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Assessing Intercultural Communicative Competence in Business English Classrooms in Chinese Universities: Challenges, Strategies, and the Measurement Gap

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Abstract: The development of Intercultural Communicative Competence (ICC) is increasingly recognized as a defining goal of Business English education, yet a persistent gap exists between this ambition and classroom reality in Chinese universities. While prior reviews have cataloged challenges and proposed pedagogical strategies, the field has largely neglected the question of how ICC should be measured—leaving teachers without the evaluative tools needed to know whether their instruction is working. This review reframes that measurement gap as the central problem. Drawing on studies published between 2015 and 2025, the paper first maps three structural challenges to ICC development in Chinese Business English contexts: limited culturally-situated communicative experience, the communicative constraints imposed by high-context norms and face maintenance, and motivational and pedagogical distortions produced by exam-oriented schooling. It then evaluates four teaching strategies—authentic materials and case studies, role-play and simulation, intercultural comparison tasks, and project-based learning—not in isolation but in terms of their compatibility with realistic assessment. The review argues that assessment is not a secondary concern to be addressed after teaching design is settled; it is the architectural constraint that determines whether ICC instruction can be held accountable. The paper proposes a multi-method assessment framework integrating portfolio evidence, rubric-based performance assessment, and validated self-report instruments, and identifies specific priorities for empirical research in the Chinese Business English context.

Keywords: Intercultural communicative competence; ICC assessment; Business English; Chinese higher education; Cross-cultural communication; Portfolio assessment; Performance rubrics

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1. Introduction

The capacity to communicate effectively across cultural boundaries has become a practical requirement

for Chinese graduates entering international business. This has made the development of Intercultural Communicative Competence (ICC)—defined by Byram (1997) as the integrated ability to deploy cultural knowledge, skills, and reflective attitudes in real communicative encounters—a central objective of Business English programs across Chinese universities ^[1]. Yet the gap between this stated objective and measurable student outcomes remains wide. Survey evidence suggests that many graduates enter professional settings with limited ability to navigate real cross-cultural interactions despite years of formal instruction ^[2–3].

The literature on how to narrow this gap has grown substantially. Researchers have proposed and evaluated a range of pedagogical strategies, from case-based learning and simulation to project-based approaches, and have documented the structural challenges that make ICC instruction difficult in the Chinese university context. This body of work is valuable, but it has a characteristic blind spot: it rarely addresses assessment. Strategy recommendations are made without specifying how teachers should know whether those strategies have worked. Published reviews of ICC pedagogy in China consistently note that conventional written examinations dominate classroom practice and are ill-suited to measuring intercultural performance, but they do not move systematically toward solutions ^[3–5].

This remark shows that the discrepancy in evaluation is not a trivial matter but the principal obstacle for responsible ICC instruction. If the teachers cannot precisely judge the students' progress in ICC, they cannot evaluate their own teaching, justify the cost of the curriculum, or provide the students with appropriate suggestions for improvement. The absence of proper assessment tools keeps the objectives of ICC unfulfilled.

The paper is arranged as follows. In Section 2, the impacts of three structural problems on the development of International Corporate Communication (ICC) in Chinese Business English settings are investigated, emphasizing the difficulties these issues cause in both teaching and evaluation. Section 3 evaluates four major educational approaches, considering their instructional effectiveness as well as their suitability for practical ICC assessment. Section 4 deals with the issue of evaluation, reviews the existing instruments, and recommends a multi-method framework appropriate for the Chinese Business English classroom. Section 5 concludes the findings and offers research directions.

2. Structural challenges to ICC development in Chinese Business English contexts

2.1. Limited culturally-situated communicative experience

Many Chinese university students enter Business English programs with minimal direct exposure to intercultural interaction. Their understanding of international business communication is typically mediated by textbooks and mass media rather than by lived experience, producing cultural knowledge that is, in Holliday's (2010) terms, "essentialist"—coherent in the abstract but brittle in specific situations ^[6]. Research consistently distinguishes between declarative cultural knowledge (knowing that communication norms differ across cultures) and the procedural competence to act on that knowledge in real encounters ^[7–8]. Students who can describe Hofstede's (1991) power distance dimension in an examination may still fail to recognize and adapt to its manifestations in a live negotiation ^[9].

This challenge has been exacerbated by the structural conditions of Chinese higher education. With large class sizes—often forty to sixty students per section—and limited instructional contact hours for Business English, authentic interactional practice is difficult to create at scale ^[10–11]. The problem is compounded by a curriculum that historically privileged linguistic accuracy over communicative performance: students have been evaluated on what they know rather than on what they can do with what they know ^[3].

Recent developments in educational technology have partially addressed this challenge. Online intercultural exchange platforms and telecollaboration projects—in which students at one university interact synchronously or asynchronously with students or professionals at institutions in other countries—can provide authentic cross-cultural communicative experience within standard course structures^[12–13]. A systematic review by O’Dowd (2021) covering 65 telecollaboration studies found consistent positive effects on cultural awareness and willingness to engage across difference, with the most robust gains in programs that incorporated structured reflection alongside interaction^[14]. The implications for Chinese Business English contexts are significant, but uptake remains limited, and the evidence base specifically from Chinese university settings is still developing^[15].

