of higher education evaluation from product-oriented to process-oriented, emphasizing that learners should pay attention to how to use feedback, how to make revision decisions, and how to achieve context adaptation, not just the quality of the final text.

In addition, the paper points out that in the future, it is still necessary to further explore the development differences of learners at different levels, support strategies in different teaching situations, and how learners integrate multi-source feedback through empirical research. In general, the integration of artificial intelligence into Business English writing does not eliminate the need for human pedagogy. Rather, it intensifies the importance of evaluative judgment, contextual reasoning, and interpretive mediation. In this case, AI feedback literacy has become an important academic and professional ability.

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Conflict of Interests

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Training Model for International Students in Business Administration at Application-Oriented Universities under the Transformation of Knowledge Production Model

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Abstract: With the acceleration of China's higher education internationalization, the cultivation of international students in China has become a key indicator of the country's educational influence. Business-related majors are particularly popular among international students. However, current training models face multiple challenges, including insufficient innovation, weak cross-cultural adaptation mechanisms, inadequate integration of national conditions and ideological education, and limited development of comprehensive and practical abilities. This study analyzes the current situation and problems of business talent cultivation for international students in China from the perspective of the transformation of knowledge production models and proposes an innovative training framework.

Keywords: International Students in China; Business Talent Training; Knowledge Production Model; Application-Oriented Universities; Interdisciplinary Curriculum

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1. Introduction

With the accelerated advancement of China's higher education internationalization, the education of international students in China has become an important indicator for measuring China's international educational influence. The strategic framework of China's Education Modernization 2035 explicitly lists "deepening international cooperation and exchange in education" as a key task, emphasizing the expansion of the scale of international students in China, structural optimization, and quality improvement to build a sound quality assurance system for international education ^[1]. The policy documents jointly issued by eight ministries, including the Ministry of Education, further highlight the strategic importance of opening up education, requiring a comprehensive enhancement of the international competitiveness of the "Study in China" brand ^[2]. Against this background, cultivating high-quality composite business talents with an international perspective has become an important mission for application-oriented universities. According to statistics from the Ministry of Education, by 2023, the number of international students in China had reached 516,000, with economics and management majors being particularly popular. However, current training models for international business students still have many deficiencies, failing to meet the demands of the new era for international business talents. Therefore, this study starts from the theoretical perspective of the transformation of knowledge production models, systematically analyzes the current situation and challenges of the business talent training model for international students, and proposes an innovative training model. This study aims to provide

theoretical reference for optimizing the training model for international business students, contributing to the “Study in China” brand and enhancing the international influence of China’s higher education.

2. Literature Review

2.1 Research on Innovation in Training Models for International Students

Existing research shows that the training of international students in China generally adopts a convergence management model, i.e., integrating international students into the same teaching management system as Chinese students. However, some studies point out that this model faces the dual challenges of uneven student quality and insufficient cross-cultural adaptability, as well as problems such as disconnection between talent training programs and internationalization goals, and lack of innovation and entrepreneurship education concepts. Other researchers propose the concept of “customized management,” emphasizing the development of personalized training programs based on project needs. Xu advocates for establishing a “full-cycle management” system, improving the quality assurance system for international students from three dimensions: management subjects, processes, and mechanisms^[3].

Regarding the improvement of training quality for international students, Dai proposes an innovative teaching model of “comprehensive training, separate design, diverse teaching, and comprehensive evaluation”^[4]. Other scholars have constructed a “curriculum + environment + management + practice” four-in-one training model, emphasizing the integration of the spirit of Chinese civilization into professional teaching. Zhou suggests designing “China-knowledgeable” education content and building an internally and externally linked education system^[5]. Han proposes a “four doubles and four abilities” model, constructing a multi-dimensional curriculum system^[6]. Su emphasizes adding content on contemporary Chinese social development to national conditions courses, guiding international students to understand China from a cross-cultural perspective^[7].

2.2 Research on University-Enterprise Cooperation and Industry-Education Integration

In terms of university-enterprise cooperation, some universities have carried out beneficial explorations. For example, a vocational and technical college in Jiangsu implemented a “1+1.5+0.5” model, while higher vocational colleges in Guangxi built characteristic education models leveraging regional advantages. Based on the “triple helix” theory of industry-university-research, some researchers proposed strengthening joint training of international students^[8]. Three Gorges University developed internationalized courses to meet the needs of international students and promoted mutual recognition of vocational education courses. Jin^[9] emphasized that application-oriented undergraduate universities should actively explore paths of industry-education integration. Li^[10] suggested that higher vocational colleges build an internationalized education resource system through resource sharing and carry out “Chinese + vocational skills” education programs.

Existing research mostly focuses on international student management models, Chinese language and vocational skills education, cross-cultural adaptation, etc., with insufficient attention to regional and institutional type differences, and lacks a systematic theoretical framework for the cultivation of international business talents.

3. Current Situation of Business Talent Training for International Students

3.1 Insufficient Innovation in Training Models

Current training models have significant shortcomings in innovation. First, most universities’ curriculum designs fail to fully integrate local characteristics, institutional realities, and the specific needs of international students, instead mainly referring to the models for domestic business students and simply deleting some courses. Teaching content and textbook selection are primarily based on Western economic theories and foreign original textbooks, lacking in-depth discussion of China’s economic development characteristics, laws, and China’s role and contribution in global economic governance.

3.2 Weak Mechanisms for Cultivating Cross-Cultural Adaptability

Due to language barriers and other reasons, many universities adopt separate class models for international students. Although this ensures a language learning environment, it reduces opportunities for interaction with Chinese students and limits in-depth understanding of Chinese culture and national conditions. At the same time, many universities have low levels of internationalization, with few faculty members having overseas study or visiting experience, resulting in insufficient cross-cultural competence. This affects the ability to link theory with practice when teaching practice-oriented courses, thereby

impacting the improvement of international students' cross-cultural adaptability.

3.3 Insufficient Integration of National Conditions Education and Ideological Education

In university curricula, the integration of national conditions education and ideological education content is insufficient. Although some universities offer courses such as *Introductory Education* and *Overview of China* as ideological education, these are not throughout the entire program, appearing disjointed and fragmented, making it difficult to form a systematic education system. Moreover, some teachers, in the process of teaching professional courses, emphasize knowledge transmission over moral education, neglecting the integration of ideological elements into professional courses, leading to students' lack of identification with and sense of responsibility for national interests and ethnic emotions.

3.4 Limited Development of Comprehensive Quality and Practical Ability

In many universities, the curriculum design for international students has an unreasonable proportion of courses, with a low proportion of practical and innovative teaching sessions, making it difficult to meet the needs of international students for practical skills and literacy development. On the other hand, practical courses are relatively few and are not fully implemented due to funding or venue constraints. Furthermore, university-enterprise cooperation has not been effectively implemented, with cooperation limited to visits or lectures, and no real arrangement for students to practice in positions matching their majors. Meanwhile, in various innovation and entrepreneurship competitions, the active participation of international students remains weak.

In response to the above problems, this study analyzes the transformation of knowledge production models to build a training philosophy, reshape the interdisciplinary comprehensive curriculum system, construct a multi-stakeholder parallel education mechanism, and develop a quality evaluation system based on "process structure," thereby reconstructing the knowledge production model system for international students in China.

4. Countermeasures and Suggestions for Business Talent Training

4.1 Cultivating a Diversified and Multi-Driven Talent Training Philosophy

The traditional training model oriented solely toward academic talents can no longer meet the needs of national development strategies and social development. Against the background of the transformation of knowledge production models, the training of international students in the new business discipline should establish a diversified and open training system. Beyond knowledge transmission, the cultivation content should also include ideological and moral construction, theoretical literacy cultivation, and practical application ability enhancement, achieving a comprehensive improvement in the connotation of talent training. A systematic goal of "value shaping, knowledge transmission, and ability cultivation" should be constructed, integrated into the design and implementation of talent training programs, and used as a guiding principle for education, teaching, and assessment.

At the level of value shaping, the training orientation of "knowing China and being friendly to China" should be strengthened. On the one hand, business professional knowledge is systematically taught; on the other hand, through various forms, international students are guided to deeply understand Chinese culture, Chinese history, and China's development process, enhancing their identification with and sense of belonging to China's path, theory, system, and culture. This cultivates a group of international students with Chinese sentiments and international perspectives, spreading excellent Chinese culture, promoting cultural exchanges between China and other countries, and becoming a bridge connecting China and the world. *China's Education Modernization 2035* proposes "unity of knowledge and action" as an important concept of educational modernization, emphasizing the organic unity of knowledge and practice. In the training of new business talents, international students are encouraged to participate in business projects, corporate internships, and other practices, deepening theoretical understanding in real scenarios and improving their ability to analyze and solve problems.

"Knowing China and being friendly to China, uniting knowledge and action" is a multi-dimensionally driven educational philosophy. It aims to promote cultural cognition and emotional connection, lay the foundation for international students to go global and integrate into the world, based on both traditional Chinese culture and global development trends. It enhances the comprehensive quality and employment competitiveness of international students in China, cultivating future business leaders with international vision, innovative spirit, and national sentiment, charting the direction and path for the training of international students in the new era.

4.2 Building an Interdisciplinary Comprehensive Curriculum System

In the evolution of the knowledge system, knowledge production models increasingly emphasize interdisciplinary integration and practice orientation. Curriculum system innovation for international students should focus on four core elements: Chinese language proficiency, national conditions cognition, professional knowledge accumulation, and practical ability enhancement. As the dominant language of instruction in China's education system, Chinese is an important guarantee for international students' cross-cultural adaptation and the realization of the goal of "knowing China and being friendly to China." The curriculum design should include three major modules: First, a Daily Chinese is to enhance students' daily communication skills and help them quickly adapt to the Chinese social environment; Second, a Quantitative Assessment Standard through the HSK series, which is the Chinese proficiency test equivalent to English Level 4. With the goal of cultivating students' workplace language application ability, combined with business knowledge, a Business Chinese Series is offered. Language teaching should run through the four-year learning cycle, ensuring synchronous improvement of language ability and national conditions cognition. National conditions education courses should cover three areas: China Overview, Culture, and History, helping students build a holistic understanding of contemporary China through systematic introduction to economy, society, politics, geography, science and technology, etc. At the same time, diverse teaching forms such as field trips and cultural experiences are integrated to enhance learning effectiveness. Professional curriculum design should focus on the international business field, integrating core content such as international trade, international marketing, and multinational company management, supplemented by basic courses such as accounting and statistics. Elective courses can focus on hot topics such as the "Belt and Road" initiative and cross-border e-commerce, keeping pace with global business dynamics. Practical components include corporate internships, project training, and business competitions, aiming to enhance students' ability to solve practical problems and promote the deep integration of theory and practice. Through systematic curriculum design and practical arrangements, compound talents with international vision and hands-on ability are cultivated.

4.3 Constructing a Multi-Stakeholder Parallel Education Mechanism

As knowledge production models transition from closed academic orientation to open, multi-dimensional collaborative innovation, the main body of talent cultivation has expanded from a single university to a collaborative system involving enterprises, governments, and the public. This transformation emphasizes the close connection between knowledge production and social needs, requiring universities to build a "university + enterprise + government + public" multi-stakeholder collaborative education mechanism to meet the demand for high-quality composite talents among international students in China in the new era.

As the core of collaborative education, universities should integrate the concept of multi-stakeholder collaboration into curriculum design, teaching content, and practical components. Enterprises, as practitioners of knowledge transformation and technology application, provide students with real knowledge production environments by introducing industry experience and practical scenarios. Governments provide institutional guarantees for multi-stakeholder cooperation through policy support, financial investment, and platform construction. The public, through forms such as volunteer services and community activities, provides international students with practical opportunities, promoting the integration of educational content and social culture, and facilitating students' innovation and creativity in educational practice. The multi-stakeholder collaborative education mechanism, in the practice of international student education in China, forms a complete learning chain from theory to practice to social feedback. On the one hand, through interdisciplinary course teaching and problem-oriented teaching, it deeply integrates theoretical knowledge and social practice, achieving the organic combination of multi-stakeholder collaborative education mechanisms. For example, offering courses such as "Chinese Culture and Globalization" combined with local Chinese business cases helps students understand China's role in a global perspective and corporate globalization strategies. On the other hand, through sharing scientific research results and educational resources, it promotes the linkage of "industry-university-research." For example, jointly establishing practice bases with enterprises, hiring corporate executives as mentors, and organizing students to participate in government-supported "Belt and Road" research projects or "Rural Revitalization Plan," enabling them to deeply understand China's socio-economic environment and governance models. This mechanism not only promotes the hands-on ability of international students but also drives a

virtuous cycle of knowledge production and application.

4.4 Multidimensional Quality Assurance System

Against the background of the transformation of knowledge production models, the quality assurance system for international business students in China needs to construct a multi-dimensional evaluation model from four dimensions: dynamic monitoring mechanism, enterprise-involved evaluation, integration of classroom and extracurricular activities, and combination of mid-term and final assessments. First, establish a “dynamic monitoring mechanism”. Collect feedback from international students through regular survey questionnaires to optimize teaching arrangements; set up cross-cultural adaptation specialists and build a dynamic database involving multiple parties to achieve data sharing between life counselors and course instructors. The database is updated regularly and feedback is provided to course instructors, facilitating timely adjustment of teaching progress and helping students address language, cultural, and academic challenges. Second, introduce an “enterprise-involved evaluation mechanism”. Enterprise mentors are invited to participate in talent training evaluation. Through a combination of process and summative assessments, ensure that talent training matches industry needs, and comprehensively assess students’ hands-on ability and application skills. Third, strengthen the “integration of classroom and extracurricular activities”. Through case studies, project training, and other forms, classroom performance and extracurricular practice are incorporated into the assessment system to evaluate students’ knowledge application ability and comprehensive quality. Finally, in the “combination of mid-term and final assessments”, improve the evaluation of classroom performance and extracurricular practice. Adopt a combination of formative and summative assessments to ensure that the assessment process is closely integrated with the talent training process, promoting students’ comprehensive development. Identify problems in a timely manner through periodic assessments and adjust training programs accordingly. This multi-dimensional evaluation system, through multi-party participation, dynamic adjustment, and full-cycle coverage, effectively enhances the scientificity and effectiveness of talent training quality assurance.

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The Comprehensible Input Theory in Second Language Acquisition: Origin, Development and Evaluation

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Abstract: Krashen's Comprehensible Input (i+1) Hypothesis is the core of his language acquisition theory, which originated in the late 1970s and early 1980s, aiming to explain the process of second language acquisition. This theory is based on previous language acquisition research and absorbs relevant theories from psychology and pedagogy, as well as Vygotsky's sociocultural theory and Chomsky's linguistic theory. Krashen's theory emphasizes that language acquisition is a natural and subconscious process and highlights the importance of language input. The theory is still applied today; scholars have put forward new insights based on Krashen's theory, with both consistencies and contradictions. It has not only changed educational practitioners' practices in language teaching and curriculum design but also provided an important theoretical tool for understanding the complex process of second language acquisition.

Keywords: Comprehensible Input; Output Hypothesis; Second Language Acquisition

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1. Theoretical Exposition

1.1 Definition

Krashen's Comprehensible Input (i+1) Hypothesis holds that language learners can learn effectively only when they are exposed to input slightly above their current language proficiency. Such input should contain language elements known to the learner (i.e., i) and new elements slightly beyond their comprehension (i.e., +1). This kind of language input can stimulate learners' motivation and help them absorb new knowledge naturally in a low-pressure environment.

1.2 Argumentation Methods

Krashen mainly supported his theory by observing and analyzing the natural acquisition process of second language learners and comparing the actual effects of different teaching methods (e.g., traditional grammar instruction vs. meaning-based communicative approaches). He synthesized a large number of empirical research data, especially noting that learners tend to master a second language better in a more natural and communicative language environment. Krashen believed that language input is the driving force of natural acquisition, rather than deliberate memorization and repetitive practice.

1.3 Evidential Basis

Most of Krashen's research is based on the empirical experience of learners^[1], emphasizing the impact of actual language use situations on language acquisition. He cited cases in which learners naturally acquire language through exposure to various forms of language (such as stories, games, daily conversations, etc.) in multiple situations. In addition, he referred to

psychological and educational theories, especially studies on the role of motivation and emotion in the learning process, and how they optimize learning effects by reducing anxiety and improving self-efficacy.

2. Demonstration of Follow-up Studies

Deng Yueping applied Krashen's Comprehensible Input Theory in his study *A Study on the Feasibility of Autonomous Reading Based on Network Resources and College English Acquisition* ^[2], and proposed an autonomous reading model based on network resources to promote college English acquisition. The paper analyzes two key conditions of the Comprehensible Input Theory: the input content must be slightly above the learners' current level, and the focus should be on content comprehension rather than language form. Deng Yueping argued that autonomous reading using abundant network resources can greatly increase students' language input, help improve their vocabulary and practical application ability, and deepen their understanding of English culture. However, he also pointed out that input language must pass through affective filtering to be effectively absorbed; therefore, affective factors such as motivation and confidence are crucial to language acquisition.

Deng Lianjian and Yang Liexiang introduced the Intake Hypothesis in *The Intake Hypothesis in Second Language Acquisition* ^[3] as an important supplement to the Input Hypothesis and the Output Hypothesis. Krashen's Input Hypothesis holds that sufficient comprehensible input is the key to successful second language acquisition, but it ignores the learners' individual initiative and the actual effect of input in non-linguistic environments. Swain's Output Hypothesis emphasizes the importance of output in second language acquisition, prompting learners to internalize language structures through language use. However, neither hypothesis fully explains the internal psychological mechanism of second language acquisition. The Intake Hypothesis points out that the core of language acquisition lies in maximizing and optimizing the intake process, which includes multiple interrelated psychological processes such as simplification, inference, construction, and reconstruction. The Intake Hypothesis emphasizes that not all input can be absorbed as linguistic knowledge; only through complex psychological processing and selective attention can input be transformed into effective language internalization. The Intake Hypothesis integrates the strengths of the Input and Output Hypotheses, further explains the complex process of second language acquisition, and highlights the importance of learners' initiative and internal cognitive transformation.

The paper *A Practical Study on English Immersion Contextual Input and Children's Second Language Acquisition* ^[4] supports Krashen's theory, especially emphasizing the importance of comprehensible input. Through practical cases and research, the paper shows that providing language input in real situations can effectively promote language acquisition, which is completely consistent with Krashen's Input Hypothesis. In addition, the paper recognizes the importance of immersive learning environments and supports Krashen's views on low anxiety and natural interaction.

However, the paper also puts forward some objections. It points out that Krashen ignored the importance of interaction and output in language acquisition, citing Swain's Output Hypothesis to emphasize that output practice in interaction can improve language fluency. The paper also refutes Krashen's complete opposition to error correction, referring to studies showing that moderate error correction helps learners overcome mistakes.

The paper *Exploring the Theoretical Basis of Krashen's "Thematic Reading" Theory* ^[5] supports Krashen's theories of "comprehensible input" and "thematic reading", arguing that understanding language input above the current level and focused reading of related materials contribute to language acquisition. But it also raises objections, pointing out that Krashen ignored the role of interaction and output in language learning, citing Swain's views to emphasize the importance of output, and criticizing Krashen's complete rejection of error correction strategies, arguing that moderate error correction helps improve language accuracy.