The assessment implication of this challenge is direct: if students lack authentic communicative experience, tests that measure factual cultural knowledge will overestimate their functional ICC. Assessment approaches need to capture what students can do, not merely what they know, and need to be sensitive to developmental change over the course of a semester or program rather than measuring a single-point snapshot.

2.2. Communicative constraints from high-context norms and face maintenance

The structural features of Chinese communication culture create distinctive difficulties for ICC instruction that go beyond the problem of exposure. Hall’s (1976) characterization of Chinese communication as high-context—meaning that significance is conveyed substantially through relational context, implicit cues, and shared understanding rather than through explicit verbal content—remains influential, though researchers have emphasized that it describes tendencies rather than uniform behavior and should not be applied prescriptively to individuals^[6 + 16–17].

For Business English instruction, the most consequential manifestation of high-context communication norms is the management of disagreement and negative response. In Chinese business settings, direct refusal is often communicated through formulas that preserve the face of both parties—what Ting-Toomey and Kurogi (1998) describe as a mutual face-maintenance orientation. A statement such as “this may present some difficulties” can function as a firm refusal, and its indirectness is not evasion but a recognized communicative convention. In low-context business environments, the same statement may be processed as expressing uncertainty or inviting negotiation^[18]. The pedagogical challenge is to help students recognize this mismatch and develop the flexibility to operate across both conventions without abandoning their own communicative resources.

Face concerns also affect the classroom dynamics of ICC instruction directly. Activities that require students to express strong opinions, deliver critical feedback to peers, or enact confrontational business scenarios may induce avoidance behavior that teachers can misread as disengagement or lack of preparation^[19]. A study by Korzilius et al. (2017) examining Chinese managers in international business contexts found that face-maintenance orientations persisted even among professionals with substantial international experience, suggesting that the challenge is not simply one of novice unfamiliarity but reflects durable communicative preferences.

This has direct implications for simulation-based and role-play activities, which are among the most commonly recommended ICC pedagogical tools. If students consistently underperform in such activities not because of limited ICC but because of discomfort with the interactive format, assessment rubrics calibrated to

low-context communicative norms will systematically underrate their competence. Culturally fair assessment design must account for this.

2.3. Motivational and pedagogical distortions from exam-oriented schooling

The third challenge is systemic. Chinese students who have passed through a twelve-year examination-oriented educational pipeline arrive at university with well-established learning orientations shaped by that experience: learning is primarily understood as the acquisition and reproduction of testable content; activities without clear examination relevance are treated as supplementary or optional; and risk-taking in communicative performance—essential for ICC development—conflicts with a culturally reinforced orientation toward correctness and the avoidance of visible error ^[10, 20].

Dörnyei and Ushioda's (2021) updated motivational self system framework offers a useful lens for understanding this challenge ^[21]. Students who cannot form a vivid “ought-to L2 self” in which intercultural communicative ability figures prominently will not invest the effort ICC development requires. Xiao and He (2008) found that when students were helped to make a concrete connection between ICC skills and their envisioned professional futures, motivational engagement with communicative activities increased measurably. This suggests that motivational reorientation—rather than pedagogical technique alone—is a precondition for effective ICC instruction.

A 2023 mixed-methods study of Business English students at four Chinese universities by Chen and Starkey found that students who received explicit career-linked framing for ICC activities showed higher sustained engagement and greater self-reported confidence in intercultural situations than a control group receiving the same activities without framing. Effect sizes were moderate but consistent. The motivational challenge is therefore not insuperable, but it requires deliberate instructional design rather than the assumption that communicative activities will generate their own motivation.

The assessment dimension of this challenge is significant. In an exam-oriented culture, students take seriously what is assessed and discount what is not. If ICC is declared as a learning objective but remains unassessed—or assessed only through written factual tests—students will rationally allocate effort elsewhere. Making ICC assessment visible, credible, and consequential is therefore not merely a measurement question; it is a motivational one.

3. Teaching strategies for ICC development: Evidence and assessment compatibility

This section evaluates four teaching strategies widely recommended for ICC development in Business English contexts. For each strategy, the review assesses the quality of available evidence for its effectiveness, its specific value in the Chinese university context, and its compatibility with realistic ICC assessment—a dimension that has been largely neglected in prior reviews.

3.1. Authentic materials and case studies

The use of authentic materials—documents, recordings, and texts produced for genuine communicative purposes rather than pedagogical ones—is among the most consistently recommended strategies in Business English teaching. Gilmore's (2007) influential review argued that authentic materials expose students to the natural range of language variation in professional contexts and provide richer input than artificially simplified materials ^[22]. For ICC specifically, case studies that present real or realistic cross-cultural business situations can develop students'

ability to analyze cultural factors and reason about communicative choices ^[5, 23].

Recent evidence has refined understanding of how case-based teaching works best. A meta-analysis by Kim et al. (2022) covering 47 studies of case-based instruction in business education found significant positive effects on analytical thinking and cross-contextual transfer when cases included structured post-analysis reflection, but near-zero effects when cases were used primarily as content delivery vehicles ^[24]. The implication for Chinese Business English contexts is that the discussion and reflection surrounding a case study—including explicit attention to how cultural factors shaped the outcome—matters more than the case material itself.

An underaddressed limitation in the existing literature is the cultural provenance of available case materials. Most published Business English case studies are drawn from North American and Northern European business contexts, which means they frame cross-cultural challenges from a Western standpoint. Chinese students benefit more from cases involving Chinese companies navigating international partnerships—particularly with partners from Southeast Asia, the Middle East, and Africa, regions where Chinese enterprises have significant engagement through Belt and Road-linked activity ^[15]. The development of China-centered case study libraries is an identified priority for the field.

From an assessment standpoint, case studies are well-suited to evaluating ICC-relevant analytical abilities: the quality of a student’s written or oral analysis of a cross-cultural business situation can be assessed using rubrics that capture cultural reasoning, perspective-taking, and the ability to propose contextually appropriate communicative strategies. This makes case-based work one of the most assessable ICC pedagogical tools available.

3.2. Role-play and business simulation

Role-play and extended business simulation are among the most widely used communicative activities in Business English instruction, and their potential contribution to ICC development is well-established in theory. By placing students in simulated cross-cultural business scenarios, these activities can provide structured practice in navigating communicative difference under conditions that allow for reflection and revision ^[25–26]. The critical element—consistently identified in recent research—is the quality of the debriefing discussion that follows the activity, not the activity itself.

A study by Sato and Loewen (2022) examining the relationship between simulation debriefing quality and subsequent ICC performance found that students who participated in structured, teacher-facilitated reflection on cross-cultural episodes during debriefing showed significantly greater improvement on a performance-based ICC measure than students whose debriefs were unstructured or student-led ^[27]. This finding has direct practical implications: teachers who use simulation as an ICC tool need training in debriefing facilitation, not just in simulation design.

The face-maintenance concerns discussed in Section 2.2 create a specific pedagogical tension in Chinese Business English classrooms. Activities that require students to enact confrontational or high-stakes communicative scenarios—such as a negotiation where one party must maintain a firm refusal or deliver critical feedback—may induce avoidance that compromises the learning value of the activity. Liu and Littlewood (1997) documented this pattern in Chinese EFL contexts, and more recent evidence from Wang and Li (2021) suggests that graduated exposure—beginning with highly structured, low-stakes scenarios before moving to more open-ended interactions—reduces avoidance behavior while preserving the

communicative challenge^[28].

The assessment challenge associated with role-play and simulation is significant but manageable. Real-time performance assessment using behavioral rubrics can evaluate how students manage cultural differences in interaction. The most robust rubric frameworks for ICC performance—including those developed by Fantini (2009) and adapted for Chinese learners by Zhong et al. (2013)—assess communicative flexibility, awareness of interactional dynamics, and the ability to repair or recover from cross-cultural misalignments. These dimensions are directly observable in simulation activities, making them assessable in ways that written tests cannot replicate.

3.3. Intercultural comparison tasks

Intercultural comparison tasks ask students to identify, analyze, and critically reflect on differences between their own and other business communication practices. These tasks can range from comparative analyses of business correspondence from different cultural contexts to structured reflection activities in which students examine their own communicative assumptions. Their primary value lies not in delivering cultural information but in developing the reflective disposition that Byram (1997) terms “critical cultural awareness” (*savoir s’engager*): the capacity to evaluate one’s own and others’ cultural practices from a principled rather than unreflective standpoint.

Kramsch’s (1993) concept of the “third place” in intercultural language learning remains theoretically significant here^[29]. ICC instruction does not aim to replace students’ existing communicative identities with target-culture norms; it aims to develop a reflective perspective from which students can operate effectively across cultural contexts while maintaining their own communicative agency. Comparison tasks, when well-designed, can cultivate this perspective. When poorly designed—particularly when they present cultures as monolithic and internally uniform—they can entrench the essentialist cultural stereotypes they are meant to displace^[6].

Recent research on digital intercultural comparison tasks has extended the possibilities of this approach. Helm (2020) documented the use of structured online discussion forums to support asynchronous intercultural comparison across universities in multiple countries, finding that students who participated in facilitated comparative discussion showed greater gains on measures of perspective-taking than those who received teacher-presented cultural information. The asynchronous format reduced the performance pressure associated with real-time interaction, which may make it particularly suitable for students with high face-maintenance orientations.

Comparison tasks are relatively straightforward to assess: written comparative analyses can be evaluated using rubrics that assess the quality of cultural reasoning, the degree to which students move beyond surface-level generalizations, and the explicitness of self-reflection. This makes them a practical component of portfolio-based ICC assessment, discussed further in Section 4.