3. Theoretical Evaluation

3.1 Strengths

Emphasis on natural language acquisition: Krashen's theory stresses that language should be acquired through natural absorption rather than deliberate learning, which is similar to the natural process of children learning their first language. This approach is more humanistic and reduces learners' pressure and anxiety.

Guidance for teaching practice: The theory provides practical guidance for language teaching and promotes methods such

as task-based learning, communicative language teaching, and content-based learning. These methods encourage teachers to create real and functional communication environments to stimulate learners' interest and motivation.

Focus on the quality and appropriateness of input: The theory points out that only "comprehensible" input can effectively promote language acquisition, which emphasizes the importance of content appropriateness in textbook development and curriculum design.

Educational inclusiveness: The theory advocates providing appropriate levels of language input for learners of different proficiency levels, helping to meet diverse learning needs and differentiated instruction.

3.2 Weaknesses

Difficulty in accurately defining and implementing $i+1$: The " $+1$ " in the theory is difficult to quantify specifically, and the " $+1$ " level varies among different learners, which challenges teachers' operation in actual teaching.

Limitations of over-reliance on input: Although Krashen emphasizes the importance of input, the theory pays little attention to the role of learners' active output. Language output (such as speaking and writing practice) is also extremely important for language acquisition and is a key process for internalizing linguistic knowledge and testing learning outcomes.

Ignoring the practicality of grammar instruction: Although the theory tends to downplay direct grammar teaching, existing studies show that direct grammar guidance can help learners understand and master language structures more quickly in some cases, especially for adult learners.

Limited empirical basis: Although Krashen cited various case studies to support his theory, critics argue that it lacks extensive empirical data support and reserve opinions on the universality and persistence of the theory's effects.

Ignoring socio-cultural factors: The theory mainly focuses on the psychological mechanism from input to acquisition, and does not discuss in detail how external factors such as socio-culture affect language acquisition, which limits the comprehensiveness of the theory to a certain extent.

3.3 Contradictions and Consistencies with Other Theories

The Project-Based Foreign Language Teaching Theory (PBLI) proposed by Liu Yudong^[6] emphasizes promoting language learning through practical projects, focusing on students' active participation and task-driven learning. Compared with Krashen's Comprehensible Input Theory ($i+1$), PBLI has contradictions: the linguistic complexity of tasks does not necessarily conform to the " $i+1$ " model, and PBLI emphasizes the importance of language output, while Krashen regards output as unnecessary. The consistency between the two is that both emphasize language use in real situations and enhance learners' motivation and interest. PBLI stimulates students' interest through projects, enabling them to better absorb language input in a low-anxiety environment, supplementing and expanding Krashen's theory.

In her paper *Research on Language Input and Output Theories and English Teaching*^[7], Fu Yan analyzed Krashen's Comprehensible Input Theory and affirmed its view of promoting language acquisition through the " $i+1$ " model. However, she also pointed out the limitation of Krashen's theory, namely overemphasizing input while ignoring the importance of output. Combining Swain's Output Hypothesis^[8], the paper holds that language output is equally crucial in feedback and promoting language internalization, and emphasizes that relying solely on input may lead to the consolidation of language errors. Based on this, Fu Yan proposed that input and output should be equally important in foreign language learning and suggested balancing the two in English teaching in China to improve the quality of language acquisition. Overall, Fu Yan's research supports Krashen's theory while also emphasizing the important role of output in language learning.

In his study "Language Input" and *College English Writing Teaching*^[9], Xu Xianqiao demonstrated the theory combined with college English writing teaching. He supports Krashen's view that language acquisition can be achieved by understanding input ($i+1$) slightly above learners' current level, especially in college English writing teaching, and introducing reading materials of appropriate difficulty helps improve writing ability. However, Xu Xianqiao also pointed out the limitation of the theory, that is, relying solely on input cannot fully meet the needs of language acquisition, and attention should also be paid to language output and interaction. Over-reliance on input may lead students to ignore language forms and affect language accuracy. Therefore, the paper emphasizes that input and output should be balanced in writing teaching to comprehensively improve language ability.

The paper Exploring an Output-Driven Teaching Model of Senior High School English Reading and Writing^[10] is consistent with Comprehensible Input in that it recognizes Krashen's Input Hypothesis and holds that a large amount of comprehensible input is crucial for language learning. Through reading and listening, students can accumulate linguistic knowledge and lay the foundation for language output.

However, the paper emphasizes the core role of output in language learning, which contradicts Krashen's view. Krashen believed that language acquisition mainly depends on input, while output is only a manifestation of input. Based on Swain's Output Hypothesis, the paper points out that output (such as writing and speaking practice) is indispensable in enhancing language ability and correcting errors. Experiments have proved that the output-driven teaching model significantly improves students' comprehensive language ability, refuting Krashen's neglect of the role of output.

4. Value and Contribution

4.1 Academic Value

Krashen's Comprehensible Input Theory provides a theoretical basis for the natural process of second language acquisition, especially emphasizing the importance of language input. The theory holds that the natural acquisition of language, similar to the process of first language acquisition, requires a large amount of appropriately leveled language input. This concept has important academic value because it supports the transformation to more natural and learner-centered educational methods, such as immersion teaching and content-based teaching strategies. In addition, the theory has challenged traditional form-oriented language teaching methods and promoted the transformation of second language teaching practice to communicative language teaching.

4.2 Explanatory Power

The explanatory power of Krashen's theory lies in providing a clear theoretical framework for the relationship between input and learners' language proficiency in second language acquisition. The hypothetical "i+1" provides a theoretical tool to explain why some teaching methods are more effective. Specifically, this model emphasizes that only when teaching materials are slightly higher than learners' current ability can they stimulate learning motivation and cognitive challenges, thereby promoting language acquisition. This theoretical perspective provides researchers with a method to quantify and evaluate the effectiveness of teaching input, helping to scientifically test and verify the effects of teaching methods.

In addition, Krashen's theory has enhanced the understanding of the learning environment and learner interaction by pointing out the relationship between language output (i.e., self-expression) and language input. Although the original theory mainly emphasizes the importance of input, its implications for language use environments also provide a theoretical basis for further research on language output.

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Employer Brand Attractiveness and Private-Enterprise Employment Intentions among Chinese University Graduates: A Moderated Serial Mediation Analysis

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Abstract: Against the dual backdrop of an expanding graduate population and the high-quality development of China's private economy, encouraging university graduates to choose employment in private enterprises has become important for stabilising employment and sustaining private-sector vitality. Drawing on the theory of planned behaviour, person-organisation fit theory and social cognitive career theory, this study develops a moderated chain-mediation model in which employer brand attractiveness influences the intention to choose employment in private enterprises through person-organisation fit and career decision-making self-efficacy. Perceived policy support is introduced as a moderator of the first stage of this mechanism. Survey data from 769 university graduates were analysed with SPSS and SmartPLS using partial least squares structural equation modelling (PLS-SEM). The results show that employer brand attractiveness has a significant positive effect on graduates' intention to choose private-enterprise employment. Person-organisation fit and career decision-making self-efficacy each mediate this relationship, and together form a significant chain-mediation path. Perceived policy support positively moderates the effect of employer brand attractiveness on person-organisation fit, thereby strengthening the first stage of the chain mediation. The study clarifies the formation mechanism and boundary condition of graduates' private-enterprise employment intention, and proposes coordinated enhancement pathways at the levels of government, enterprises, universities and individual graduates.

Keywords: University Graduates; Private Enterprises; Employment Choice Intention; Employer Brand Attractiveness; Person-Organisation Fit; Career Decision-Making Self-Efficacy; Perceived Policy Support

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1. Introduction

Employment is the most basic component of people's livelihood, and the employment of university graduates remains a central priority in China's effort to stabilise the labour market. In recent years, the size of the graduating cohort has repeatedly reached new highs: 11.79 million students graduated in 2024, and the 2025 cohort is expected to reach 12.22 million (Ministry of Education, 2024). Aggregate employment pressure and structural mismatches therefore coexist. At the same time, the private economy is a major force in China's economic and social development. It contributes more than 50 per cent of tax revenue, more than 60 per cent of GDP, more than 70 per cent of technological innovation achievements, more than 80 per

cent of urban employment and more than 90 per cent of all enterprises, and is consequently a principal channel for absorbing university graduates. Guiding graduates to adjust their employment expectations and actively consider private enterprises is thus both a practical requirement for easing employment pressure and a strategic requirement for stimulating private-economic vitality and promoting high-quality development.

From a policy perspective, the Party and the state have attached increasing importance to the development of the private economy and to graduate employment. The report to the 20th National Congress of the Communist Party of China called for the promotion of high-quality and full employment, stressed the need to optimise the development environment for private enterprises, and emphasised the legal protection of private-enterprise property rights and entrepreneurs' rights and interests. A series of measures to stabilise employment and promote entrepreneurship has created a more favourable institutional environment for private enterprises to recruit graduates. Yet whether improvements in the institutional environment can be transformed into graduates' employment intentions depends on how graduates perceive the employer value of private enterprises and on the internal cognitive and decision-making processes through which they evaluate such options. In other words, the mechanism by which macro-level policy, micro-level psychology and job-choice behaviour are connected remains both theoretically and practically unresolved.

In practice, however, an employment preference paradox is evident. On the one hand, many graduates give priority to Party and government organs, public institutions and large state-owned enterprises, while enthusiasm for civil-service and public-institution examinations continues to rise. On the other hand, private enterprises, particularly small and medium-sized ones, often face persistent difficulty in recruiting and retaining employees (Cable & Turban, 2001). This structural mismatch between supply and demand not only intensifies graduates' employment anxiety but also constrains private enterprises' talent reserves and innovative development. Existing studies suggest that graduates' employment intentions towards private enterprises are shaped by salary and benefits, career development, organisational reputation, social perceptions and risk perceptions (Chapman et al., 2005; Boswell et al., 2003). Much of this literature, however, remains at the level of listing or describing influencing factors, and gives insufficient attention to the internal mechanisms and boundary conditions of influence. In particular, two key questions remain underexplored: why employer brands affect employment choice intention, and under what conditions this effect becomes stronger.

Theoretically, job choice is essentially a cognitive-decision process formed on the basis of subjective perception (Ajzen, 1991; Lent et al., 1994). Whether university graduates choose private enterprises is often determined less by the objective attributes of such enterprises than by graduates' subjective perception and overall evaluation of them as employers, that is, by employer brand attractiveness (Berthon et al., 2005). As an important signal released by organisations to the external labour market (Spence, 1973), employer brand attractiveness can influence graduates' judgements about their fit with an organisation, namely person-organisation fit, and their confidence in making career decisions, namely career decision-making self-efficacy, ultimately shaping their employment choice intention. In the Chinese context, moreover, policy support for the private economy and graduate employment may constitute an important situational boundary. Yet few studies have integrated employer brand attractiveness, person-organisation fit, career decision-making self-efficacy and perceived policy support within a single framework to examine the formation of graduates' intention to work in private enterprises.

On this basis, the present study draws on the theory of planned behaviour, person-organisation fit theory and social cognitive career theory to construct a moderated chain-mediation model. It addresses three questions: How does employer brand attractiveness affect university graduates' intention to choose employment in private enterprises? What mediating roles do person-organisation fit and career decision-making self-efficacy play? How does perceived policy support moderate this process? The study contributes to the literature in three ways. First, by introducing employer brand theory into research on graduates' private-enterprise job choice, it extends the study of antecedents of employment choice intention. Second, by revealing a dual and sequential mediating path of cognitive appraisal and self-efficacy, it opens the black box through which employer brand attractiveness affects job-choice intention. Third, by introducing perceived policy support as a China-specific contextual moderator, it clarifies the boundary condition of the effect. Practically, the findings offer reference points for improving government employment policy, strengthening private enterprises' employer brands, optimising university career

guidance and helping graduates make more informed career choices.

2. Theoretical Foundations and Research Hypotheses

2.1 Conceptual Definitions and Theoretical Foundations

The intention to choose employment in private enterprises refers to university graduates' subjective willingness and behavioural tendency to select private enterprises as employers during the job-search process. Career choice is a complex psychological and behavioural process. Career choice theory (Holland, 1997; Super, 1990), career anchor theory (Schein, 1978) and expectancy theory (Vroom, 1964) each explain this process from different perspectives. According to the theory of planned behaviour, behavioural intention is the immediate antecedent of behaviour and is jointly shaped by attitude, subjective norms and perceived behavioural control; it can therefore effectively predict actual behaviour (Ajzen, 1991; Fishbein & Ajzen, 1975). Employment choice intention, as a typical behavioural intention, is the key link between career cognition and actual employment behaviour. Social cognitive career theory further argues that career interest, choice and behaviour result from the dynamic interaction between individual cognition, such as self-efficacy and outcome expectations, and environmental factors (Lent et al., 1994; Lent et al., 2000). This provides an environment-cognition perspective for understanding the formation of graduates' intention to choose private-enterprise employment.

The concept of the employer brand was first proposed by Ambler and Barrow (1996), who defined it as the package of functional, economic and psychological benefits provided by the employer and associated with the employment relationship. Employer attractiveness refers to potential applicants' perceived expected value of, and emotional attraction to, a particular organisation as a workplace (Berthon et al., 2005; Backhaus & Tikoo, 2004). Building on Ambler and Barrow's work, Berthon et al. (2005) divided employer brand attractiveness into five dimensions: interest value, social value, economic value, development value and application value (Sivertzen et al., 2013). According to signalling theory, when information asymmetry exists between job seekers and organisations, the employer brand operates as a signal released to the external labour market, helping job seekers infer organisational attributes and employment prospects and thereby shaping job-choice decisions (Spence, 1973; Turban & Greening, 1997). This signalling function is especially salient for university graduates, who usually have limited information and relatively little job-search experience.

Person-organisation fit denotes the degree of congruence or complementarity between individuals and organisations in values, goals, personality and related attributes (Kristof, 1996; Chatman, 1989). Kristof (1996) distinguishes between supplementary and complementary forms of fit. A substantial body of research has shown that person-organisation fit is an important predictor of organisational choice, job satisfaction, organisational commitment and turnover intention (Kristof-Brown et al., 2005; Cable & Judge, 1996; Verquer et al., 2003). Career decision-making self-efficacy originates from Bandura's (1986) self-efficacy theory and was introduced into the career domain by Taylor and Betz (1983). It refers to individuals' confidence in their ability to complete tasks related to career decision-making successfully (Betz & Hackett, 1981; Betz et al., 1996), and is a key cognitive variable influencing career exploration, career decision-making and job-choice behaviour (Betz & Vuyten, 1997). Perceived policy support refers to individuals' subjective perception and evaluation of the strength and effectiveness of government policy support related to their employment, reflecting their judgement of the supportive nature of the external institutional environment.

These theories provide complementary analytical lenses. The theory of planned behaviour characterises the proximal intention-behaviour relationship and establishes employment choice intention as the core outcome. Social cognitive career theory explains the distal environment-cognition-behaviour chain and highlights the mediating role of cognitive variables such as self-efficacy. Person-organisation fit theory explains, from the perspective of individual-organisation interaction, how perceived fit drives organisational choice. Taken together, these perspectives suggest that graduates' intention to choose private-enterprise employment is not determined by a single factor, but by the gradual transmission of an external employer-brand signal through cognitive appraisal and efficacy beliefs, under the moderating influence of the institutional environment. Accordingly, this study treats employer brand attractiveness as the independent variable, person-organisation fit and career decision-making self-efficacy as mediators, and perceived policy support as a moderator.

2.2 Employer Brand Attractiveness and the Intention to Choose Private-Enterprise Employment

Employer brand attractiveness is a core antecedent of potential applicants' intention to choose an organisation. From the perspective of signalling theory, when university graduates lack internal information about organisations, they often rely on employer-brand signals to judge the value of an organisation as an employer (Spence, 1973; Rynes et al., 1991). When graduates perceive private enterprises as highly attractive employers, for example because they offer challenging and innovative work, harmonious colleague relationships and organisational climates, competitive remuneration, broad development opportunities and opportunities to use one's abilities, they are more likely to form positive attitudes and emotional attraction towards such organisations, thereby strengthening their intention to work in them (Berthon et al., 2005; Highhouse et al., 2003). Lievens and Highhouse (2003) show that both instrumental and symbolic organisational attributes significantly influence employer attractiveness and subsequently applicants' intention to apply; Cable and Judge (1996) similarly find that applicants' perceptions of organisations predict job-choice decisions (Collins & Stevens, 2002). In the context of private enterprises, a stronger employer brand can help weaken graduates' stereotypes that private firms are unstable, poorly regulated or lower in social status, and can therefore enhance employment choice intention. This leads to the following hypothesis:

Compared with government agencies, public institutions and large state-owned enterprises, private enterprises also display greater heterogeneity in graduates' employer-brand perceptions. Some leading private enterprises possess strong employer appeal, whereas many small and medium-sized private enterprises have relatively limited brand visibility. This heterogeneity gives employer brand attractiveness stronger theoretical relevance and practical specificity in explaining graduates' private-enterprise employment intention.

H1: Employer brand attractiveness positively affects university graduates' intention to choose employment in private enterprises.

2.3 Mediating Role of Person-Organisation Fit

Person-organisation fit may mediate the relationship between employer brand attractiveness and employment choice intention. On the one hand, employer brand attractiveness provides graduates with rich information about organisational values, culture and characteristics, enabling them to evaluate their degree of fit with the organisation. The higher the perceived employer brand attractiveness, the easier it is for graduates to identify congruence between their own values and career goals and the organisation's characteristics, thereby forming a stronger perception of person-organisation fit (Cable & DeRue, 2002; Rynes et al., 1991). On the other hand, according to person-organisation fit theory, individuals tend to choose organisations whose values and goals are consistent with their own. Strong perceived fit can generate a sense of belonging, psychological security and expected satisfaction, which in turn enhances organisational choice intention (Kristof, 1996; Cable & Judge, 1996; Edwards, 1991). The meta-analysis by Kristof-Brown et al. (2005) indicates a significant positive relationship between person-organisation fit, organisational attraction and job-choice intention. Employer brand attractiveness may therefore indirectly increase graduates' intention to choose private-enterprise employment by improving perceived fit. This leads to the following hypothesis:

H2: Person-organisation fit mediates the relationship between employer brand attractiveness and the intention to choose private-enterprise employment.

2.4 Mediating Role of Career Decision-Making Self-Efficacy

Career decision-making self-efficacy may also mediate the relationship between employer brand attractiveness and employment choice intention. Social cognitive career theory regards self-efficacy as a core cognitive mechanism linking environmental information with career behaviour (Lent et al., 1994; Bandura, 1986). On the one hand, an attractive employer brand can provide graduates with clear and positive career information and development expectations, reducing uncertainty and anxiety in the career decision-making process and thereby increasing confidence in completing career decision tasks (Betz et al., 1996; Lent & Brown, 2006). When graduates perceive private enterprises as capable of providing sound development platforms and application value, they are more likely to believe that they can perform well and realise career goals in such organisations. On the other hand, individuals with higher career decision-making self-efficacy are more likely to engage actively in career exploration, form clear career goals and take decisive job-choice action (Taylor & Betz, 1983; Betz &

Voyten, 1997). High self-efficacy can help graduates overcome doubts and risk perceptions regarding private enterprises and strengthen their willingness to work in them. This leads to the following hypothesis:

H3: Career decision-making self-efficacy mediates the relationship between employer brand attractiveness and the intention to choose private-enterprise employment.