3.4. Project-based learning

Project-based learning (PBL) offers the most extended and contextually rich environment for ICC development available within standard course structures. By asking students to work collaboratively on real-world problems over multiple weeks, PBL provides sustained engagement with the kinds of communicative challenges—ambiguity, negotiation, conflicting perspectives, and the need to coordinate across difference—

that characterize actual international business work ^[30–31]. Stoller's (2006) review of content-based and project-based language teaching found positive effects on learner autonomy and intrinsic motivation, both of which are important preconditions for genuine ICC development ^[32].

More recent evidence has refined understanding of the conditions under which PBL supports ICC development specifically. A study by Zhang and Stoller (2020) in Chinese university English classrooms found that PBL projects which included explicit intercultural dimensions—such as comparative research on business practices in different national contexts, or preparation of materials for a foreign client—produced significantly greater gains on ICC measures than generic project work ^[33]. The explicit interculturality of the project, rather than its extended format per se, drove the ICC-relevant learning.

Two implementation challenges are particularly salient in the Chinese university context. First, PBL requires students to exercise initiative, manage ambiguity, and make independent decisions—behaviors that may conflict with educational dispositions shaped by exam-oriented schooling ^[10]. Krajcik and Shin (2014) recommend a scaffolded PBL implementation model in which teachers provide extensive structure and milestones early in the project and gradually withdraw support as students develop confidence ^[34]. Chen and Starkey's (2023) study found that explicit scaffolding in the first third of a PBL project was a significant predictor of successful completion and ICC gain ^[35].

Second, the collaborative elements of PBL projects are shaped by group dynamics that may be influenced by face-maintenance concerns and hierarchical norms. Group members may be reluctant to challenge each other's ideas openly, leading to consensus-by-default rather than genuine collaborative reasoning. Teachers should design peer feedback structures explicitly and, where possible, create low-stakes practice opportunities for critical dialogue before the main project begins.

From an evaluation viewpoint, PBL is the most strenuous and beneficial assessment situation. It produces various kinds of assessable materials such as process records, intermediate results, final reports and reflective diaries, which enable the teacher to assess the development of ICC throughout the project, not only at a certain moment. The difficulty lies in the construction of rubrics and assessment methods which can evaluate this development accurately and quickly under the realistic constraints of workload.

4. The measurement gap: Toward a framework for ICC assessment in Chinese Business English classrooms

The central argument of this review is that the development of reliable, practical ICC assessment tools is the most important unresolved problem in Business English education in Chinese universities. This section develops that argument in four parts: it characterizes the nature and scale of the current gap; reviews three categories of available assessment approaches; identifies the specific constraints of the Chinese Business English classroom context; and proposes a multi-method assessment framework.

4.1. The scale and consequences of the assessment gap

Gu's (2016) survey of over 1,170 EFL teachers at Chinese universities provides the most comprehensive empirical documentation of the assessment gap. Gu found that while the large majority of surveyed teachers expressed belief in the importance of ICC assessment, the vast majority continued to rely on written vocabulary and grammar examinations that were not designed to capture intercultural communicative performance. Many teachers reported uncertainty about what ICC assessment should look like in practice,

and most reported receiving no formal training in ICC assessment methods.

The consequences of this gap are not merely technical. As argued in Section 2.3, in an examination-oriented educational culture, students allocate effort to what is assessed. When ICC is declared as a learning objective but measured only through conventional tests—or not measured at all—students receive a clear signal that the intercultural dimension of their Business English course is not consequential. This institutional signal systematically undermines the motivational interventions discussed in Section 2.3 and Section 3.

The measurement gap also makes it difficult to evaluate the effectiveness of pedagogical strategies. The existing literature on ICC teaching strategies in Chinese Business English contexts relies heavily on self-report and convenience samples, with relatively few studies employing pre-post designs with validated ICC measures^[15]. Without reliable measurement, it is not possible to determine which strategies work, for which students, and under what conditions—the questions that would make the research literature most useful to practitioners.

4.2. Available assessment approaches

Three categories of ICC assessment tools are relevant to the Chinese Business English context: validated self-report instruments, performance-based assessment with rubrics, and portfolio-based assessment.

Validated self-report instruments provide a standardized basis for measuring students' self-assessed ICC across defined dimensions. Several instruments have been developed specifically for Chinese learners. Zhong et al.'s (2013) Intercultural Communicative Competence Self-Rating Scale (ICCS-SRS) was designed for Chinese English major undergraduates and covers the attitudinal, knowledge, and skills components of Byram's (1997) model. Fantini and Tirmizi's (2006) YOGA (Your Objectives, Guidelines, and Assessment) form takes a different approach, using goal-setting and reflective self-assessment as a developmental tool rather than a summative measure^[36]. More recently, Deardorff's (2011) process-oriented ICC model has informed several instruments that attempt to capture the dynamic, situated nature of intercultural competence rather than treating it as a fixed set of traits^[37].