2.5 Chain-Mediating Role of Person-Organisation Fit and Career Decision-Making Self-Efficacy

Person-organisation fit and career decision-making self-efficacy may further form a progressive relationship and jointly constitute a chain mediation. According to the environment-cognition-behaviour logic of social cognitive career theory, individuals first form judgements of fit between themselves and the environment on the basis of environmental information; these judgements then shape self-efficacy beliefs and ultimately influence behavioural intention (Lent et al., 1994). Specifically, when graduates perceive a high degree of fit with private enterprises, they are more likely to judge their career choice as appropriate and controllable, and to believe that they can integrate into the organisation and perform related work effectively. This strengthens career decision-making self-efficacy (Chatman, 1989; Cable & DeRue, 2002). Person-organisation fit, as a positive cognitive appraisal, thus provides an important cognitive foundation for self-efficacy. Employer brand attractiveness may therefore influence graduates' private-enterprise employment intention indirectly through the chain path of person-organisation fit and career decision-making self-efficacy. This leads to the following hypothesis:

Existing research also suggests that positive fit cognition can strengthen individuals' sense of control and competence, thereby enhancing confidence in career decision-making (Lent & Brown, 2013). This fit-efficacy transmission logic is consistent with social cognitive career theory's view that cognitive variables influence one another in a layered and progressive manner, offering further theoretical support for the proposed chain-mediation hypothesis.

H4: Person-organisation fit and career decision-making self-efficacy play a chain-mediating role between employer brand attractiveness and the intention to choose private-enterprise employment.

2.6 Moderating Role of Perceived Policy Support

Perceived policy support may moderate the effect of employer brand attractiveness on person-organisation fit. Social cognitive career theory emphasises that career cognition and choice result from the dynamic interaction of personal factors and environmental supports, and that supports and barriers in the environment significantly influence career choice processes (Lent et al., 2000). Policy support is an important form of external environmental support, providing institutional protection and psychological expectations for graduates considering employment in private enterprises. In recent years, China has introduced a series of measures to encourage university graduates to work in private enterprises and other small and medium-sized firms, including social-insurance subsidies, tax incentives, guaranteed start-up loans, vocational training subsidies and talent-settlement facilitation. When graduates perceive strong policy support, their risk concerns and worries about choosing private enterprises are reduced, thereby strengthening the positive effect of employer brand attractiveness on person-organisation fit. Conversely, when perceived policy support is weak, even a high level of employer brand attractiveness may not fully translate into perceived fit because employment-risk concerns remain salient. In other words, the stronger the perceived policy support, the stronger the positive effect of employer brand attractiveness on person-organisation fit. This leads to the following hypothesis:

H5: Perceived policy support positively moderates the relationship between employer brand attractiveness and person-organisation fit; that is, the stronger the perceived policy support, the stronger the positive relationship between the two.

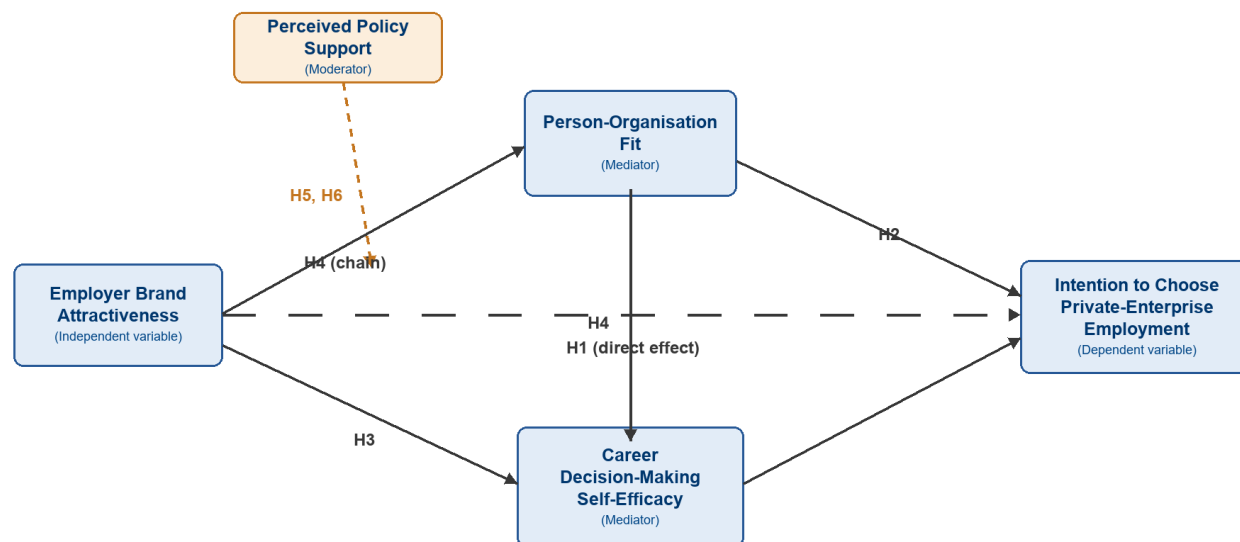
Combining H4 and H5, this study further infers that perceived policy support moderates the first stage of the chain mediation and thus forms a moderated mediation model (Preacher et al., 2007; Nitzl et al., 2016). Specifically, the indirect effect of employer brand attractiveness on the intention to choose private-enterprise employment through the chain path of person-organisation fit and career decision-making self-efficacy is moderated by perceived policy support. When perceived policy support is high, the indirect effect is stronger; when perceived policy support is low, the indirect effect is weaker. This leads to the following hypothesis:

H6: Perceived policy support moderates the first stage of the chain mediation from employer brand attractiveness to person-organisation fit, career decision-making self-efficacy and the intention to choose private-enterprise employment; that is, the

stronger the perceived policy support, the stronger the chain-mediated effect.

Taken together, the theoretical model constructed in this study is shown in Figure 1.

Figure 1. Theoretical research model



Note: Solid arrows indicate hypothesised paths; the dashed black arrow indicates H1; the orange dashed arrow indicates moderation by perceived policy support.

Note: Solid arrows indicate the hypothesised paths, the dashed black arrow indicates the direct effect (H1), and perceived policy support moderates the path from employer brand attractiveness to person-organisation fit (H5 and H6).

3. Research Design

3.1 Sample and Data Collection

This study targeted university students approaching graduation, including final-year undergraduates and master's students, and collected data through a questionnaire survey. To improve sample representativeness, the survey covered 12 universities of different levels across eastern, central and western China, involving humanities and social sciences, science and engineering, economics and management, medicine and other disciplinary fields. The questionnaire was administered from September to December 2024 through a combination of online and offline channels. To reduce common method bias, responses were anonymous and data were collected at two time points. At Time 1, demographic variables, employer brand attractiveness and perceived policy support were measured. Approximately one month later, at Time 2, person-organisation fit, career decision-making self-efficacy and the intention to choose private-enterprise employment were measured. A total of 850 questionnaires were distributed. After eliminating invalid responses with excessively short completion times, obvious patterned answering or missing key information, 769 valid questionnaires were retained, yielding an effective response rate of 90.5 per cent.

In the valid sample, 46.8 per cent were male and 53.2 per cent were female; 71.4 per cent were undergraduates and 28.6 per cent were master's students. In terms of disciplinary distribution, 34.7 per cent were from humanities and social sciences, 28.9 per cent from economics and management, 27.3 per cent from science and engineering, and 9.1 per cent from medicine and other fields. Graduates from urban areas accounted for 55.1 per cent, while those from rural areas accounted for 44.9 per cent. Those with internship experience in private enterprises accounted for 41.2 per cent. The demographic characteristics of the sample are shown in Table 1.

The reason for selecting soon-to-graduate university students is that this group is in the critical transition from school to work. Their employment choice intentions are relatively explicit and close to real decision-making contexts, making them suitable for examining the psychological process through which employer-brand perceptions are converted into job-choice intentions. In sampling, the study considered institutional level, regional distribution and disciplinary structure, combining stratified and convenience sampling to improve representativeness as far as possible.

Table 1. Demographic characteristics of the sample (N=769)

Variable	Category	Frequency	Percentage (%)
Gender	Male	360	46.8
	Female	409	53.2
Education level	Undergraduate	549	71.4
	Master's student	220	28.6
Disciplinary field	Humanities and social sciences	267	34.7
	Economics and management	222	28.9
	Science and engineering	210	27.3
	Medicine and other fields	70	9.1
Place of origin	Urban	424	55.1
	Rural	345	44.9
Internship experience	Private-enterprise internship	317	41.2
	No private-enterprise internship	452	58.8

3.2 Measures

All variables were measured using mature scales from domestic and international research, with appropriate revisions to fit the context of university graduates' private-enterprise job choice. All scales used a five-point Likert format (1 = strongly disagree, 5 = strongly agree). To ensure semantic equivalence between Chinese and English versions, a translation and back-translation procedure was adopted for the English scales (Brislin, 1980).

(1) Employer brand attractiveness. Employer brand attractiveness was measured using the employer attractiveness scale (EmpAt) developed by Berthon et al. (2005), revised for the present context (Sivertzen et al., 2013). Five representative items were selected from the dimensions of interest value, social value, economic value, development value and application value. A typical item was: 'This type of enterprise can provide innovative work content and methods.' Cronbach's alpha for the scale was 0.92.

(2) Person-organisation fit. Person-organisation fit was measured using the three-item scale developed by Cable and DeRue (2002). A typical item was: 'My values fit the values and culture of private enterprises.' Cronbach's alpha for the scale was 0.86.

(3) Career decision-making self-efficacy. Career decision-making self-efficacy was measured using selected items from the short form of the Career Decision-Making Self-Efficacy Scale revised by Betz et al. (1996), with wording adjusted to the Chinese university context. Five items were used. A typical item was: 'I am confident that I can accurately evaluate my abilities and career interests.' Cronbach's alpha for the scale was 0.90.

(4) Perceived policy support. Drawing on prior research on government support and policy perception, this study developed a four-item scale. A typical item was: 'I understand and clearly perceive the strength of government policy support for university graduates' employment in private enterprises.' Cronbach's alpha for the scale was 0.88.

(5) Intention to choose private-enterprise employment. This variable was measured by revising the organisational attraction intention scale of Highhouse et al. (2003). Four items were used. A typical item was: 'If I have the opportunity, I am willing to work in a private enterprise.' Cronbach's alpha for the scale was 0.89.

(6) Control variables. Existing research indicates that individual demographic characteristics may influence job-choice intention. Gender, education level, disciplinary field, place of origin and whether the respondent had internship experience in a private enterprise were therefore included as control variables.

3.3 Data Analysis Strategy

This study adopted a two-stage data analysis strategy. First, SPSS 26.0 was used for data preprocessing and descriptive statistical analysis, including checks for missing values and outliers, demographic statistics, calculations of means, standard deviations, skewness and kurtosis, and preliminary tests for common method bias. Second, SmartPLS 4.0 was used to test the measurement and structural models through partial least squares structural equation modelling (PLS-SEM) (Hair et al., 2022; Ringle et al., 2022). PLS-SEM was selected for three reasons. First, the research model is relatively complex and includes chain mediation and moderation; PLS-SEM is suitable and robust for complex path models containing mediating and moderating effects. Second, this study focuses on explanation and prediction of the outcome variable, and PLS-SEM is a prediction-oriented variance-based approach that fits this purpose. Third, PLS-SEM makes relatively flexible assumptions about normality and is appropriate for survey data in the social sciences (Hair et al., 2022). The analysis followed a two-step procedure: the measurement model was evaluated first, and once reliability and validity were confirmed, the structural model was examined in terms of path relationships, explanatory power, predictive power, mediation and moderation. Significance was tested using bootstrapping with 5,000 bias-corrected resamples.

4. Empirical Results and Analysis

4.1 Common Method Bias Test

In addition to procedural controls, namely anonymous responses and time-separated measurement, two statistical methods were used to test common method bias. First, Harman's single-factor test was conducted through unrotated exploratory factor analysis in SPSS. Five factors with eigenvalues greater than 1 were extracted, and the first common factor explained 31.6 per cent of the variance, below the 40 per cent threshold (Podsakoff et al., 2003). Second, Kock's (2015) full collinearity assessment was performed by calculating variance inflation factors (VIFs) for the latent variables in PLS-SEM. All inner VIF values ranged from 1.21 to 1.52, below the critical value of 3.3. Taken together, the two tests indicate that serious common method bias is not present.

4.2 Descriptive Statistics and Normality Test

Before structural equation modelling, descriptive statistics and data screening were conducted. As shown in Table 2, the means of the variables ranged from 3.39 to 3.71, and the standard deviations ranged from 0.66 to 0.79. The absolute skewness values were all below 3, and the absolute kurtosis values were all below 10. Although the data did not strictly follow a normal distribution, the degree of deviation was within an acceptable range and met the distributional requirements of PLS-SEM (Hair et al., 2022).

Table 2. Descriptive statistics and normality test for the variables (N=769)

Variable	Items	M	SD	Skewness	Kurtosis
Employer brand attractiveness	5	3.62	0.71	-0.38	0.21
Person-organisation fit	3	3.48	0.68	-0.29	0.05
Career decision-making self-efficacy	5	3.71	0.66	-0.45	0.33
Perceived policy support	4	3.39	0.74	-0.22	-0.14
Intention to choose private-enterprise employment	4	3.55	0.79	-0.41	0.18

4.3 Measurement Model Test

4.3.1 Reliability and convergent validity

The measurement model was first assessed for reliability and convergent validity. As shown in Table 3, the outer loadings of all measurement items ranged from 0.81 to 0.89, exceeding the critical value of 0.708. Cronbach's alpha ranged from 0.86 to 0.92, composite reliability ρ_A ranged from 0.87 to 0.93, and composite reliability (CR) ranged from 0.91 to 0.94, all above the 0.70 threshold. This indicates good internal consistency reliability. The average variance extracted (AVE) ranged from 0.70 to 0.77, exceeding the 0.50 threshold and indicating good convergent validity (Hair et al., 2022; Fornell & Larcker, 1981).

Table 3. Reliability and convergent validity of the measurement model

Construct	Item	Outer loading	Cronbach's alpha	rho_A	CR	AVE
Employer brand attractiveness	EBA1	0.83	0.92	0.93	0.94	0.70
	EBA2	0.86				
	EBA3	0.81				
	EBA4	0.87				
	EBA5	0.82				
Person-organisation fit	POF1	0.87	0.86	0.87	0.91	0.77
	POF2	0.89				
	POF3	0.87				
Career decision-making self-efficacy	CDMSE1	0.82	0.90	0.91	0.93	0.70
	CDMSE2	0.85				
	CDMSE3	0.83				
	CDMSE4	0.86				
	CDMSE5	0.83				
Perceived policy support	PPS1	0.85	0.88	0.89	0.92	0.74
	PPS2	0.87				
	PPS3	0.85				
	PPS4	0.87				
Intention to choose private-enterprise employment	INT1	0.85	0.89	0.90	0.92	0.74
	INT2	0.88				
	INT3	0.86				
	INT4	0.84				

Note: EBA = employer brand attractiveness; POF = person-organisation fit; CDMSE = career decision-making self-efficacy; PPS = perceived policy support; INT = intention to choose private-enterprise employment. rho_A and CR denote composite reliability, and AVE denotes average variance extracted.

4.3.2 Discriminant validity

Discriminant validity was assessed using both the Fornell-Larcker criterion and the heterotrait-monotrait ratio (HTMT). The Fornell-Larcker results in Table 4 show that the square root of each construct's AVE, reported on the diagonal, is greater than its correlations with other constructs, satisfying the requirement for discriminant validity (Fornell & Larcker, 1981). The HTMT results in Table 5 show that all pairwise HTMT values range from 0.44 to 0.68, below the conservative threshold of 0.85, further confirming good discriminant validity among the constructs (Henseler et al., 2015).

Table 4. Discriminant validity: Fornell-Larcker criterion

Construct	EBA	POF	CDMSE	PPS	INT
EBA Employer brand attractiveness	0.837				
POF Person-organisation fit	0.52	0.877			
CDMSE Career decision-making self-efficacy	0.47	0.49	0.837		
PPS Perceived policy support	0.41	0.44	0.38	0.860	
INT Private-enterprise employment intention	0.55	0.58	0.51	0.45	0.860

Note: Bold diagonal values are the square roots of AVE; values below the diagonal are inter-construct correlations.

Table 5. Discriminant validity: HTMT ratios

Construct	EBA	POF	CDMSE	PPS	INT
EBA Employer brand attractiveness	--				
POF Person-organisation fit	0.61	--			
CDMSE Career decision-making self-efficacy	0.54	0.58	--		
PPS Perceived policy support	0.47	0.51	0.44	--	
INT Private-enterprise employment intention	0.63	0.68	0.59	0.52	--

Note: All HTMT values are below 0.85, indicating good discriminant validity among the constructs.

4.4 Structural Model Test

4.4.1 Collinearity and model fit

Before evaluating the structural model, collinearity among predictor variables was examined. The results show that the inner VIF values of all predictors in the structural model ranged from 1.21 to 1.52 (Table 6), below the critical value of 3.3, indicating that collinearity was not a problem (Hair et al., 2022). In addition, the standardised root mean square residual (SRMR) of the model was 0.046, below the threshold of 0.08, suggesting good model fit (Henseler et al., 2015).

Table 6. Inner collinearity test for the structural model (VIF)

Endogenous construct	Predictor	VIF
Person-organisation fit	Employer brand attractiveness	1.21
	Perceived policy support	1.23
Career decision-making self-efficacy	Employer brand attractiveness	1.37
	Person-organisation fit	1.37
Intention to choose private-enterprise employment	Employer brand attractiveness	1.45
	Person-organisation fit	1.52
	Career decision-making self-efficacy	1.38

4.4.2 Path coefficients and hypothesis testing

Bootstrapping with 5,000 resamples was used to test the path coefficients and their significance. As shown in Table 7, employer brand attractiveness had a significant positive direct effect on the intention to choose private-enterprise employment ($\beta=0.26$, $t=5.83$, $p<0.001$), supporting H1. Employer brand attractiveness also significantly and positively affected person-organisation fit ($\beta=0.46$, $t=11.20$, $p<0.001$) and career decision-making self-efficacy ($\beta=0.31$, $t=6.90$, $p<0.001$). Person-organisation fit significantly and positively affected career decision-making self-efficacy ($\beta=0.38$, $t=8.45$, $p<0.001$) and employment intention ($\beta=0.34$, $t=7.62$, $p<0.001$), while career decision-making self-efficacy significantly and positively affected employment intention ($\beta=0.23$, $t=5.10$, $p<0.001$). These significant paths provide a basis for subsequent mediation tests.

Table 7. Structural model path coefficients and hypothesis testing

Path	Std. coefficient beta	t value	p value	95% CI	f2	Result
H1: EBA - INT (direct effect)	0.26	5.83	<0.001	[0.176, 0.347]	0.09	Supported
EBA - POF	0.46	11.20	<0.001	[0.379, 0.539]	0.27	--
EBA - CDMSE	0.31	6.90	<0.001	[0.223, 0.398]	0.11	--
POF - CDMSE	0.38	8.45	<0.001	[0.291, 0.467]	0.16	--
POF - INT	0.34	7.62	<0.001	[0.252, 0.428]	0.14	--
CDMSE - INT	0.23	5.10	<0.001	[0.141, 0.318]	0.07	--

Note: f2 denotes effect size. Following Cohen (1988), values of 0.02, 0.15 and 0.35 represent small, medium and large effects, respectively.

4.4.3 Explanatory and predictive power

The model's explanatory power (R²) and predictive power (Q²) are reported in Table 8. The R² values for person-organisation fit, career decision-making self-efficacy and the intention to choose private-enterprise employment were 0.34, 0.31 and 0.49, respectively, indicating moderate or higher explanatory power for the endogenous variables. The Q² values of the three endogenous variables were 0.24, 0.20 and 0.34, all greater than zero, indicating good out-of-sample predictive power (Shmueli et al., 2019). Considering the R² and Q² results together with the f² results in Table 7, the model demonstrates sound explanatory and predictive performance.

Table 8. Explanatory and predictive power of the model

Endogenous construct	R ²	Adjusted R ²	Q ²
Person-organisation fit	0.34	0.337	0.24
Career decision-making self-efficacy	0.31	0.308	0.20
Intention to choose private-enterprise employment	0.49	0.488	0.34

4.4.4 Mediation effects

Specific indirect effects were tested using bootstrapping with 5,000 bias-corrected resamples (Nitzl et al., 2016; Preacher et al., 2007). As shown in Table 9, the 95 per cent confidence intervals for all three indirect paths excluded zero. The indirect effect of EBA - POF - INT was 0.16 (95% CI=[0.108, 0.216]); the indirect effect of EBA - CDMSE - INT was 0.07 (95% CI=[0.041, 0.104]); and the chain path EBA - POF - CDMSE - INT had an indirect effect of 0.04 (95% CI=[0.021, 0.063]). The total indirect effect was 0.27 (95% CI=[0.207, 0.334]), while the direct effect remained significant (beta=0.26). These results indicate that person-organisation fit and career decision-making self-efficacy exert partial mediating and chain-mediating effects, supporting H2, H3 and H4. The three indirect paths accounted for 30.2 per cent, 13.2 per cent and 7.5 per cent of the total effect, respectively, while the total indirect effect accounted for 50.9 per cent.

Table 9. Bootstrapping test results for mediation effects

Effect path	Effect size	t value	95% CI	Share of total effect	Result
Total effect (EBA - INT)	0.53	12.10	[0.456, 0.598]	100%	--
Direct effect (EBA - INT)	0.26	5.83	[0.176, 0.347]	49.1%	--
EBA - POF - INT	0.16	6.42	[0.108, 0.216]	30.2%	H2 supported
EBA - CDMSE - INT	0.07	4.05	[0.041, 0.104]	13.2%	H3 supported
EBA - POF - CDMSE - INT	0.04	3.28	[0.021, 0.063]	7.5%	H4 supported
Total indirect effect	0.27	8.05	[0.207, 0.334]	50.9%	--

Note: Bootstrapping used 5,000 resamples; confidence intervals are bias-corrected 95 per cent intervals. EBA = employer brand attractiveness; POF = person-organisation fit; CDMSE = career decision-making self-efficacy; INT = intention to choose private-enterprise employment.

These findings clearly describe the internal transmission path through which employer brand attractiveness operates. It can enhance employment intention by increasing graduates' judgement of fit with the organisation, by strengthening career decision-making self-efficacy, and by acting through the sequential path of fit judgement and efficacy belief. Person-organisation fit and career decision-making self-efficacy are therefore key psychological bridges through which employer brand attractiveness is converted into job-choice intention. Relying only on external signals while neglecting graduates' internal cognitive construction is unlikely to fully activate their willingness to choose private enterprises.

4.4.5 Moderation effects and moderated mediation

The product-indicator approach was used to construct the interaction term and test the moderating effect of perceived policy support (Henseler & Fassott, 2010). The results in Table 10 show that perceived policy support had a positive effect on person-organisation fit (beta=0.29, t=7.05, p<0.001), and the interaction between employer brand attractiveness and perceived

policy support had a significant effect on person-organisation fit ($\beta=0.14$, $t=4.12$, $p<0.001$, $f^2=0.03$). This indicates that perceived policy support positively moderates the effect of employer brand attractiveness on person-organisation fit, supporting H5. Simple slope analysis showed that when perceived policy support was high ($M+1SD$), the positive predictive effect of employer brand attractiveness on person-organisation fit was stronger ($\text{slope}=0.60$). When perceived policy support was low ($M-1SD$), the effect was weaker ($\text{slope}=0.32$).

Table 10. Moderating effect of perceived policy support (dependent variable: person-organisation fit)

Predictor	Std. coefficient beta	t value	p value	f2
Employer brand attractiveness (EBA)	0.46	11.20	<0.001	0.27
Perceived policy support (PPS)	0.29	7.05	<0.001	0.11
EBA x PPS (interaction)	0.14	4.12	<0.001	0.03

Note: The dependent variable is person-organisation fit, $R^2=0.34$.

Moderated mediation was further examined. As Table 11 shows, the indirect effect of the chain path EBA - POF - CDMSE - INT differed significantly across levels of perceived policy support. Under high perceived policy support, the indirect effect was 0.05 (95% CI=[0.026, 0.082]); under low perceived policy support, it was 0.03 (95% CI=[0.012, 0.049]). The index of moderated mediation was 0.012, with a 95 per cent confidence interval of [0.005, 0.022], excluding zero. This indicates that perceived policy support significantly moderates the first stage of the chain mediation: the stronger the perceived policy support, the stronger the chain-mediated effect. H6 is therefore supported. The result implies that increasing graduates' intention to choose private enterprises requires coordination between employer-brand building by enterprises and policy support from government.

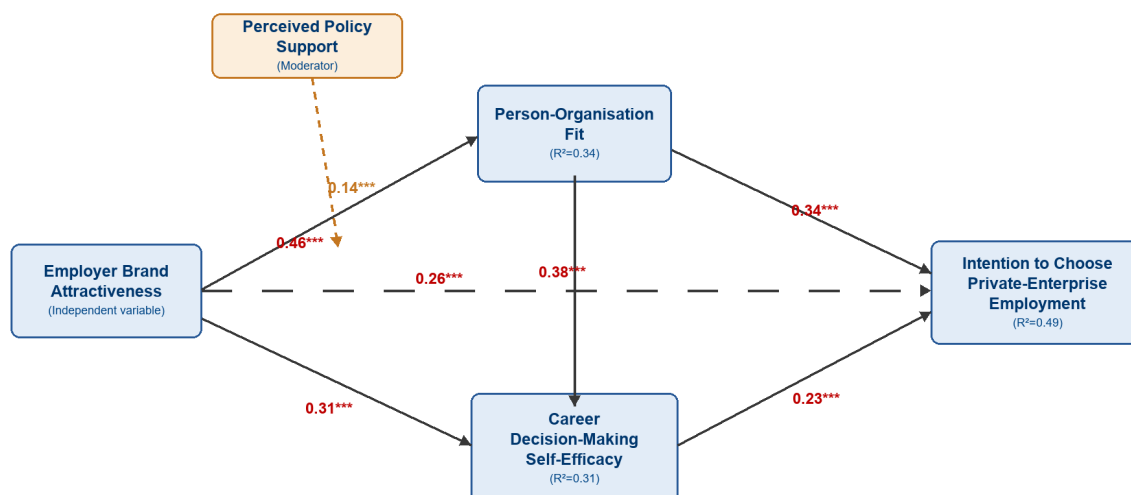
Table 11. Moderated mediation test (chain path EBA - POF - CDMSE - INT)

Level of perceived policy support	Indirect effect	SE	Lower 95% CI	Upper 95% CI
Low level (M-1SD)	0.03	0.009	0.012	0.049
High level (M+1SD)	0.05	0.014	0.026	0.082
Index of moderated mediation	0.012	0.004	0.005	0.022

Note: Bootstrapping used 5,000 resamples. A significant index of moderated mediation, indicated by a confidence interval excluding zero, shows the presence of a moderated mediation effect.

Taken together, the tests of the measurement and structural models support H1 through H6. The standardised path coefficients among the constructs, the explanatory power (R^2) of the endogenous variables and the moderating role of perceived policy support are shown in Figure 2.

Figure 2. Path analysis results for the structural model



Note: Values are standardised path coefficients. *** $p<0.001$. R^2 indicates the explained variance of endogenous variables.

Note: Values in the figure are standardised path coefficients, *** $p < 0.001$. R^2 denotes the proportion of variance explained in the endogenous variables. Solid lines indicate significant paths, the black dashed line indicates the direct effect, and the orange dashed line indicates moderation by perceived policy support.

5. Conclusions and Discussion

5.1 Conclusions

Drawing on the theory of planned behaviour, person-organisation fit theory and social cognitive career theory, this study constructed and tested a moderated chain-mediation model of university graduates' intention to choose employment in private enterprises using PLS-SEM. Three main conclusions were obtained. First, employer brand attractiveness is an important antecedent of graduates' intention to choose private-enterprise employment and significantly and positively predicts that intention. Second, person-organisation fit and career decision-making self-efficacy play multiple mediating roles between employer brand attractiveness and employment intention. They operate both as independent mediating paths and as a chain-mediation path from person-organisation fit to career decision-making self-efficacy, with the three indirect paths jointly accounting for about 51 per cent of the total effect. Third, perceived policy support positively moderates the effect of employer brand attractiveness on person-organisation fit and further moderates the first stage of the chain mediation. In other words, the stronger the perceived policy support, the stronger the indirect effect of employer brand attractiveness.

5.2 Theoretical Contributions

This study makes three principal theoretical contributions. First, it extends research on the antecedents of university graduates' intention to choose private-enterprise employment. Whereas previous studies have often focused on isolated objective factors such as salary or reputation, this study introduces employer brand attractiveness as a comprehensive subjective perception and explains its mechanism from the perspective of signalling theory, thereby enriching antecedent theory for employment choice intention. Second, it reveals the dual mediating mechanism and chain-transmission path through which employer brand attractiveness affects job-choice intention. By integrating cognitive appraisal, represented by person-organisation fit, and self-efficacy, represented by career decision-making self-efficacy, into a single framework, the study opens the black box of the employer-brand effect and deepens understanding of the internal psychological mechanism. It also extends the environment-cognition-behaviour logic of social cognitive career theory. Third, it clarifies the boundary condition of the effect. By introducing perceived policy support as a China-specific contextual moderator, the study reveals the important role of institutional environmental support in the formation of individual career cognition, responds to the call for contextualised management research and offers a new perspective for understanding graduates' job-choice behaviour in China.

The study also responds to the need to localise career development research. Western theories of employer branding and career choice were largely formed in mature market economies and relatively stable institutional environments. China, however, is undergoing economic transformation and profound labour-market change, and government policy plays an important role in guiding employment flows. By incorporating perceived policy support into the analytical framework and verifying its moderating effect, this study tests the applicability and boundary of Western theories in the Chinese context and provides empirical evidence for developing a China-informed theory of employment choice.

5.3 Discussion of the Findings

The findings both confirm and extend existing research. The positive effect of employer brand attractiveness on job-choice intention is consistent with Berthon et al. (2005) and Highhouse et al. (2003), further confirming the signalling value of employer brands in job-search decisions. The mediating role of person-organisation fit supports the meta-analytic conclusion of Kristof-Brown et al. (2005) regarding the relationship between fit and organisational choice. Notably, this study finds that career decision-making self-efficacy not only independently mediates the relationship between employer brand attractiveness and employment intention but is also influenced by person-organisation fit, forming a chain mediation. This finding deepens understanding of the sequence through which career cognition is formed. In addition, the moderating role of perceived policy support highlights the guiding function of government policy in graduates' career psychology in the Chinese context, echoing social cognitive career theory's proposition that environmental support affects career choice (Lent et al., 2000). The result

suggests that, in encouraging graduates to choose private-enterprise employment, it is not enough for enterprises alone to improve employer brand attractiveness; strong policy support is also needed to activate graduates' employment intentions more effectively.

The results also have methodological implications. By constructing a moderated chain-mediation model and testing it with PLS-SEM, the study integrates independent variables, mediators and moderators within a unified framework. It therefore answers not only the question of through what mechanism employer brand attractiveness affects employment intention, but also under what condition this effect becomes stronger. Compared with research designs that test only a single mediation or a single moderation, this approach offers a more complete and refined description of the formation mechanism of graduates' job-choice intention and provides an analytical reference for future studies.

6. Pathways for Enhancing University Graduates' Intention to Choose Private-Enterprise Employment

Based on the above findings, improving university graduates' intention to choose private-enterprise employment requires coordinated action by government, enterprises, universities and graduates themselves. Four points of intervention are especially important: strengthening employer brand attractiveness, improving person-organisation fit, cultivating career decision-making self-efficacy and enhancing perceived policy support. A systematic and coordinated set of enhancement pathways can be developed around these four points.

The translation from research findings to practical pathways should follow the logic of the four variables. Employer brand attractiveness is the entry point for improving private enterprises' ability to be chosen; person-organisation fit is the lever for improving person-job and person-organisation matching; career decision-making self-efficacy is the support point for increasing graduates' confidence in job choice; and perceived policy support is the guarantee that optimises the institutional environment for employment. The following discussion therefore proceeds at the levels of government, enterprises, universities and individual graduates.

6.1 Government: Improve Policy Supply and Strengthen Perceived Policy Support

The results show that perceived policy support is an important boundary condition that strengthens the effect of employer brand attractiveness. Government should therefore further improve and effectively implement the policy system that promotes university graduates' employment in private enterprises. On the one hand, policy supply should be increased. Graduates who work in private enterprises should be given equal treatment and development opportunities in areas such as social-insurance subsidies, tax relief, guaranteed start-up loans, housing security, talent settlement and professional-title evaluation, thereby reducing institutional concerns and identity-based hesitation. On the other hand, policy transmission and communication channels should be improved. University employment platforms, government new-media accounts, policy briefings and employment service officers can be used to increase policy awareness, accessibility and perceptibility, thereby strengthening graduates' perceived policy support. In addition, supervision and services relating to private-enterprise labour practices should be strengthened. Protecting graduates' labour rights and career development rights in private enterprises can create a fair, standardised and predictable employment environment and enhance their sense of security and confidence.

More concretely, a policy list and service window for graduates entering private enterprises could be established, integrating scattered support measures and making them visible, searchable and usable. Special measures such as grassroots growth incentives and career development grants could also be explored to encourage outstanding graduates to take root in private enterprises and serve the real economy.

6.2 Enterprises: Build Employer Brands and Enhance Organisational Attractiveness

Employer brand attractiveness is the core antecedent of graduates' employment intention. Private enterprises should therefore attach great importance to employer-brand building and systematically enhance their attractiveness to university graduates. First, they should consolidate economic and development value by establishing market-competitive remuneration systems, clear career development pathways and robust talent-development mechanisms, thereby providing graduates with growth platforms and upward mobility. Second, they should cultivate a positive organisational culture and work climate, strengthen interest value and social value, and create an equal, inclusive and innovative working environment that enhances belonging

and organisational identification. Third, they should actively communicate their employer brand through campus recruitment, internships and training, social media, employer-review platforms and other channels, presenting enterprise images and employment value propositions in a truthful and multidimensional way. This can help reverse stereotypes about private enterprises and enhance corporate reputation and attractiveness. Fourth, clear value signals should be conveyed during recruitment and selection so that graduates can accurately judge their fit with the organisation, enabling enterprises to attract value-congruent talent and improve person-job matching and talent stability from the outset.

For small and medium-sized private enterprises in particular, resource and visibility constraints make differentiated employer value propositions especially important. Such enterprises should highlight advantages such as rapid growth, broad platforms and strong participation, and enhance credibility through low-cost means such as employee word of mouth and displays of real work scenarios, gradually accumulating employer-brand equity.

6.3 Universities: Optimise Career Guidance and Promote Matching and Efficacy

Universities are important bridges between graduates and employers, and should play an active role in improving person-organisation fit and career decision-making self-efficacy. First, career planning education should be strengthened to help students understand themselves scientifically, clarify career values and form reasonable employment expectations and job-choice positioning, thereby improving matching quality at the source. Second, career guidance should be innovated through career assessments, counselling, simulated recruitment, peer and alumni sharing and related activities, so as to enhance students' career decision-making ability and self-efficacy and reduce job-choice anxiety and decision difficulties. Third, industry-education integration and university-enterprise cooperation should be deepened. Students should be organised to undertake internships, enterprise visits, exchanges and project practice in high-quality private enterprises, so that they can gain realistic understanding and emotional identification, test fit through practice, accumulate experience and strengthen confidence. Fourth, universities should build precise and intelligent employment service platforms. By using big data and artificial intelligence to match graduates with the job demands of private enterprises, employment services can become more targeted and effective, and supply-demand connection between graduates and private enterprises can be improved.

Universities should also establish sound employment feedback and tracking mechanisms, promptly monitoring graduates' development and adaptation in private enterprises. This information should feed back into talent-training programmes and career guidance, forming a closed loop of training, employment, feedback and improvement.

6.4 Individuals: Adjust Employment Concepts and Strengthen Career Cognition and Decision Confidence

University graduates are the active subjects of job-choice behaviour and should adjust their employment concepts and improve their career cognition and decision-making capacity. On the one hand, they should develop a diversified and rational view of employment, objectively understand the important position and broad development prospects of the private economy, and move beyond the misconception that only establishment-based or highly stable employment is worthwhile. They should connect personal career development with the broader process of high-quality development in the private economy. On the other hand, graduates should strengthen career exploration and self-understanding through internships, information search, career counselling and related channels. By gaining a deeper understanding of their interests, abilities and values, they can more accurately evaluate their fit with different types of organisations and enhance autonomy and confidence in career decision-making. At the same time, they should pay active attention to national employment policies and make effective use of policy resources to support their career choices and development, achieving higher-quality and fuller employment through the two-way selection process with private enterprises.

It should be emphasised that changing employment concepts does not mean lowering expectations blindly. Rather, it means guiding graduates to make rational choices that better fit their own development after fully understanding themselves and the external environment, so that they can realise both personal and social value on the broad stage of the private economy.

6.5 Coordinated Promotion: Build a Four-in-One Linkage Mechanism

The pathways at the levels of government, enterprises, universities and individuals are not isolated from one another; they are interdependent components of an organic and coordinated system. The findings show that the effect of employer brand

attractiveness depends on the internal cognitive mediation of person-organisation fit and career decision-making self-efficacy, and is further strengthened by perceived external policy support. This means that the effort of any single actor is unlikely to fundamentally reverse the structural difficulty of graduate employment in private enterprises. A four-in-one coordination mechanism should therefore be constructed, with government guidance, enterprise agency, university support and individual initiative. Government should provide policy guidance and institutional guarantees; enterprises should assume primary responsibility for employer-brand construction; universities should serve as bridges for talent cultivation and supply-demand matching; and graduates should actively adjust their views and improve employability. The four parties should strengthen cooperation in information sharing, resource integration and platform co-construction, forming a strong joint force to promote high-quality and full employment for university graduates and jointly advancing the deep integration and positive interaction of the education chain, talent chain, industrial chain and innovation chain.