Self-report instruments have well-known limitations: they measure what students believe about their own competence, not what they can actually do in interaction. They are also subject to social desirability effects. Despite these limitations, they serve an important function as low-cost, scalable pre-post measurement tools that can track development over a semester and provide students with structured self-reflection prompts. Fantini (2009) recommends treating self-report instruments as one component of a multi-method assessment approach rather than as standalone evaluations.

Performance-based assessment uses direct observation of student behavior in communicative tasks—most commonly role-play or simulation activities—evaluated against rubrics designed to capture ICC-relevant dimensions. The most developed rubric frameworks for ICC performance include Fantini's (2009) multi-dimensional assessment guide, the rubrics developed by the Association of American Colleges and Universities (AAC&U) Intercultural Knowledge and Competence VALUE rubric, and the adapted versions of Byram's (1997) model proposed by Zhong et al. (2013) for Chinese learners^[38]. These rubrics typically assess dimensions including cultural knowledge, perspective-taking, communicative flexibility, and the ability to manage cross-cultural episodes productively.

Performance-based assessment is resource-intensive: assessing each student individually during a simulation activity is time-consuming and requires teacher training in rubric application. Peer assessment and

co-assessment—in which students apply rubrics to evaluate each other’s performance—can reduce teacher workload while also contributing to ICC development, since evaluating others’ cross-cultural behavior requires the same analytical perspective-taking that ICC requires in production. However, face-maintenance concerns may affect the quality of peer feedback in Chinese classroom contexts, and peer assessment procedures need to be designed with this in mind.

Portfolio-based assessment asks students to compile structured collections of evidence documenting their ICC development over time. A typical ICC portfolio for a Business English course might include written analyses of case studies, reflection journals from simulation activities, self-assessments using a validated instrument, and a capstone reflective essay in which the student analyzes their own development across the course. Liddicoat and Scarino (2013) argue that portfolio assessment is particularly well-suited to ICC because it captures developmental processes rather than single-point performance and creates opportunities for the self-reflection that is central to ICC development itself^[39].

Recent evidence on portfolio-based ICC assessment in Asian higher education contexts is encouraging. A study by Lee and Song (2023) comparing portfolio and examination-based assessment of ICC in Korean and Chinese university EFL courses found that portfolio assessment groups showed greater gains on validated ICC measures at follow-up than examination groups, with the largest difference in the reflective and attitudinal dimensions of ICC^[40]. Importantly, qualitative data from the study indicated that the portfolio process itself—particularly the requirement to write reflective entries—was experienced by students as a meaningful learning activity rather than merely an evaluation exercise.

4.3. Constraints and adaptations for Chinese Business English contexts

Any proposal for improved ICC assessment in Chinese Business English classrooms must be realistic about the constraints of that context. Class sizes of forty to sixty students, limited contact hours (typically two to four per week), and institutional assessment cultures centered on standardized examinations all constrain what is feasible. Assessment approaches that are theoretically appropriate but practically unimplementable will not be adopted.

Three adaptations are particularly important. First, assessment methods must be integrated into existing course structures rather than added as supplements. Portfolio tasks, for example, should replace or transform existing writing assignments rather than being added to them. Second, rubrics should be designed for efficiency as well as validity: a rubric with five to seven dimensions that can be applied in ten to fifteen minutes per student is more likely to be used consistently than a theoretically comprehensive instrument that requires forty-five minutes per assessment. Third, peer and self-assessment components should be scaffolded explicitly, with training sessions and model examples, particularly in contexts where students have limited prior experience with reflective or evaluative activities.

Teacher training is a prerequisite for assessment reform. Gu’s (2016) finding that most teachers lack confidence in ICC assessment methods points to a professional development need that neither curriculum reform nor new assessment tools can address on their own. University-level professional development programs for Business English teachers should incorporate ICC assessment design as a core component, and this need should be reflected in the priorities of teacher education programs and continuing education providers.

4.4. A proposed multi-method assessment framework

Drawing on the evidence reviewed above, this paper proposes a multi-method ICC assessment framework organized around three complementary components, designed to be implementable within realistic Chinese Business English course structures.

The first component is a validated self-report instrument administered at the beginning and end of the course. For Chinese Business English learners, Zhong et al.'s (2013) ICCS-SRS provides a normed baseline appropriate to the population; teachers who wish to track attitudinal development specifically may supplement this with adapted items from Deardorff's (2011) process model. Pre-post comparison provides evidence of change across the course and gives students a structured framework for understanding their own development.

The second component is a structured ICC portfolio maintained throughout the course. The portfolio should include at minimum: (a) written analyses of two or three case studies, evaluated using a rubric assessing cultural reasoning quality; (b) reflection journal entries from role-play and simulation activities, prompting students to identify cross-cultural episodes and analyze them explicitly; and (c) a capstone reflective essay of approximately 800 to 1,000 words in which students evaluate their own ICC development and identify areas for continued growth. Portfolio tasks should be distributed across the semester, graded against clear rubrics shared with students in advance, and include formative feedback at interim submission points.