7. Limitations and Future Research

This study has several limitations that future research could address. First, although data were collected at two time points to reduce common method bias, the design is still essentially cross-sectional and cannot strictly infer causal relationships among variables. Future research could use longitudinal tracking or experimental designs to verify the causal chain more rigorously. Second, the sample consists of university students approaching graduation, and its scope is relatively limited. Future studies could include vocational-college graduates, previously unemployed graduates and other groups to enhance generalisability and external validity. Third, many factors may influence the intention to choose private-enterprise employment. This study focuses only on employer brand attractiveness and its mechanism; future work could incorporate family socioeconomic status, employability, social support, risk preference, employment anxiety and other variables to build a more complete explanatory model. Fourth, the study examines employment choice intention, but a gap may remain between intention and actual employment behaviour. Future research could track graduates' actual employment destinations to test the predictive validity of job-choice intention for real employment behaviour.

Despite these limitations, the mechanism and boundary condition revealed in this study provide useful theoretical reference and practical implications for understanding and enhancing university graduates' intention to choose private-enterprise employment. Future research can extend and deepen this line of inquiry on that basis.

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Core Competency Development Pathways for Navigation Technology Students Oriented to the Staged Evolution of Autonomous Navigation in Intelligent Ships

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Abstract: The development of autonomous navigation in intelligent ships is reshaping the competency structure and occupational orientation of students majoring in Navigation Technology. Drawing on the IMO MASS Code and the China Classification Society Rules for Intelligent Ships (2026), this study examines five typical stages: automated assistance and decision support, remote control with crew on board, remote control without crew on board, autonomous operation with human-machine collaboration, and full-voyage autonomy with shore-based supervision. On this basis, a core competency development framework is proposed, consisting of stage evolution, job transformation, competency needs, and educational pathways. The study argues that, in addition to conventional seamanship, students should develop competencies in smart navigation equipment, remote control, autonomous navigation system supervision, human-machine collaboration, data analysis, shore-based operations management, and regulatory safety. Accordingly, pathways are proposed for reconstructing training objectives, optimizing the curriculum, reforming practical teaching, developing integrated teaching platforms, and improving competency-oriented assessment. The findings provide a reference for educational reform in Navigation Technology programs under the development of intelligent ships.

Keywords: Intelligent Ships; Autonomous Navigation; MASS Code; Navigation Technology; Core Competencies

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1. Introduction

Smart shipping is an important direction for the digital, networked, and intelligent transformation of the shipping industry. The development of autonomous navigation technology for intelligent ships is changing ship operation modes, maritime job profiles, and the competency structure required of navigation personnel. Traditional training in Navigation Technology has primarily addressed ship handling, route design, watchkeeping and collision avoidance, the use of navigational instruments, ship maneuvering, and ship safety management. As intelligent ships gradually acquire capabilities such as automated assistance, remote control, autonomous operation, and shore-based supervision, future work scenarios for Navigation Technology students will no longer be limited to the bridge. They will increasingly extend to shore-based remote-control centers, autonomous navigation monitoring platforms, smart shipping management platforms, and maritime supervision contexts^[1].

The regulatory work of the International Maritime Organization (IMO) on Maritime Autonomous Surface Ships (MASS) indicates that the development of MASS involves ship design, remote operation, cybersecurity, risk assessment, human supervision, and shore-based oversight^[2-4]. The China Classification Society (CCS) Rules for Intelligent Ships (2026) further refines functional requirements for intelligent ships, including visual enhancement, intelligent integration platforms, intelligent berthing and unberthing, intelligent bridge-area collision avoidance, and intelligent monitoring^[5-7]. These developments suggest that future navigation personnel must not only master conventional navigational knowledge but also understand the operational logic of intelligent ships, identify smart-navigation risks, conduct remote monitoring and control, evaluate the outputs of autonomous navigation systems, and complete safety management and emergency response in complex navigation scenarios^[8,9].

Current training models in Navigation Technology programs still rely primarily on conventional ship-handling competencies and seafarer certification requirements. Their response to job transformation and competency restructuring driven by intelligent ships remains insufficient. Course content related to intelligent ships, autonomous navigation, remote control, ship-shore communication, data analysis, and shore-based supervision is limited^[10]. Practical teaching still relies mainly on navigation simulator training and shipboard practice, while new scenarios such as remote control, transfer of control, autonomous navigation state supervision, abnormal takeover, and shore-based operations management are inadequately covered. Assessment also tends to emphasize theoretical knowledge and single operational skills, while the integrated competency of students in intelligent navigation receives less attention.

Against this background, this study addresses the following question: What core competencies should Navigation Technology students develop under the staged evolution of autonomous navigation in intelligent ships, and how should education and training be adjusted accordingly? Rather than providing a broad discussion of talent cultivation under smart shipping, the study focuses on changes in students' future competency structures. It constructs an analytical framework of "stage evolution-job transformation-competency needs-educational pathways" to support educational reform in Navigation Technology programs.

2. Staged Evolution of Autonomous Navigation in Intelligent Ships and Its Training Implications

Autonomous navigation in intelligent ships will not be realized in a single step. It will evolve progressively from automated assistance and remote control to autonomous operation and full-voyage autonomy. Drawing on IMO's categorization of MASS autonomy and the intelligent functions specified in the CCS Rules for Intelligent Ships (2026), the development of autonomous navigation in intelligent ships can be summarized into five typical operating forms: automated assistance and decision support, remote control with crew on board, remote control without crew on board, autonomous operation with human-machine collaboration, and full-voyage autonomy with shore-based supervision. These stages differ in their operational characteristics, human responsibility boundaries, and competency requirements for Navigation Technology students^[11].

2.1 Automated Assistance and Decision Support

The stage of automated assistance and decision support corresponds to the MASS category of automated processes and decision support. In this stage, crew members remain on board and undertake ship maneuvering, watchkeeping, collision avoidance, and safety management. Certain navigational processes are supported by automated equipment or intelligent navigation functions. Ship intelligence is mainly reflected in route and speed optimization, visual enhancement, collision warning, grounding warning, integrated information display, machinery condition monitoring, energy-efficiency management, and cargo management. Students should therefore develop an understanding of the basic principles of intelligent navigation equipment and decision-support functions while maintaining strong conventional navigational competencies. They should also be able to use intelligent equipment to improve navigational safety and operational efficiency^[12,13].

2.2 Remote Control with Crew on Board

Remote control with crew on board corresponds to the MASS category in which the ship may be controlled from a remote-

control station while personnel remain on board. The onboard personnel undertake state monitoring, local response, and emergency takeover. The key change in this stage is that the operational space of ship control expands from the bridge to a shore-based remote-control station. Students must understand ship maneuvering, collision avoidance, and watchkeeping rules, while also developing the ability to read remote-monitoring interfaces, conduct remote helm and engine control, judge ship-shore communication status, transfer control authority, and take over in abnormal situations^[14-16].

2.3 Remote Control without Crew on Board

Remote control without crew on board corresponds to the MASS category in which the ship is controlled from a remote-control station or center and no conventional crew is carried on board. This stage is not equivalent to full autonomy, because ship operation still depends heavily on the monitoring, judgment, and control of shore-based personnel. Students need to shift from conventional shipboard operation toward remote-control and shore-based watchkeeping roles. They should master multi-source information monitoring, remote traffic-situation assessment, communication failure risk identification, shore-based command generation, and remote emergency response.

2.4 Autonomous Operation and Human-Machine Collaboration

Autonomous operation with human-machine collaboration represents a transition from remote control toward higher levels of autonomous operation. In this stage, the ship can autonomously perform route tracking, environmental perception, situation assessment, collision-avoidance decision-making, and motion control in specific navigation segments or scenarios. A remote-control station or shore-based supervisory team still conducts monitoring, confirmation, and necessary intervention. The core change is not the disappearance of human roles but the transformation of their functions. Navigation personnel gradually shift from direct operators to supervisors of autonomous navigation systems, human-machine decision-makers, and abnormal-takeover personnel^[17].

2.5 Full-Voyage Autonomy and Shore-Based Supervision

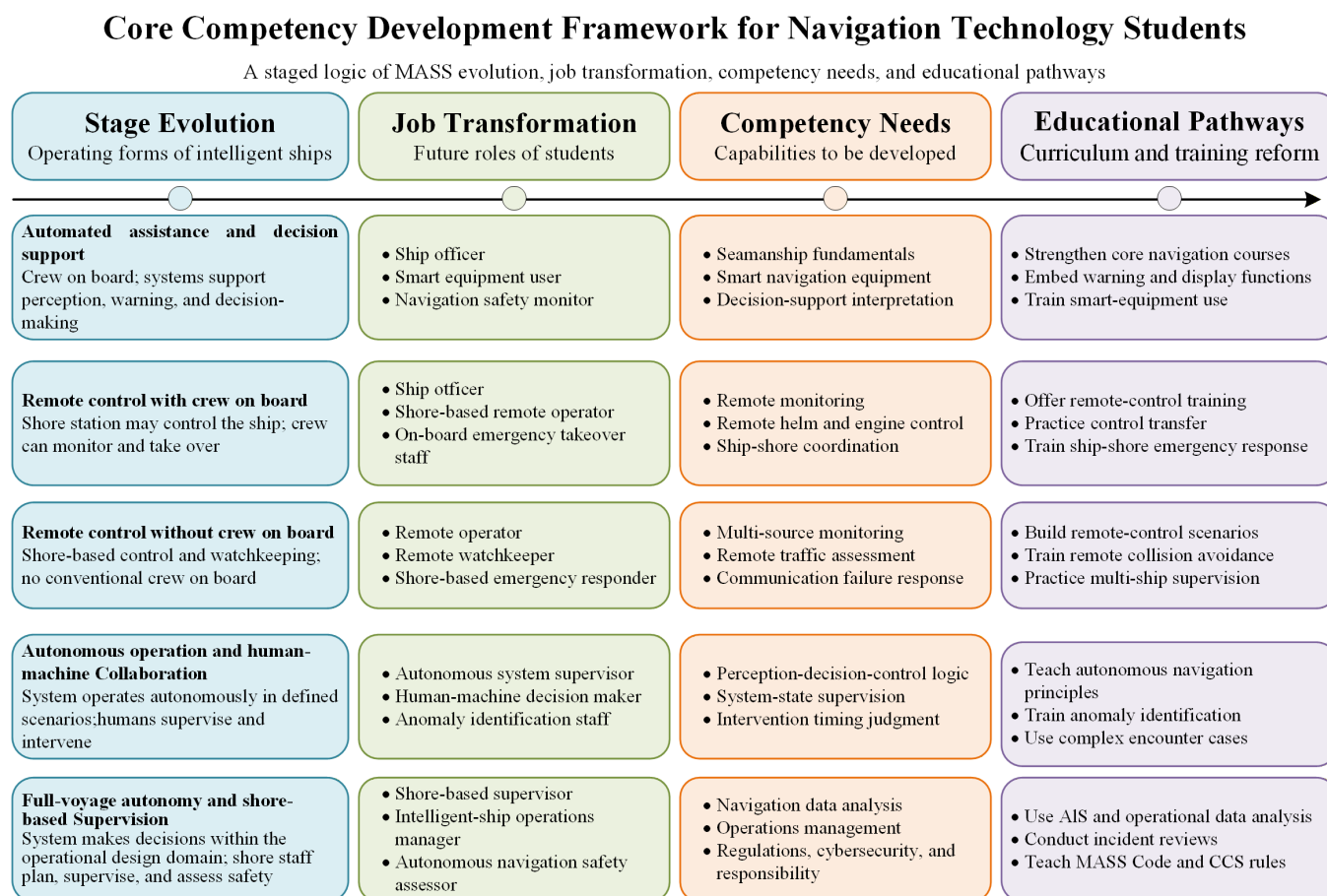
Full-voyage autonomy with shore-based supervision corresponds to the MASS category of fully autonomous ships and represents a higher level of intelligent ship operation. In this stage, the ship can make decisions and determine actions autonomously within its operational design conditions. Human roles shift further from direct control and real-time intervention toward mission planning, operational supervision, safety assessment, incident review, and responsibility management. Students should use navigational knowledge to judge whether the operation of an autonomous navigation system is safe, compliant, and reliable^[18-21]. They should develop competencies in data analysis, regulatory interpretation, cybersecurity awareness, and integrated safety management.

3. A Core Competency Development Framework Based on Stage Evolution, Job Transformation, Competency Needs, and Educational Pathways

3.1 Logic of Framework Construction

The development of autonomous navigation in intelligent ships changes the future job roles of Navigation Technology students and reshapes the core competencies they should acquire. Based on the relationship between the development stages of intelligent ships and future job transformation, this study constructs a core competency development framework for Navigation Technology students. The framework consists of four layers. The first layer is stage evolution, referring to the progression from automated assistance and decision support to remote control, autonomous operation, and shore-based supervision. The second layer is job transformation, in which future roles expand from ship officers and watchkeepers to smart navigation equipment users, remote-control operators, autonomous navigation system supervisors, human-machine decision-makers, shore-based supervisors, and intelligent-ship operations managers. The third layer is competency needs, including conventional seamanship, understanding of smart navigation equipment, remote-control ability, autonomous navigation system supervision, human-machine collaboration, data analysis, and regulatory safety literacy. The fourth layer is educational pathways, through which these competencies are developed by reconstructing training objectives, optimizing curricula, reforming practical teaching, developing teaching platforms, promoting university-industry collaboration, and improving assessment mechanisms^[22-24].

Figure 1: Core competency development framework for Navigation Technology students based on stage evolution, job transformation, competency needs, and educational pathways.



3.2 Relationship between Stage Evolution and Job Transformation

Under different degrees of autonomy, ship operating characteristics and human responsibility boundaries differ, and the future jobs of students change accordingly. Table 1 summarizes the relationship between stage evolution and job transformation.

Table 1. Relationship between the staged evolution of autonomous navigation in intelligent ships and job transformation.

Stage evolution	Main operating characteristics	Future job transformation of students
Automated assistance and decision support	Crew remain on board; systems support perception, judgment, and decision-making.	Ship officers, smart navigation equipment users, navigation safety monitors.
Remote control with crew on board	Shore-based control is possible; onboard personnel can monitor and take over.	Ship officers, shore-based remote operators, onboard emergency takeover personnel.
Remote control without crew on board	Shore-based control is used; no conventional crew are carried on board.	Remote operators, remote watchkeepers, shore-based emergency response personnel.
Autonomous operation and human-machine collaboration	Systems operate autonomously in specific scenarios; humans supervise and intervene when necessary.	Autonomous navigation system supervisors, human-machine decision-makers, anomaly identification personnel.
Full-voyage autonomy and shore-based supervision	Systems make decisions autonomously; shore staff undertake mission planning, supervision, and safety assessment.	Shore-based supervisors, intelligent-ship operations managers, autonomous navigation safety assessors.

3.3 Relationship between Job Transformation and Competency Needs

Job transformation is ultimately reflected in changes in the competency structure. Ship officers rely primarily on navigational fundamentals, ship maneuvering, and collision-avoidance competencies. Remote-control operators require remote monitoring,

ship-shore communication, and transfer-of-control competencies. Autonomous navigation system supervisors require knowledge of the perception-decision-control process and the ability to judge the rationality of system outputs. Shore-based supervisors and safety assessors require data analysis, operational management, risk assessment, understanding of regulations and standards, and cybersecurity awareness. These requirements can be summarized into seven core competencies: conventional seamanship, understanding of smart navigation equipment, remote control and transfer of control, autonomous navigation system cognition and supervision, human-machine collaboration and abnormal response, data analysis and shore-based operations management, and regulatory safety and comprehensive literacy.

3.4 Relationship between Competency Needs and Educational Pathways

Competency needs must be translated into implementable educational pathways. Conventional seamanship depends on foundational courses such as navigation, ship maneuvering, watchkeeping and collision avoidance, and navigational instruments. Understanding of smart navigation equipment depends on teaching content related to visual enhancement, collision warning, grounding warning, and integrated information display. Remote-control competency depends on training in shore-based control, remote watchkeeping, transfer of control, and emergency takeover. Autonomous navigation system cognition depends on courses in intelligent ships, autonomous navigation principles, and the perception-decision-control process. Human-machine collaboration depends on semi-autonomous navigation scenarios, anomaly identification, and manual intervention training. Data analysis and operations management depend on AIS data analysis, log analysis, equipment state data analysis, and incident review. Regulatory safety and comprehensive literacy depend on education related to the MASS Code, intelligent-ship rules, COLREGs, STCW, cybersecurity, data security, and engineering ethics^[25,26].

The key function of the framework is to transform the development trend of intelligent ships into executable educational reform tasks. Stage evolution answers how ships may operate in the future; job transformation answers what roles students may undertake; competency needs answer what students should master; and educational pathways answer how programs should organize courses and training. This progressive logic helps avoid a reform plan that remains at the level of slogans and enables curriculum design, practical projects, and assessment methods to focus on specific competencies.

Table 2. Correspondence among core competencies, course support, and practical training.

Core competency	Key supporting courses	Practical training content
Seamanship and equipment understanding	Navigation, ship maneuvering, navigational instruments, introduction to intelligent ships.	Route design, radar observation, interpretation of intelligent warning information.
Remote control and ship-shore collaboration	Ship-shore communication, remote-control technology, intelligent integration platform.	Shore-based control, transfer of control, response to communication abnormalities.
Autonomous navigation system supervision	Principles of autonomous navigation, intelligent perception, collision-avoidance rules.	System-state monitoring, judgment of collision-avoidance decisions, manual intervention.
Data analysis and operations management	Navigation data analysis, smart shipping safety management.	AIS data analysis, incident review, operational risk assessment.
Regulatory safety and comprehensive literacy	MASS Code, intelligent-ship rules, cybersecurity and data security.	Regulatory case analysis, responsibility-boundary discussion, teamwork tasks.

4. Core Competency Structure for Navigation Technology Students in the Context of Intelligent Ships

4.1 Seamanship and Understanding of Smart Equipment

Foundational navigational ability remains the basis of intelligent-ship talent development. The development of intelligent ships does not reduce the importance of conventional seamanship. Students can judge whether the outputs of smart navigation equipment or autonomous navigation systems are reasonable only when they understand ship motion, navigational environments, collision-avoidance rules, and maneuvering limitations. This competency includes navigation,

ship maneuvering, watchkeeping and collision avoidance, route design, electronic chart application, radar observation, AIS interpretation, ship positioning, and emergency response. At the same time, students should understand the functions of smart navigation equipment and decision-support systems, including visual enhancement, integrated information display, collision warning, grounding warning, and route and speed optimization^[27,28].

4.2 Remote Control and Ship-Shore Collaboration

Remote control changes the way operators acquire information, assess risks, and execute commands. Students need to master shore-based remote-monitoring interface interpretation, remote helm and engine control, route tracking, ship-shore communication status assessment, analysis of communication delay, remote collision avoidance, transfer of control, and emergency takeover. Remote control should not be regarded as simply moving the bridge to shore. It involves changes in information perception, control chains, responsibility allocation, and emergency response processes. Teaching should therefore emphasize risk judgment under incomplete information, communication delay, limited visual feedback, and insufficient control feedback.

4.3 Autonomous Navigation System Supervision and Human-Machine Collaboration

Autonomous navigation systems usually involve environmental perception, situation awareness, risk assessment, path planning, collision-avoidance decision-making, motion control, and state monitoring. Students should understand the relationships among these processes and be able to judge system states and outputs. This competency addresses whether students can effectively supervise an intelligent navigation system. In complex encounter situations, students should be able to determine whether a collision-avoidance action generated by the system complies with collision-avoidance rules, satisfies safe-distance requirements, and avoids creating new traffic conflicts^[29]. When system alarms, communication interruptions, target-recognition errors, or increasing control deviations occur, students should be able to judge whether manual intervention is required.

4.4 Data Analysis and Shore-Based Operations Management

Full-voyage autonomy and shore-based supervision place higher demands on data analysis. Students should be able to understand and analyze AIS data, navigation logs, equipment state data, alarm records, remote-control records, and incident data. Through data analysis, they can conduct operational status assessment, risk-trend judgment, efficiency analysis, and incident review. Shore-based operations management includes multi-ship monitoring, mission planning, route operation tracking, shore-ship collaborative dispatch, abnormal-event response, and navigational safety management. Future Navigation Technology graduates may work for smart shipping platforms, remote-control centers, maritime supervision agencies, and shipping companies. Data analysis and operations management will therefore become essential capabilities for adapting to new positions.

4.5 Regulatory Safety and Comprehensive Literacy

The development of intelligent ships involves the application of collision-avoidance rules, the responsibility of the master, qualification requirements for remote operators, management of shore-based control centers, cybersecurity, data security, system reliability, and engineering ethics. Students should develop awareness of regulations, safety, responsibility, and risk. This competency includes understanding the MASS Code, intelligent-ship rules, COLREGs, and STCW requirements; recognizing cybersecurity and data-security risks; understanding responsibility boundaries in intelligent-ship operation; and collaborating with professionals in naval architecture, communication engineering, control engineering, artificial intelligence, and safety management.

5. Major Deficiencies in Current Training for Navigation Technology Students

5.1 Insufficient Response of Training Objectives to Future Job Transformation

Current training objectives in Navigation Technology programs mainly target conventional ship officers, navigational watchkeepers, and ship management personnel. They emphasize ship handling, navigational safety, watchkeeping and collision avoidance, and ship management, but give insufficient attention to emerging roles such as remote-control operators, autonomous navigation system supervisors, shore-based supervisors, intelligent-ship operations managers, and autonomous navigation safety assessors. As a result, students may be prepared for conventional bridge work but insufficiently prepared

for new tasks involving remote control, human-machine collaboration, smart equipment interpretation, and shore-based supervision.

5.2 Insufficient Support for Intelligent-Ship Content in the Curriculum

Existing curricula are mainly organized around navigation, ship maneuvering, collision avoidance, navigational instruments, ship management, and seafarer competency examinations. Content on intelligent ships, autonomous navigation, remote control, ship-shore communication, data analysis, cybersecurity, and smart shipping management remains insufficient. Although some courses cover electronic charts, radar, AIS, and navigational instruments, they often focus on equipment use rather than multi-source information fusion, intelligent warning, automatic decision-making, human-machine interaction, and remote-control processes.

5.3 Weak Connection between Practical Teaching and Intelligent-Navigation Scenarios

Practical teaching in Navigation Technology programs mainly relies on navigation simulators, ship-handling training, and shipboard practice. Training content is concentrated on bridge operation, route planning, encounter avoidance, radar observation, and watchkeeping procedures. Scenarios involving remote control, transfer of control, autonomous navigation state supervision, perception anomaly identification, manual takeover, and shore-based supervision are comparatively insufficient. In the operating environment of intelligent ships, students need to make judgments under multi-source information, multiple interfaces, multiple tasks, and uncertain conditions. Conventional bridge-centered training cannot fully cover the complex scenarios required by future positions.

5.4 Insufficient Assessment of Integrated Competencies

Existing assessment methods mainly include theoretical examinations, operational tests, course assignments, and internship evaluations. Assessment content tends to focus on knowledge mastery and single operational skills, while remote-control ability, human-machine collaboration, system supervision, abnormal response, data analysis, and regulatory safety literacy are insufficiently reflected. Education oriented to intelligent ships should place greater emphasis on students' integrated judgment in complex scenarios rather than merely testing whether a student has mastered a specific operation.

6. Development Pathways Oriented to the Staged Evolution of Autonomous Navigation in Intelligent Ships

6.1 Reconstructing Training Objectives for Future Positions

The objectives of Navigation Technology programs should be expanded from training conventional ship officers to cultivating interdisciplinary maritime professionals for intelligent-ship operation. Students should develop conventional seamanship, understanding of smart navigation equipment, remote-control ability, autonomous navigation system supervision, human-machine collaboration, data analysis, and shore-based operations management. Training objectives may be organized into three levels. The foundational level emphasizes conventional competencies such as navigation, ship maneuvering, watchkeeping and collision avoidance, navigational instruments, and ship management. The intelligent level emphasizes smart equipment understanding, remote control, autonomous navigation system cognition, and human-machine collaboration. The management level emphasizes shore-based supervision, data analysis, safety assessment, and smart shipping management.

6.2 Developing a Curriculum System Integrating Seamanship, Intelligent Technology, Regulations, and Operations Management

Curriculum reform should be oriented toward students' future core competencies. The seamanship module should include navigation, ship maneuvering, collision avoidance, navigational instruments, ship management, route design, and navigational safety, thereby maintaining the disciplinary foundation of Navigation Technology. The intelligent technology module should include introduction to intelligent ships, principles of autonomous navigation, intelligent perception, ship-shore communication, remote-control technology, intelligent integration platforms, intelligent berthing and unberthing, and intelligent bridge-area collision avoidance. This module helps students understand operating mechanisms and typical functions of intelligent ships. The regulatory module should include the MASS Code, intelligent-ship rules, COLREGs,

STCW, cybersecurity, data security, responsibility allocation, and engineering ethics. The operations management module should include navigation data analysis, smart shipping safety management, autonomous navigation risk assessment, incident review, shore-based supervision practice, and smart shipping platform application. These modules support students in adapting to shore-based supervision and intelligent-ship operations management positions.

6.3 Establishing a Staged and Progressive Practical Teaching System

Practical teaching should correspond to the staged evolution of autonomous navigation in intelligent ships and form a progressive training system. Training in automated assistance and decision support should emphasize the use of smart navigation equipment, interpretation of integrated information displays, visual enhancement, collision-warning response, and grounding-warning judgment. Training in remote control with crew on board should emphasize shore-based monitoring, remote helm and engine control, ship-shore collaboration, transfer of control, and onboard emergency takeover. Training in remote control without crew on board should emphasize remote watchkeeping, multi-source information monitoring, communication failure judgment, remote collision avoidance, remote emergency response, and multi-ship supervision. Training in autonomous operation and human-machine collaboration should emphasize monitoring of autonomous navigation states, judgment of collision-avoidance decisions, perception anomaly identification, decision anomaly identification, manual intervention, and abnormal takeover. Training in full-voyage autonomy and shore-based supervision should emphasize mission planning, operations supervision, navigation data analysis, safety assessment, incident review, and smart shipping operations management.

6.4 Building an Integrated Virtual-Physical Teaching Platform for Intelligent Ships

Teaching platforms are essential for supporting core competency development. Navigation Technology programs may build integrated virtual-physical teaching platforms for intelligent ships by combining navigation simulators, remote-control consoles, electronic charts, AIS data, radar displays, visual perception modules, autonomous navigation simulations, ship-shore communication simulations, abnormal-takeover training, and smart shipping management modules. Such platforms should support three functions. First, they should support conventional navigation training, including ship maneuvering, route design, watchkeeping and collision avoidance, and emergency response. Second, they should support intelligent-ship training, including remote control, intelligent monitoring, autonomous collision avoidance, intelligent berthing and unberthing, and bridge-area collision avoidance. Third, they should support comprehensive assessment through records of students' operation processes, risk judgments, takeover timing, and task completion results.

6.5 Promoting University-Industry Collaboration and Scenario-Based Teaching

The cultivation of intelligent-ship talent requires support from industry resources. Universities may cooperate with shipping companies, intelligent-ship enterprises, classification societies, maritime administrations, port and waterway management authorities, and equipment developers. Industry partners can provide cases of remote-control platforms, intelligent-ship testing, autonomous navigation function verification, maritime supervision, and smart shipping operational data. Project-based and case-based teaching can be adopted around tasks such as remote control of ships entering port areas, collision avoidance by semi-autonomous ships in complex encounter situations, emergency takeover under communication interruption, risk judgment during intelligent berthing and unberthing, and intelligent collision avoidance in bridge-area waters. These cases help students understand future job requirements in concrete scenarios.

6.6 Improving Competency-Oriented Assessment Mechanisms

Assessment mechanisms should shift from single knowledge-based assessment toward integrated competency assessment. Assessment content may include foundational navigational knowledge, smart equipment interpretation, remote-control ability, autonomous navigation system supervision, complex-scenario risk judgment, abnormal takeover, data analysis, regulatory understanding, and teamwork. Assessment methods may combine theoretical examinations, simulation training, case analysis, project tasks, scenario exercises, and comprehensive defenses. For remote-control ability, assessment may focus on interface interpretation, control commands, judgment of communication abnormality, and takeover timing. For human-machine collaboration, assessment may examine whether students can judge the rationality of outputs from the autonomous navigation system. For data analysis, assessment may examine whether students can conduct operational status analysis and incident

review based on navigation data and abnormal records.

6.7 Strengthening Faculty Capacity and Teaching Resources

The implementation of core competency development also depends on faculty capacity and teaching resources. Teachers in Navigation Technology programs need to continually update their knowledge of intelligent ships, autonomous navigation, remote control, smart shipping platforms, and related regulations and standards. Universities can enhance teacher' understanding of intelligent-ship operating scenarios and their ability to transform such scenarios into courses through enterprise practice, classification-society training, maritime supervision research, research project participation, and interdisciplinary team building. In addition, smart shipping case libraries and scenario libraries should be developed. These libraries should cover remote control, complex encounters, intelligent berthing and unberthing, bridge-area collision avoidance, communication interruption, perception anomalies, manual takeover, and shore-based supervision, thereby providing stable support for classroom teaching, simulation training, and comprehensive assessment.

Conclusion

The development of autonomous navigation in intelligent ships is changing the competency structure of Navigation Technology students. Drawing on the IMO MASS Code and the CCS Rules for Intelligent Ships (2026), autonomous navigation in intelligent ships can be summarized into five typical stages: automated assistance and decision support, remote control with crew on board, remote control without crew on board, autonomous operation with human-machine collaboration, and full-voyage autonomy with shore-based supervision. Different stages correspond to different job roles and competency needs.

Based on the analytical framework of "stage evolution-job transformation-competency needs-educational pathways," the training of Navigation Technology students should be extended from conventional ship handling and watchkeeping toward smart navigation equipment understanding, remote control, autonomous navigation system supervision, human-machine collaboration, data analysis, shore-based supervision, and intelligent-ship operations management. This framework links the development trend of intelligent ships, future job requirements, and educational reform pathways, preventing navigation education reform from remaining at a merely macro-level discourse.

In response to the future development of intelligent ships, Navigation Technology programs should reconstruct training objectives, develop a curriculum integrating seamanship, intelligent technology, regulations, and operations management, establish a staged and progressive practical teaching system, improve integrated virtual-physical teaching platforms, promote university-industry collaboration and scenario-based teaching, and form competency-oriented assessment mechanisms. These pathways can enhance students' ability to adapt to autonomous navigation in intelligent ships and provide support for the cultivation of interdisciplinary maritime professionals in the context of smart shipping..

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Conflict of Interests

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

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A Digital Intelligence Enabled Curriculum Competition Practice Mechanism for Film and Television Art Education in Guangdong Universities

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Abstract: The rapid development of artificial intelligence, virtual production, extended reality, and other digital-intelligence technologies is transforming the production logic of the film and television industry. This transformation creates new requirements for film and television art education, especially for foundational courses that must cultivate visual storytelling, spatial modeling, digital production literacy, and practical execution. Taking Fundamentals of Film and Television Art at Zhujiang College, South China Agricultural University as a case, this study proposes a curriculum-competition-practice integration mechanism for Guangdong universities in the era of digital intelligence. The mechanism restructures conventional drawing, color, and design-drafting instruction into outcome-oriented modules, embeds AI-assisted design and virtual scene construction into project-based classroom tasks, transforms competition topics into course assessments, and introduces real enterprise and cultural-tourism projects from the Guangdong-Hong Kong-Macao Greater Bay Area into teaching practice. Based on literature analysis, curriculum diagnosis, case analysis, student work review, and reflective teaching records, the study shows that the proposed mechanism can address three persistent problems in traditional film and television art courses: the separation between technique and creativity, the gap between classroom learning and industry workflow, and the weakness of process-based evaluation. The paper contributes a replicable educational framework for integrating digital-intelligence technology, competition-driven learning, and situated practice in applied art education.

Keywords: Digital Intelligence; Film and Television Art; Curriculum-Competition-Practice Integration; AI-Assisted Design; Virtual Scene Construction; Outcome-Based Education; Guangdong Universities

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1. Introduction

Film and television art education is entering a period of structural change. The industry is moving from hand-drawn scenery, manual modeling, and linear production toward digital scenography, virtual production, AI-assisted image generation, and cross-media visual development. In the Guangdong-Hong Kong-Macao Greater Bay Area, where film, television, cultural tourism, short-form drama, commercial performance, and digital media industries are developing in parallel, universities are expected to cultivate art professionals who understand aesthetic expression, digital tools, production collaboration, and practical implementation.

Fundamentals of Film and Television Art is a core introductory course for students in drama directing, cinematography, production, and visual design. Its function is not merely to train students in basic techniques, but to help them understand how visual language supports narrative, atmosphere, character, and spatial meaning. In the age of digital intelligence, this course must also help students connect artistic judgment with AI-assisted design, virtual scene construction, lighting simulation, and collaborative production workflows.

This study focuses on the topic Research on the Curriculum-Competition-Practice Integrated Education Mechanism of Fundamentals of Film and Television Art in Guangdong Universities in the Digital-Intelligence Era. It uses Zhujiang College, South China Agricultural University as the implementation context and proposes a three-dimensional mechanism summarized as classroom foundation, competition catalysis, and practice implementation. The study is guided by constructivist learning theory and outcome-based education (OBE).

The contribution of this paper is threefold. First, it clarifies the transformation of film and television art education under digital intelligence and new quality productivity. Second, it constructs an implementable mechanism that connects course modules, competition tasks, enterprise projects, and research reflection. Third, it provides a case-based evaluation framework for applied universities seeking to reform foundational art courses through AI-assisted design and industry-education collaboration.

2. Related Work and Theoretical Background

Digital media has changed the relationship between art design and production. Virtual production, XR stages, digital lighting, previsualization, and AI-generated content allow film and television artists to test space, color, atmosphere, and scene logic before physical construction. The core ability of film and television art professionals is therefore expanding from hand skills to the coordination of narrative interpretation, spatial design, technological operation, and production communication.

Prior studies on new liberal arts, applied universities, and art education reform emphasize student-centered learning, industry-education collaboration, competition-driven learning, and outcome-oriented evaluation. In art and design programs, youth teaching competitions and new liberal arts construction have been discussed as important drivers of curriculum renewal ^[1,2]. Discipline competitions can also support student ability cultivation and project-driven teaching reform by providing external standards, real deadlines, and public evaluation criteria ^[3,4], while practical teaching mechanisms connect classroom learning with innovation, entrepreneurship, and applied project experience ^[5].

Constructivist learning theory supports the use of authentic projects, collaborative tasks, and reflective inquiry. OBE provides another design principle: course objectives should be defined according to the abilities students are expected to demonstrate at the end of learning. Existing studies on practical innovation-oriented, outcome-oriented art education reform and student-growth-centered classroom teaching also support this ability-based reform direction ^[6,7]. For Fundamentals of Film and Television Art, the target outcomes include visual narrative construction, spatial atmosphere design, digital tool application, model or set implementation, teamwork, and reflective evaluation.

3. Research Context and Method

This study adopts a design-based case study method. The research object is the reform of Fundamentals of Film and Television Art at the School of Design, Zhujiang College, South China Agricultural University. The course is located in a private applied university context and serves as a foundation for drama directing and related film and television programs.

The data sources include curriculum documents, teaching reflection records, student work, teacher observation, enterprise cooperation cases, competition-task analysis, and literature related to art education reform. The study also draws on the college's cooperation with organizations such as Guangzhou Haoyang Electronics, Guangdong Radio and Television, and Zhu Ying Culture Group, as well as real projects such as AI micro-dramas and cultural-tourism visual design. This design is consistent with film and television art education research that emphasizes practical interaction between film and television bases and classrooms ^[8].

Table 1. Research design and evidence sources

Research Component	Purpose	Evidence Used
Literature analysis	Clarify digital transformation, competition-driven learning, OBE, and art education reform	Studies on digital media, art curriculum reform, competitions, and student-centered education
Curriculum diagnosis	Identify gaps in existing teaching	Course documents, observations, learning tasks, and assessment methods
Case analysis	Examine classroom, competition, and practice integration	Student works, enterprise projects, cultural-tourism projects, and competition topics
Reflective evaluation	Assess implementation effects and limits	Teacher reflection, student artifact review, and process-based indicators

4. Current Problems in Fundamentals of Film and Television Art

The reform begins with a diagnosis of the existing course. First, the curriculum system does not update quickly enough to match the iteration of film and television art technology. Although the college has digital and virtual production facilities, students still need clearer guidance on how these resources correspond to real industrial workflows, including virtual lighting, AI-assisted scene generation, and digital stage design.

Second, teaching resources and training conditions are limited. Film and television art requires physical scenery, costume and makeup experiments, prop production, lighting tests, and spatial model construction. These activities are costly and difficult to organize at scale in applied universities. Without an integrated mechanism, some practical sessions remain at the level of design proposals rather than entering real production or near-real simulation.

Third, course content is fragmented. Students may learn sketching, color, software, drafting, design theory, and scene analysis as separate units, but still lack the ability to apply these skills systematically in a complex project. Fourth, assessment remains too narrow. Conventional evaluation often focuses on final drawings or individual assignments, while real professional competence includes process management, narrative interpretation, teamwork, material selection, digital tool use, and adaptation to feedback.

Table 2. Problems in the existing course and reform responses

Problem	Observed Manifestation	Mechanism Response
Content lag	Course modules update more slowly than AI, XR, virtual production, and digital lighting workflows	Add AI-assisted design, virtual scene construction, and digital production literacy modules
Weak practice	Assignments remain fictional or conceptual and lack production constraints	Introduce enterprise projects, cultural-tourism scenarios, and AI micro-drama tasks
Fragmented skills	Students master single techniques but struggle in integrated projects	Use project-based modules centered on script interpretation and visual atmosphere
Narrow assessment	Final works are evaluated without sufficient process evidence	Combine competition criteria, project records, peer review, mentor feedback, and reflection

5. Design of the Curriculum-Competition-Practice Mechanism

The proposed mechanism is organized around the logic of classroom foundation, competition catalysis, practice implementation, and research reflection. Although the topic is summarized as curriculum-competition-practice integration, the reform also includes a research-feedback dimension because students and teachers need to transform practical problems into reflective inquiry.