The third component is a performance-based assessment conducted during a role-play or simulation activity near the end of the course. Teachers evaluate students' ICC performance using a simplified version of an established rubric—five to seven dimensions are recommended for efficiency—covering cultural knowledge application, communicative flexibility, and repair behavior. Where class sizes make individual teacher assessment impractical, structured peer assessment using the same rubric can supplement or partially replace teacher assessment, with appropriate training and moderation.

These three components together address the full range of ICC dimensions defined by Byram (1997)—attitudes, knowledge, skills of interpreting and relating, skills of discovery and interaction, and critical cultural awareness—while remaining implementable within the resource constraints of Chinese university Business English teaching. The framework is not offered as definitive but as a basis for empirical evaluation. Studies that test the validity, reliability, and practical feasibility of this framework in Chinese Business English classrooms are a priority for future research.

5. Conclusion

This review has argued that the central problem in ICC development in Chinese Business English classrooms is not the absence of effective pedagogical strategies—the literature has produced a robust toolkit—but the absence of credible, practical assessment tools. Without reliable measurement, ICC objectives remain aspirational rather than operational: teachers cannot evaluate their own instruction, students do not receive meaningful developmental feedback, and the institutional signals of examination-oriented schooling continue to direct student effort away from intercultural learning.

The three structural challenges examined in Section 2—limited culturally-situated communicative experience, high-context communicative norms and face-maintenance pressures, and the motivational and

pedagogical distortions of exam-oriented schooling—each have direct implications for assessment design that prior reviews have not systematically addressed. The four pedagogical strategies evaluated in Section 3 are most effective when they are explicitly integrated with assessment processes: case study analyses that feed portfolio evidence, simulations whose debriefs produce reflection journal entries, comparison tasks that develop rubric-assessed analytical writing, and PBL projects whose multiple deliverables provide rich assessment evidence across the course.

The multi-method assessment framework proposed in Section 4—combining validated self-report instruments, structured portfolio assessment, and rubric-based performance evaluation—offers a practical basis for addressing the measurement gap. Its implementation requires institutional support for teacher professional development in assessment design, and its validity in the Chinese Business English context requires empirical testing. Both of these are tractable priorities.

For Business English teachers in Chinese universities, the practical implication of this review is that the most important single step toward more effective ICC instruction is the introduction of meaningful ICC assessment. When students experience ICC as a genuinely assessed dimension of their course—when they receive rubric-based feedback on their cross-cultural reasoning, maintain portfolios documenting their intercultural learning, and are evaluated on their communicative performance in simulation—the motivational and pedagogical dynamics of the course change. ICC ceases to be a declared objective with unclear consequences and becomes a visible, actionable dimension of learning. This is the precondition for all the other improvements this review has proposed.

Disclosure statement

The author declares no conflict of interest.

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The Symbiosis Exploration of Figurative Form and Abstract

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Abstract: Nowadays, contemporary oil painting creation has entered the stage of multi-integration. The traditional research paradigm of binary opposition and boundary separation between concreteness and abstraction in the past can no longer meet the needs of innovative iteration of oil painting language. In most existing studies, the realistic modeling logic or purely abstract formal laws are explained separately, and the symbiotic mechanism of their coexistence and embedment has not been systematically sorted out. At present, a large number of creative practices have already broken the boundary between the two styles, and completed the collaborative expression of concrete object carriers and abstract formal elements in the same visual plane. Based on the symbiotic relationship as the core research perspective, this paper combs through the theoretical origin and aesthetic characteristics of their symbiosis. It refines the creative path from four dimensions: visual framework of the picture, artistic conception creation, media application, and narrative expression. Combined with typical Chinese and foreign oil paintings, this paper clarifies the complementary logic of concrete bearing narrative and abstract emotion, and proves that their symbiosis is not a superficial form splicing, but an organic unity of visual order and spiritual connotation, which can broaden the expression boundary of contemporary oil paintings and provide targeted theoretical and practical reference for creators.

Keywords: Oil painting creation; Figurative form; Abstract elements; Symbiosis; Visual language

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1. Introduction

In the process of oil painting for hundreds of years, concrete representation and abstract expression have long been regarded as two independent creative paths that are irrelevant. With the continuous updating of the concept of contemporary artistic creation, the single creative mode of pure realism or pure abstraction exposes obvious limitations of expression: realistic works are easy to weaken their spiritual tension because of excessive description of details, and pure abstract works are difficult to establish a stable emotional connection with ordinary viewers, and the integration of concreteness and abstraction has become the mainstream creative direction at present. The underlying logic of their symbiosis is hidden in the Chinese

and Western aesthetic traditions: Western classical oil paintings have their own abstract aesthetic feeling in the form of lines and color blocks, and China's traditional freehand brushwork concept of "similarity and dissimilarity" also provides mature philosophical support for the compatibility of form and meaning. This paper jumps out of the judgment idea of binary opposition, combs the inherent logic and aesthetic characteristics of their symbiosis, and forms a theoretical and practical framework with reference.

2. The theoretical basis and aesthetic connotation of the symbiosis of concrete form and abstract elements in oil painting

2.1. Theoretical origin of the symbiotic relationship between them

The symbiosis of oil painting concreteness and abstraction is not an artificial skill of contemporary creators, but a dual attribute of oil painting media, which connects the Eastern and Western painting systems and traditional aesthetic logic in series.

Although Western classical oil paintings focus on concrete representation, they never deny the independent aesthetic value of abstract forms: in Leonardo da Vinci's modeling discussion, it is clear that lines, light and shade, and color blocks have independent visual rhythm, and the blurred background of classical portraits and the rhythm of clothes pleats are all hidden abstract elements attached to concrete objects. Impressionism completely untied the subordinate orientation of color, and no longer required color to serve only the reproduced images. Cold and warm color blocks and brush strokes directly became emotional outlets. The trees and starry sky in Van Gogh's works were only narrative carriers, and the abstract order built by flowing lines and strong contrasting color blocks was the core of the spiritual expression of the picture.

Oriental philosophy provides a mature theoretical base for this kind of symbiosis: Zhouyi advocates relying on concrete objects to convey feelings, without sticking to the details of complete re-enactment, moderately refining, leaving blank and freehand brushwork to naturally open up the connection channel between realistic modeling and abstract artistic conception. In recent years, domestic creators have explored the path of Chinese and Western integration, implanted the traditional freehand thinking into oil painting creation, and on the premise of retaining the complete image shape, generated random textures by scraping, overlapping, and splashing colors, and built symbiotic creation logic adapted to the local context. The concept of "critical vision" in modern visual theory also proves that both pure concreteness and pure abstraction are extreme expressions, and their coexistence and embedding is the normal state of complete output of painting language^[1].

2.2. The core aesthetic connotation of their symbiosis

The core logic of symbiotic aesthetics is complementary checks and balances, two-way achievement, and there is no antagonistic relationship between one side and the other: the concrete form first covers the basic recognition attribute of the picture, completing the basic function of narrative anchoring and pulling in the distance of the viewer's empathy, while the abstract elements jump out of the limitation of the repetition of objects and images, and assume the role of setting off emotions, lifting artistic conception and polishing the rhythm of exclusive forms. Figurative images help ordinary viewers quickly grasp the creative theme and directly lower the understanding threshold of purely abstract works; Abstraction sifts out the redundant fine details in realistic description, breaks the sense of rigidity in copying reality, digs into the spiritual core under the surface image, and leaves a wider space for the creators to express their emotions.

The combination of the two expressions can produce a balanced texture of reality and reality: the

figurative oil painting without abstract deployment can easily become a meaningless replica of the real scene, with dull pictures and thin visual rhythm; The abstract creation completely divorced from the concrete carrier has no realistic support, and the spiritual output is easy to be vague and empty. The symbiosis mode just neutralizes the shortcomings of the two kinds of creation, embeds abstract languages such as color blocks, lines, textures and deconstruction modeling on the basis of recognizable objects, and finally realizes the coordination and unity of form, meaning and reality, which is also the unique aesthetic characteristic of contemporary oil painting that is different from traditional realism and modern pure abstract creation ^[2].

3. Practical path of symbiosis between concrete form and abstract elements in oil painting creation

3.1. The layered construction of virtual and real vision

The actual painting and drafting stage is completely in line with the landing logic of “building the core skeleton → laying the secondary level → global calibration and fine-tuning.”

The first step is to outline the basic framework of concrete objects in the drafting process: first, determine the core expression object closely following the creative topic, whether it is a figure, a still life or a landscape theme, first accurately determine the external outline and the internal body structure, directly nail down the visual center of the whole painting, and lay a solid foundation by solid realistic modeling to ensure that the recognition of the core visual subject is sufficient, and the subsequent superposition of abstract elements will not disturb the focus logic of the picture at all.

Enter the second step after finalizing the concrete outline of the main body, and implant the abstract visual design along the established composition framework: comb the spatial arrangement of the whole painting with the idea of geometric segmentation, coordinate the background and corner areas with scattered lines, cold and warm color blocks, and the level difference between light and dark, and bring out the natural dynamic rhythm by inserting lines and contrasting color blocks, so as to abstract the non-core expression areas such as distant view, interlining and sky.

In the last step, the proportion of reality and reality in the whole painting is uniformly calibrated: the realistic details of the core image are completely preserved, the depiction accuracy of the secondary image is actively compressed, the blank space of the picture is filled with abstract color blocks and random lines, and the balance between density and movement is smoothed, and the whole visual order is completed. In still life creation, the objects, fruits, and vegetables are molded first, and then the background is reconstructed by painting color blocks and extending lines. In landscape creation, the outline of mountains, rivers, and plants is locked, and then the water and sky are paved with loose texture, all of which are the actual landing of this step-by-step logic ^[3].