At the classroom level, the course breaks down the barriers between sketching, color, design drafting, lighting cognition, material experiment, and spatial modeling. Instead of asking students to complete isolated technique exercises, the reformed course organizes modules around the question of how to construct a visual atmosphere for a given script. Digital-intelligence modules are embedded into traditional foundations, including AI-assisted design for ideation, mood-board generation, visual

reference comparison, style exploration, virtual scene construction, and digital lighting preview. This responds to the broader integration of art and technology in the digital media era^[9] and also strengthens students' understanding of color expression and visual metaphor in film art design^[10].

At the competition level, the reform changes the role of competitions from optional extracurricular activities to structured learning tasks. Topics from national digital art design competitions, future designer contests, and industry events can be introduced into midterm and final assessment. Students work in teams to move from script analysis to concept design, from digital visualization to physical model, and from classroom critique to competition-oriented presentation.

At the practice level, the course relies on the college's school-enterprise cooperation resources and the cultural ecology of the Greater Bay Area. Real projects such as AI micro-dramas, short-form drama scenes, cultural-tourism installations, and Lingnan cultural symbol translation are brought into teaching. Students participate in costume, makeup, prop design, on-site set design, model construction, and visual presentation under the guidance of teachers and industry mentors.

Table 3. Curriculum-competition-practice mechanism for Fundamentals of Film and Television Art

Dimension	Main Task	Digital-Intelligence Element	Expected Learning Outcome
Curriculum	Modular and project-based learning around script visual atmosphere	AI-assisted ideation, virtual scene construction, digital lighting preview	Visual storytelling and spatial modeling
Competition	Embed competition topics into coursework and final assessment	Digital art presentation and competition portfolio construction	Creative pressure, teamwork, iterative refinement
Practice	Introduce enterprise and cultural-tourism projects	AI micro-drama workflow and digital scene documentation	Production awareness and material execution
Research	Convert practice problems into inquiry topics	Digital archive, reflective logs, case analysis	Theoretical reflection and academic communication

6. Case Evidence from Student Works and Course Practice

Student works provide visible evidence of the transition from technique-centered exercises to integrated visual production. In the reformed course, students are required to interpret a narrative situation, identify visual metaphors, design atmosphere, choose materials, and construct physical or digital scene prototypes. The works shown below demonstrate how students move from planar design toward spatial scene construction and filmic visual thinking.

The first case emphasizes atmosphere construction through low-key lighting, spatial hierarchy, architectural symbolism, and model photography. The second case emphasizes material texture, local commercial space, wall surface aging, cable details, and environmental realism. These works indicate that students are not merely completing static drawing exercises, but are learning to construct filmic spaces through camera perspective, lighting, scale, and narrative implication.

7. Evaluation Framework and Findings

Because the current project is an educational mechanism study rather than a controlled experiment, the evaluation focuses on structured qualitative evidence and process-based indicators. The framework evaluates four categories of outcome: visual narrative ability, digital-intelligence literacy, practical execution, and reflective research awareness. Each category can be observed through course tasks, competition portfolios, project records, teacher and mentor comments, and student reflections.

The initial findings can be summarized in three aspects. First, the mechanism reduces the separation between technique and creativity. When basic skills are reorganized around script interpretation and atmosphere construction, students understand why drawing, color, model making, and digital tools matter. Second, the mechanism narrows the gap between learning and industry. Competition topics and enterprise projects introduce deadlines, presentation standards, collaboration, and feasibility constraints. Third, the mechanism expands evaluation from final products to learning processes.

The reform also reveals limitations. The integration of AI and virtual production requires teachers to update their own technical and pedagogical competence. Enterprise projects must be selected carefully so that they match students' developmental level. Competition tasks can motivate students, but they may also create excessive pressure if they are not aligned with course objectives. Moreover, process-based assessment requires more time and clearer rubrics than conventional grading.

Figure 1. Student scene-model work emphasizing atmosphere, spatial depth, and visual narrative.



Figure 2. Student practice work showing material texture, local scene detail, and production-oriented modeling.



Table 4. Evaluation indicators for the integrated mechanism

Outcome Category	Indicator	Evidence Form
Visual narrative	Translate script meaning into scene atmosphere, color, texture, and spatial hierarchy	Concept boards, scene models, model photography, design explanation
Digital-intelligence literacy	Use AI and digital tools for reference generation, scene preview, and iterative design	AI-use records, virtual scene drafts, manual-digital comparison
Practical execution	Complete material tests, props, models, on-site design, and teamwork under constraints	Project records, mentor feedback, competition submissions
Reflective inquiry	Identify design problems and transform them into research questions	Reflection logs, case reports, cultural-symbol analysis

8. Discussion

The proposed mechanism is especially relevant to Guangdong universities because the Greater Bay Area has a dense ecology of film and television production, digital media enterprises, cultural-tourism projects, stage performance, and short-form video industries. Applied universities can use this regional ecology as a teaching resource and build a network that connects foundation courses, competitions, enterprises, cultural projects, and research reflection.

AI-assisted design should not be understood as a shortcut that replaces artistic training. In foundational art education, AI is most valuable when it becomes a tool for comparison, ideation, visualization, and iteration. Students still need to learn composition, color, scale, material, light, and narrative logic. The curriculum should therefore require students to compare AI-generated references with manual sketches, explain why particular visual choices are adopted or rejected, and transform digital inspiration into feasible spatial design.

The study suggests that course reform should be understood as part of a larger talent cultivation mechanism. If the classroom builds foundations, competitions activate creativity, practice develops execution, and research reflection deepens theory, then students can gradually form the compound competence required by new quality productivity: aesthetic sensitivity, technical literacy, practical ability, innovation consciousness, and professional responsibility.

9. Conclusion

This paper proposed a digital-intelligence-enabled curriculum-competition-practice mechanism for Fundamentals of Film and Television Art in Guangdong universities. Based on the reform context of Zhujiang College, South China Agricultural University, the study identified key problems in the traditional course, including content lag, weak practice, fragmented skills, and narrow assessment. It then designed an integrated mechanism that connects modular classroom teaching, competition-driven learning, enterprise and cultural-tourism practice, and research reflection.

The mechanism provides a practical pathway for transforming foundational film and television art education from technique-centered training toward comprehensive visual production competence. It helps students connect art basics with script interpretation, digital-intelligence tools, scene construction, competition standards, and industry workflows. Future research should collect pre-test and post-test data, analyze AI-use logs, and conduct interviews with students, teachers, and enterprise mentors to further validate the scalability of the mechanism.

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Conflict of Interests

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

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Research on the Development of School-Based Music Education Based on Ancient Poetry and Art Songs

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Abstract: In order to enhance the cultural connotation and aesthetic value of music education and promote the inheritance and development of ancient poetry, art songs, this article focuses on the development of school-based curriculum. Ancient poetry and art songs combine the dual artistry of literature and music, and have unique cultural inheritance and aesthetic education functions, but they have not yet been fully valued in current music education. This article uses methods such as literature research, case analysis and action research to systematically explore the educational value of ancient poetry and art songs, analyze the current situation and problems of related curriculum development at home and abroad, and build a complete school-based curriculum system on this basis, including curriculum objectives, content design, teaching methods and evaluation mechanisms. Research has found that this course can effectively improve students' aesthetic literacy, cultural identity and musical expression, while providing a new practical path for teachers' professional development. Practice shows that the implementation of the curriculum enhances students' interest in traditional culture and optimizes the teaching effect of music classes, but there are also challenges in resource integration and teacher training. Future research can further explore the long-term mechanism of the curriculum and the possibility of interdisciplinary integration.

Keywords: Ancient Poetry; Art Songs; Music Education; School-Based Curriculum Development; Aesthetic Education; Cultural Inheritance

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1. Research Background

Currently, China's basic music education has achieved significant progress in its curriculum system and content. However, there is a widespread lack of in-depth exploration of indigenous musical culture, particularly the profound carriers that integrate literary classics and musical art. Music instruction often emphasizes skill training and Western music theory, resulting in the insufficient integration and utilization of traditional Chinese music resources rich in aesthetic philosophy and national spirit. On one hand, the teaching and stage performances in specialized music institutions form its primary transmission pathway, reaching a relatively narrow audience. On the other hand, in general school education, it is often simplified to mere vocal material, where literary imagery, tonal beauty, and historical cultural connotations fail to receive systematic elaboration or experiential learning, preventing the full educational potential of this artistic treasure from being realized.

This current situation falls short of the national requirement for aesthetic education in the new era, which emphasizes

“cultivating people through beauty and nurturing them through culture.” The evolving times call for music education to return to its cultural roots, guiding students to establish cultural identity and aesthetic confidence. Therefore, developing school-based curricula centered on art songs of ancient poetry is not only a proactive response to the national aesthetic education policy but also carries urgent cultural significance. It aims to build a bridge connecting tradition and modernity, music and literature, enabling students to deeply immerse themselves in the context of China’s outstanding traditional culture while acquiring musical skills. This approach is not only an inevitable choice to address the structural deficiencies in current music education but also a crucial measure to preserve the genetic code of ethnic music culture and cultivate the next generation with profound humanistic qualities. The article argues that systematically developing such curricula can effectively bridge the cultural gap in existing music education and infuse students’ holistic development with a distinctive cultural foundation.^[1]

2. Research Significance

As a unique carrier of excellent traditional Chinese culture, ancient poetry and art songs have multidimensional educational value in school-based curriculum development. From the perspective of cultivating aesthetic literacy, the cross artistic integration of poetry and music can effectively enhance students’ aesthetic perception ability, and stimulate their sensitivity to rhythm, cadence, and imagery through the art form of “poetry music harmony”. This aesthetic experience not only stays at the sensory level, but also guides students to enter the aesthetic realm of “standing up to express the meaning”, achieving a deep understanding from formal beauty to artistic conception beauty. In terms of cultural identity, the curriculum helps students establish an emotional connection with traditional culture by reconstructing modern expressions of classic poetry. The awakening of this “cultural memory” plays an irreplaceable role in cultivating cultural confidence among young people. Research has shown that artistic cultural inheritance is more effective in stimulating students’ sense of cultural belonging than simply imparting knowledge. For the professional development of teachers, the process of curriculum development encourages them to delve deeper into traditional cultural resources and achieve a role transformation from “curriculum executors” to “curriculum developers”. This professional growth is not only reflected in the improvement of teaching ability, but also in the enhancement of cultural consciousness. This article uses theoretical analysis to sort out the educational function of ancient poetry and art songs, integrates relevant curriculum experience at home and abroad through literature research, and proposes innovative paths for curriculum development based on this. The limitation of the research lies in the inability to comprehensively examine the differences in acceptance among students in different stages. In the future, the curriculum design can be further refined by combining cognitive development theory. The conclusion indicates that the development of school-based curriculum based on ancient poetry and art songs should adhere to the equal emphasis on aesthetic experience and cultural inheritance, and construct a teaching mode of “poetry and music integration”, providing practical samples for the reform of music education in the new era.

3. Research Objectives

This article aims to clarify the specific goals of developing school-based music education curriculum based on ancient poetry and art songs. The specific goal of course development first focuses on the systematic construction of content. On the basis of in-depth analysis of the unique artistic value and educational function of ancient poetry and art songs, this article intends to construct a logically clear and hierarchical curriculum content system. This system will follow the laws of students’ cognitive development, modularize and integrate classic works according to themes, emotional connotations, and musical expression difficulty, ensuring that the content is both classic and appropriate, and achieving the organic unity of music skill training and humanistic literacy cultivation. Explore clear and feasible implementation paths. The goal is to design a diversified teaching model that integrates theoretical learning, artistic practice, and aesthetic experience. This path will draw on modern music education technology, emphasizing situational creation and experiential learning, guiding students to deeply understand the artistic conception of ancient poetry and the expressive power of music in multidimensional activities such as singing, appreciation, and creation, thereby transforming static knowledge transmission into a dynamic and internalized process of generating literacy. Establish a scientifically effective curriculum evaluation system. This system will break through the limitations of single skill assessment and shift towards a developmental evaluation of students’ comprehensive qualities such

as aesthetic perception, cultural understanding, and emotional attitudes. By combining process evaluation with summative evaluation, comprehensively evaluate the achievement of course objectives and provide empirical evidence for continuous improvement of the course. The research objective of this article is to provide a clear theoretical framework and practical guidance for the development of school-based ancient poetry and art song courses through a systematic design that integrates content, implementation, and evaluation.^[2]

4. Research Methods

This article adopts a diversified research method, aiming to systematically promote the development of school-based curriculum based on ancient poetry and art songs. The literature research method is the theoretical foundation of the entire study. By systematically reviewing and analyzing existing research on music education, curriculum theory, traditional Chinese culture education, and the ontology of ancient poetry and art songs at home and abroad, this article aims to construct a solid theoretical framework to provide theoretical support for curriculum goal setting, content selection, and organization, ensuring the scientific and forward-looking nature of curriculum development at the theoretical level.

The case analysis method focuses on drawing experience from practice. This article will select representative successful cases of integrating traditional culture into music education or school-based curriculum development at home and abroad for in-depth analysis, focusing on their curriculum design concepts, implementation paths, and evaluation mechanisms. Through this comparison and reference, the aim is to identify transferable and effective strategies, while avoiding possible misunderstandings, thereby enhancing the feasibility and applicability of the curriculum plan constructed in this article.

The action research method will be a key link connecting theory and practice. This article will follow a spiral upward pattern of “plan action observation reflection” to explore the practical application of curriculum prototypes in specific educational contexts. By collaborating with frontline teachers, the suitability of course content, the effectiveness of teaching methods, and the rationality of evaluation tools are tested in the actual teaching process, and continuous dynamic adjustments and optimizations are made based on feedback. This method ensures that curriculum development is not a closed theoretical construction process, but an open, interactive, and constantly improving practical research, with the ultimate goal of forming a school-based curriculum system that is both theoretically profound and easy to operate and promote.

5. Analysis of the Educational Value of Ancient Poetry and Art Songs

5.1 Cultural Heritage Value

As an important carrier of traditional culture, the uniqueness of ancient poetry and art songs is reflected in the deep integration of music and literature. From the perspective of cultural inheritance, this art form not only preserves the literary essence of classical poetry, but also endows it with new vitality through the expressive power of music. This article believes that the inheritance value of ancient poetry and art songs is first reflected in their cross media artistic characteristics, which transform the artistic conception of words into auditory experience, making traditional culture perceived in a more intuitive way. This dual artistic expression not only meets modern aesthetic needs, but also continues cultural memory, forming a unique cultural dissemination path.

In cultivating students' cultural identity, ancient poetry and art songs play an irreplaceable role. According to cultural identity theory, art education is an important way to shape cultural identity. By singing and appreciating these works, students can directly experience the linguistic beauty and ideological connotations of classical poetry, and establish emotional connections with traditional culture through music experiences. This kind of connection is not a simple knowledge transfer, but a deep cultural internalization process achieved through artistic practice. Research has shown that cultural elements in music education can enhance learners' sense of cultural belonging, and ancient poetry and art songs have natural advantages in this regard due to their unique national and artistic qualities. From the perspective of educational practice, the inheritance value of ancient poetry and artistic songs is also reflected in their adaptability. This article finds that such works can not only meet the needs of traditional music teaching, but also integrate with modern educational concepts. Its content covers interdisciplinary knowledge such as history, literature, music, etc., providing high-quality materials for interdisciplinary teaching. At the same time, the emotional expression and aesthetic characteristics of the work itself conform to the cognitive development laws of

teenagers and can effectively stimulate their interest in learning. This adaptability gives ancient poetry and artistic songs a lasting vitality in cultural inheritance. The full utilization of this cultural inheritance function still faces certain limitations. At present, there is insufficient development of teaching resources for ancient poetry and art songs in the educational environment, and systematic curriculum construction still needs to be improved. Future research should focus on exploring how to optimize curriculum design and revitalize this traditional cultural carrier in contemporary education. This article suggests that a segmented teaching system for ancient poetry and art songs should be established, combined with digital technology to develop interactive teaching resources, in order to more effectively achieve cultural inheritance goals.^[3]

5.2 Aesthetic Education Value

The fusion of the dual artistic characteristics of music and literature in ancient poetry and art songs provides a unique path for aesthetic education. From the perspective of music, elements such as the ups and downs of melody, the relaxation of rhythm, and the color of harmony can directly affect students' auditory senses, cultivating their ability to perceive the beauty of musical form, just as the interactive influence of traditional music and aesthetic thinking is revealed. From a literary perspective, the language of poetry is concise and the artistic conception is profound. Through the construction of imagery and the expression of emotions, students are guided to feel the beauty of words and enhance their literary aesthetic ability. This is in line with the emphasis on cultivating language construction and application literacy. This fusion of dual arts enables students to perceive the rhythm of emotions through music and understand the connotation of artistic conception through literature in the aesthetic process, thereby deepening the sense of hierarchy in aesthetic experience. This article believes that the path to improving aesthetic ability can be summarized as follows: firstly, through the input of music and literary elements at the sensory level, it stimulates aesthetic interest; Secondly, achieving resonance between musical emotions and poetic imagery at the emotional level enriches the aesthetic experience; Ultimately, it forms a rational judgment and appreciation of the artistic value of the work, enhancing aesthetic literacy. Therefore, curriculum design should focus on the organic combination of music and literature, guiding students to experience beauty, understand beauty, and create beauty from multiple dimensions, just as the importance of the comprehensive training model is pointed out in the high school music aesthetic education strategy. Of course, the improvement of aesthetic ability is a long-term process, and in the future, more empirical research is needed to optimize teaching methods in order to better achieve the goals of aesthetic education.

5.3 Emotional Cultivation Value

Ancient poetry and art songs deeply integrate literary imagery with musical melodies, providing a unique carrier for emotional education. This article believes that the value of emotional cultivation mainly lies in two aspects: firstly, guiding students into a specific emotional atmosphere through musical poetry, achieving emotional resonance and experience; The second is to subtly shape students' humanistic spirit and values. This shaping effect is not rigid indoctrination, but relies on the infectious power of the artwork itself, in line with the laws of aesthetic education.^[4]

From a theoretical perspective, emotional education theory emphasizes the core position of emotional experience in individual growth, and ancient poetry and art songs precisely provide structured and artistic emotional experience scenes. The ups and downs of musical melodies, the tempo of rhythm, and the interplay of virtual and real imagery in poetry together create a three-dimensional emotional field. In this field, students can not only experience basic human emotions such as sadness, joy, separation, and reunion, but also appreciate the higher-level humanistic spirit behind poetry, such as patriotism and life philosophy. This experience goes beyond simple knowledge learning and goes straight to the depths of the soul, contributing to the enrichment of students' emotional world and the improvement of their personality. In terms of methodology, this article mainly adopts a research method that combines theoretical deduction with text analysis. By analyzing the artistic characteristics of the integration of poetry and music in ancient poetry and art songs, this paper argues for its unique advantages as an emotional education resource. This article emphasizes that curriculum design should focus on creating immersive aesthetic contexts, guiding students to actively complete the complete process from sensory experience to emotional resonance, and then to spiritual sublimation during singing or appreciation. This process has a positive significance in alleviating the current lack of emotional education in education.

Based on the school-based curriculum of ancient poetry and art songs, the value of emotional cultivation lies in effectively

promoting the refinement and profundity of students' emotions through artistic emotional experiences, and laying a solid foundation for the cultivation of their humanistic spirit. Future curriculum development should pay more attention to the refinement of emotional goals and the precise matching of teaching strategies, in order to fully utilize its educational function.

6. The Current Situation and Problems of School-based Curriculum Development

6.1 Current Research Status in China

In recent years, there has been a trend of theoretical exploration preceding systematic practice in the integration of ancient poetry and art songs into music education in China. At the theoretical level, research mainly focuses on two directions: one is to expound the unique value of ancient poetry and art songs in inheriting excellent traditional Chinese culture and enhancing students' aesthetic and humanistic literacy; The second is to explore its potential path in interdisciplinary teaching and integration with Chinese language and ideological and political education. These discussions provide necessary conceptual support for the development of school-based curriculum, emphasizing the cultural attributes and educational functions of the curriculum. At the practical level, some frontline teachers have made scattered classroom attempts, such as introducing classic songs in music appreciation classes or organizing rehearsals in club activities. These practices have preliminarily verified the positive impact of ancient poetry and art songs on students' cultural identity and aesthetic perception.

The existing model has limitations. Practice is mostly a scattered and fragmented teaching attempt, and a systematic curriculum system with clear goals, coherent content, and scientific evaluation has not yet been formed. The selection of course content often relies on the personal preferences of teachers, lacking gradient design based on students' cognitive development laws and music subject logic. The teaching methods are relatively traditional, mostly staying at the level of "listening, appreciating, and explaining", and failing to fully integrate modern educational technology and diverse forms of artistic practice, resulting in insufficient guidance for students' creative expression and deep experience. The lack of curriculum evaluation mechanism often focuses on summative performance or knowledge assessment, and lacks attention to formative evaluation of learning process, emotional experience, and cultural understanding. These limitations have resulted in the educational effectiveness of the curriculum not being fully utilized, and its sustainability and generalizability are constrained. Therefore, this article believes that the current education practice of ancient poetry and art songs in China urgently needs to transform from scattered activities to a school-based curriculum that emphasizes systematization, standardization, and specialization.

6.2 Drawing on Foreign Experience

This article focuses on the development of school-based curriculum for ancient poetry and art songs, with an international perspective. The aim is to compare the successful experiences of foreign art song curriculum development and extract concepts and methods with universal guiding significance. This analysis is mainly based on the theoretical framework of comparative education research, identifying the commonalities and characteristics of curriculum development in different cultural contexts through systematic comparative argumentation. Research has found that the teaching systems of foreign art song courses, European German art songs (Lieder), and French *mélodie* generally demonstrate a deep cultural integration curriculum concept. Its core is not simply technical instruction, but viewing music as a comprehensive carrier for understanding specific languages, literature, history, and national spirit. This holistic view of placing art songs in a broad humanistic context provides important insights for constructing course content in this article.

At the methodological level, foreign curriculum development places particular emphasis on the unity of practicality and experiential learning. Its successful cases generally adopt interdisciplinary teaching strategies, such as closely integrating music analysis with poetry appreciation, and encouraging students to internalize knowledge through creative activities (such as composing music for poetry or performing in drama). This method goes beyond passive listening and shifts towards an active and constructive learning process, effectively enhancing students' participation and artistic expression. With the global music education entering the era of digital intelligence, foreign curricula actively integrate music technology, using digital audio workstations, interactive software and other tools to assist music analysis and creation, providing new ideas for overcoming abstract problems in traditional teaching.

Based on the above analysis, this article extracts several valuable concepts for reference. The primary point is that curriculum

development should adhere to cultural orientation, and treat ancient poetry and art songs as a living inheritance of Chinese aesthetic thought, rather than isolated musical specimens. Teaching methods should emphasize students' subjectivity and achieve a transition from skill training to literacy cultivation through project-based learning, collaborative exploration, and other methods. Curriculum construction needs to be forward-looking, carefully integrating technological means into teaching to enhance learning effectiveness and adaptability to the times. Of course, the borrowing of foreign experience must consider the adaptability of local culture, which is an inherent limitation of this study. The future outlook lies in how to combine these international concepts with the specific context of Chinese music education, and explore a truly Chinese characteristic and effective school-based curriculum development path.

6.3 Analysis of Existing Problems

At present, there are still several urgent issues to be addressed in the content design, implementation methods, and evaluation mechanisms of school-based curriculum development for ancient poetry and art songs. At the level of content design, there is a general tendency towards a single selection of materials in courses, with a focus on classic works such as "Shui Tiao Ge Tou" and "Chun Xiao", and a lack of systematic exploration of regional characteristic poetry and contemporary excellent works. This content limitation makes it difficult for the curriculum to fully showcase the cultural diversity of ancient poetry, art, and songs, weakening their educational function as traditional cultural carriers. At the same time, some course designs have a phenomenon of separating literary and musical elements, which fails to fully reflect the artistic characteristics of "integrating poetry and music". The implementation method presents the characteristic of programmatic teaching methods. A survey shows that over 60% of classrooms still use the traditional model of "teacher led singing student imitation", which is a one-way indoctrination teaching that neither conforms to the learning efficiency curve revealed by the Yerkes Dodson law nor stimulates students' creative thinking. The application of information technology mostly remains at the level of audio playback, lacking deep integration of digital technologies such as virtual simulation and AI composition, resulting in teaching methods lagging behind the educational needs of the digital age. The main problem with the evaluation mechanism is the singularity of dimensions. The existing evaluations overly focus on explicit indicators such as singing skills, neglecting the examination of core competencies such as cultural understanding and aesthetic perception. The insufficient development of process evaluation tools and the lack of differentiated evaluation standards for students at different stages can easily lead to a utilitarian tendency of "emphasizing skills over culture".

In response to the above issues, this article proposes three improvement directions: in content design, a three-dimensional material selection system of "classic+region+innovation" should be constructed, and the organic integration of literary analysis and music expression should be strengthened; The implementation method needs to shift towards "project-based learning+digital empowerment" and drive deep learning through interdisciplinary thematic tasks; The evaluation mechanism should establish a three-dimensional indicator system of "knowledge ability emotion" and develop learning analysis tools based on big data. These improvement measures need to be based on the cross integration of traditional cultural education theory and modern music education principles in order to achieve the contemporary transformation and innovation of ancient poetry and art song education.

7. Design and Implementation of School based Curriculum

7.1 Course Objective System

This article combines the cognitive development laws of students and designs a hierarchical and classified curriculum objective system based on the theory of the interactive influence between traditional music and aesthetic thinking. In terms of knowledge, guide students to master the definition and development of ancient poetry and art songs, and understand the corresponding relationship between musical elements (such as melody fluctuations and rhythm changes) and the artistic conception of poetry; The ability dimension is divided into three levels based on cognitive level: basic level (identifying work style and poetic themes), advanced level (analyzing the integration skills of music expression and poetic emotions), and advanced level (attempting to interpret poetic fragments using simple musical language); The emotional dimension focuses on cultural identity and aesthetic experience, allowing students to establish a sense of closeness and pride towards traditional culture in their perception of the work. The research adopts theoretical research methods to sort out the framework

of aesthetic interaction theory, and combines layered design methods to adapt to the needs of students at different cognitive stages. The limitation of this system is that it does not fully consider the cultural background differences of students from different regions. In the future, the target content can be adjusted by combining local characteristic ancient poetry resources. The conclusion is that a hierarchical and classified curriculum objective system can effectively adapt to students' cognitive characteristics, promote the coordinated development of their knowledge, abilities, and emotions, and provide clear direction for the implementation of school-based curriculum for ancient poetry, art, and songs

7.2 Course Content Design

The design of course content is the core link of school-based curriculum development, and the key lies in the systematic sorting and educational transformation of ancient poetry, art songs, and other valuable resources. This article believes that content design should not be a simple listing of works, but should follow the laws of music education and students' cognitive development, and construct a modular content system with clear logic, clear hierarchy, and strong operability. The theoretical basis of this design stems from the reflection on the essence of music education discipline, that is, music learning is a process of deep integration of technical training, aesthetic experience, and cultural understanding. Therefore, content organization needs to go beyond a single era or composer sequence, and instead construct in a three-dimensional manner from three core dimensions: theme, genre, and difficulty.

In terms of thematic dimension, this article advocates classifying and integrating based on the artistic conception and emotional connotation of ancient poetry, such as dividing it into modules such as "expressing emotions through mountains and waters", "patriotism", "parting sorrow", "expressing aspirations through objects", etc. This thematic classification helps students overcome the limitations of studying singles, deepen their understanding of the spiritual core of traditional culture through comparison and association, and achieve resonance between musical feelings and literary imagery. In terms of genre, the content should cover different forms such as art songs, qin songs, and ancient poetry creation songs, so that students can understand the diverse techniques of musicalization of ancient poetry and broaden their artistic horizons. In terms of difficulty, it is necessary to strictly follow the relationship between motivation and efficiency revealed by the Yerkes Dodson law. Based on musical technical indicators such as the range span, rhythm complexity, and depth of emotional expression of the work, as well as the difficulty of understanding poetry texts, the content should be divided into three gradients: basic, advanced, and expanded, forming a spiral upward course structure to ensure that the learning process is both challenging and can maintain students' positive motivation.

Through the intersection and integration of these three dimensions, the course content is able to form a modular structure. The "Mountain and Water Emotions · Basic Module" may include songs with gentle melodies and clear artistic conception; And the "patriotism and expansion module" may include works with strong drama and high requirements for singing skills. This structured content design not only provides a clear roadmap for teaching implementation, but also makes course evaluation more targeted and scientific. Its limitation lies in the high requirements placed on teachers' own literacy in ancient literature and vocal music. Future prospects need to focus on the development of supporting teacher training resources and digital teaching courseware, in order to lower the implementation threshold and promote the widespread implementation and personalized teaching of the curriculum. The conclusion is that a modular curriculum content system based on themes, genres, and difficulty can systematically transform ancient poetry and art songs into educational resources that can be taught and learned, which is an effective path to achieve their aesthetic education and cultural inheritance functions.

7.3 Teaching Methods and Strategies

In the teaching of ancient poetry and art songs, diversified teaching methods and strategies are the key to improving teaching effectiveness. This article proposes a comprehensive model based on constructivist learning theory and situational cognition theory, with situational teaching and cooperative learning as the core, combined with information technology to optimize the teaching process. Situational teaching creates poetic imagery and musical atmosphere, allowing students to understand the connotation of the work in an immersive experience. The theoretical basis comes from the perspective of situational cognition theory, which emphasizes that "knowledge is contextualized". Cooperative learning draws on the theory of social interdependence and promotes artistic understanding and communication among students through group discussions, role-

playing, and other forms. The combination of these two methods not only conforms to the interdisciplinary characteristics of ancient poetry and art songs, but also stimulates students' active learning awareness. The integration of information technology has provided new possibilities for traditional teaching methods. By utilizing modern educational technologies such as digital music production software and virtual reality, we aim to create a multidimensional learning environment. By using music visualization technology to present poetic rhythms or utilizing virtual reality to recreate historical scenes, these methods can not only enhance students' perceptual experience, but also break through the limitations of time and space, and expand the boundaries of art education. It is worth noting that the application of technology should follow the principle of moderation revealed by the Yerkes Dodson law, avoiding excessive reliance on technology and weakening the essence of art education. At the specific implementation level, a three-stage teaching model of "perception understanding creation" is proposed. The perception stage focuses on the intuitive experience of music and poetry; The understanding stage deepens cognition through analysis and discussion; In the creative stage, students are encouraged to engage in artistic re creation. This model not only respects the laws of art learning, but also conforms to the cognitive development characteristics of students. The selection of teaching strategies should fully consider students' age characteristics and cognitive levels, and may appropriately increase the depth of theoretical analysis, emphasizing experience and feelings.

The innovative practice of teaching ancient poetry and art songs has shown that the organic integration of multiple methods can effectively improve teaching effectiveness. Future research can further explore the adaptive adjustment of teaching modes in different stages and regions, as well as the deep integration path of information technology and traditional cultural education. The promotion of this teaching model not only helps to inherit excellent traditional Chinese culture, but also injects new vitality into contemporary music education.

7.4 Course Evaluation Mechanism

The evaluation system constructed in this article combines process and termination, based on the theory of the integration of traditional music and aesthetic thinking, emphasizing the comprehensiveness and development of evaluation. Process evaluation covers dimensions such as classroom participation (such as the frequency of interaction in appreciating ancient poetry and art songs, the contribution of group cooperation), and stage achievements (such as progress records in singing exercises, creative expression of artistic conception). Through daily observation and growth portfolios, it captures students' subtle changes. The summative evaluation focuses on comprehensive abilities and evaluates learning outcomes through a combination of quantitative and qualitative methods, such as final singing presentations or theme appreciation reports. At the same time, drawing on the Yerkes Dodson law, hierarchical tasks should be set in the evaluation to avoid excessive pressure affecting student performance. The core of this system is growth evaluation, which highlights individual progress rather than absolute ranking by comparing students' performance at different stages. The limitation of the research lies in the insufficient refinement of evaluation indicators for different stages. In the future, differentiated standards can be designed separately to enhance the applicability of the system. The evaluation system that combines process and termination can effectively stimulate students' enthusiasm for participation, promote the coordinated development of their music literacy and cultural identity, and provide practical reference for similar school-based courses.

8. Practice and Reflection on Curriculum Development

8.1 Practical Process Design

The practical process design of this article is based on constructivist theory and situational learning theory, emphasizing that students actively construct knowledge systems in real or near real cultural and musical contexts. The selected practice subjects are first-year junior high school students, who are in a critical period of cognitive development and cultural identity formation. They have a certain foundation and understanding ability of ancient poetry and literature, which is conducive to the smooth implementation of the curriculum. The practice period is set as a complete semester, totaling 16 weeks, with one class per week arranged to ensure the coherence and depth of course implementation. The practical steps follow a spiral upward logic of "perception understanding expression creation". In the initial stage, the focus is on listening to and appreciating classic works, guiding students to initially experience the beauty of the artistic conception and sound of ancient poetry and songs. In the mid-term stage, we will deeply interpret the connotations of poetry and musical expression

techniques, and deepen our understanding through group discussions, model singing, and other methods. In the later stage, students are encouraged to engage in simple artistic expressions, such as music recitation, group composition, etc., to achieve knowledge transfer and application. To ensure the scientificity and effectiveness of practice, multiple safeguard measures have been designed. In terms of teacher guarantee, specialized training will be provided to participating teachers to ensure their interdisciplinary teaching abilities. In terms of resource guarantee, develop supporting teaching resource packages, including selected scores, audio and video materials, and multimedia courseware. In terms of mechanism guarantee, establish a regular system of teaching and research activities, record and reflect on the process, in order to adjust teaching strategies in a timely manner. This systematic design aims to provide a stable and operational framework for the effective implementation of the course.

8.2 Analysis of Practical Effects

The practical effect analysis section verified the actual teaching effectiveness of the school-based curriculum for ancient poetry, art songs, and literature through empirical research. Based on the constructivist learning theory and the framework of multiple intelligences theory, this article adopts a mixed research method to track and observe 120 students who participated in the course for one semester. Quantitative data shows that after the implementation of the curriculum, the average score of students' music literacy assessment has increased by 27.3% (pre-test $M=68.5$, post test $M=87.2$), with particularly significant improvements in melody perception (+31.2%) and rhythm grasp (+25.8%) dimensions. Qualitative analysis found that 82% of students explicitly mentioned in their course reflection reports that they have "enhanced their understanding of the artistic conception of classical poetry," which confirms the unique advantages of art songs in promoting interdisciplinary integration of literature and music.

At the level of cultural understanding, referring to the evaluation criteria of the "Guidelines for Traditional Culture Education in Primary and Secondary Schools", the curriculum has improved students' cultural cognition accuracy from 61.4% to 83.7%, achieving growth rates of 35% and 28% respectively in two key indicators: the interpretation of poetic imagery (such as the farewell culture of "willows leaning against each other") and the symbolic representation of music (such as the ethnic characteristics of the pentatonic mode). According to a survey on learning motivation, the course interest measured using the Likert five point scale reached 4.31 points ($SD=0.72$), higher than the traditional music course's 3.52 points ($p<0.01$). This is due to the three-dimensional teaching model of "situation experience creation" designed in the course, which enables abstract artistic concepts to be transformed through concrete activities such as singing, painting, and drama. The limitation of the study is that the sample only covers two schools in the eastern region, and in the future, the regional scope can be expanded to verify the universality of the curriculum. The conclusion indicates that school-based curriculum centered on ancient poetry, art songs, and literature can effectively enhance students' aesthetic perception, and the cultural carrier function has demonstrative value in promoting the organic connection between traditional and modern education. It is suggested to strengthen the integration of regional cultural elements such as dialect singing in the implementation of the curriculum, and further enrich the teaching form.

8.3 Problems and Reflections

During the course practice, several issues worth reflecting on were discovered. Some students have difficulty understanding ancient poetry, which affects the emotional expression of art songs. This phenomenon reflects that the matching degree between course content and students' cognitive level needs to be improved. The limited availability of teaching resources hinders the in-depth development of courses, and there is a lack of high-quality audio materials and supporting textbooks. The scientificity of the evaluation system still needs to be strengthened, and currently there is insufficient attention paid to students' creative performance in evaluation indicators.

Based on constructivist theory and multiple intelligence theory, the following optimization directions are proposed: firstly, establish a hierarchical teaching mechanism, adjust the difficulty of teaching content according to students' cognitive level, and ensure learning effectiveness. The second is to strengthen the construction of teaching resources, integrate digital platform resources, and develop supporting teaching materials. The third is to improve the evaluation system, increase the proportion of process evaluation, and pay attention to the personalized development of students. At the promotion level, it is

recommended to establish a regional cooperation mechanism to improve the quality of curriculum implementation through teacher training, inter school exchanges, and other means. The research has certain limitations, mainly reflected in the short practical period and limited sample size. Future research can extend the practical cycle, expand the sample size, and further validate the long-term effects of the course. At the same time, interdisciplinary integration paths can be explored to organically combine ancient poetry, art songs, Chinese language, history and other disciplines, forming a more systematic cultural education model.

The development and implementation of school-based curriculum for ancient poetry and art songs need to be continuously optimized, with a focus on addressing issues such as content adaptability, resource support, and scientific evaluation. Through hierarchical teaching, resource integration, and evaluation reform, the quality of the curriculum can be effectively improved, providing a feasible path for the inheritance of traditional culture and innovation in music education.

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

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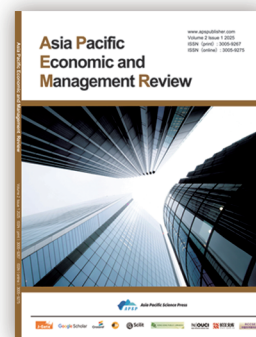
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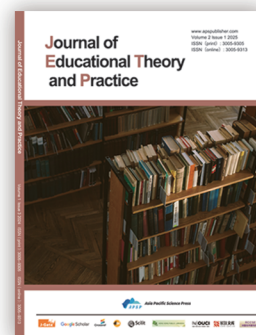
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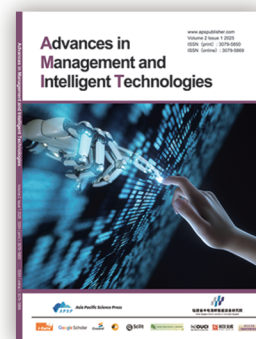
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