3.2. The shaping of the inner spirit of oil painting

The depth description of the picture follows the third-order practical path of “keynote anchoring-layered emotion-artistic conception integration.”

The first stage relies on figurative modeling to anchor the basic emotional tone: to complete the fine shaping of figurative carriers such as the five senses and limbs, regional scenes, natural scenery, etc., to convey the core creative theme through the arrangement logic and morphological characteristics between objects and images, and to build an entity narrative support bearing subjective emotional output ^[4].

After the figuration of the subject is finished, it enters the second stage, and the adaptive abstract technique is applied to complete the emotional contrast in different regions: based on the preset overall spiritual orientation, the marginal blank space and background area of the picture are processed, and if it is necessary to put out warm emotional expression, it can be realized by thick piles of pigments and fragmented staggered strokes; If you want to create a quiet and poetic atmosphere, you can choose the methods of low saturation color blooming and blurring the boundary, and supplement the delicate and hidden emotional dimension that the figurative realistic system cannot carry through differentiated abstraction.

In the final stage, the harmony and unification of the virtual and real atmosphere of the whole picture are completed: the core narrative anchor point of the work is built with concrete modeling, and the coverage ratio and force of the abstract texture in different regions are dynamically calibrated, so that the abstract emotional expression naturally attaches to the concrete carrier to extend and penetrate, and the closed-loop construction of the overall spiritual artistic conception of the picture is completed layer by layer ^[5].

3.3. The differentiation of multi-media materials

The practical application of oil painting materials is promoted by three progressive processes of “functional division-domain modeling-auxiliary material empowerment,” and the process intensity is flexibly adjusted by anchoring the actual and false expression weight of the picture throughout the process, instead of applying a unified material application standard.

The first step is to clearly define the functional area of the canvas: based on the visual weight of the picture, combined with the narrative core anchored in the previous composition, the canvas is divided into three types of blocks: the core subject expression area, the secondary image setting-off area, and the background atmosphere blank area. Different blocks are matched with different material processing logic in advance, and the applicable boundary between realistic figurative modeling and experimental abstract texture is clearly defined from the source to avoid expression conflict between the two languages.

The second step is to create targeted materials in different regions: select the fine tin tube oil painting pigment with moderate coverage in the core main body area, and polish it layer by layer, and then cover the next layer after the oil painting is completely dried, so as to finely output concrete details to ensure the completeness of the recognition of the object outline and structure; In the setting-off areas such as the edge and background of the picture, nonstandard methods such as excessive turpentine diluted pigment splashing, scraper dipping thick pigment stacking, and clean gauze pressing and erasing are used to artificially generate random abstract visual effects such as irregular color blocks without preset feeling, concave-convex texture, blurred diffusion afterimage ^[6].

In the last step, comprehensive auxiliary materials are superimposed to enhance the abstract texture: light auxiliary materials such as toner and fine sand are mixed and sprinkled in the non-core foil area, and a mottled and rough special material layer is generated by relying on the viscosity of semi-dry pigment, and a complementary tension is formed by the abstract effect of natural overflow of material properties and the regular figurative modeling in the core area, and a complete picture of virtual and real symbiosis is finally landed by relying on the material process.

3.4. The construction of multiple narrative spaces

In the final adjustment stage of oil painting pictures, the landing logic is advanced along the path of “core narrative completion-abstract translation of secondary materials-blank boundary calibration,” and the whole

process is closely related to the preset narrative expression target calibration details in the initial stage of creation, so as to avoid invalid changes deviating from the theme in the adjustment process.

The first step is to give priority to the fine polishing of the core concrete narrative image: the characters and scene subjects corresponding to the main line of the story should be supported in detail, and small-scale concrete details such as micro-expressions and personal accessories should be supplemented according to the identity characteristics of the characters, and the complete narrative context should be clearly explained to ensure that the viewer can anchor the story core of the picture at first sight, and the basic framework bearing the narrative function should be firmly tied first.

The second step is to abstract and simplify the non-core picture area: actively cut off unnecessary realistic redundant details in the foreground and edge environment, disassemble scattered objects in corners into geometric lines and flat painted blocks, weaken the straightforward concrete narrative expression by means of boundary rubbing, morphological deconstruction and geometric refining, and leave enough aesthetic margin by abstract processing.

The last step is to adjust the proportion between the narrative content of the whole picture and the blank space: repeatedly debugging the area weight of the concrete narrative plate and the abstract blank space will not make the story convey fuzzy deviation, but also expand the multi-dimensional interpretation possibility of the work by using the elastic space left by the abstraction, and finally build the narrative aesthetic level of the picture ^[7].

4. The deep influence of the symbiosis of concrete form and abstract elements on the development of contemporary oil painting

4.1. Innovating the ontology language of oil painting and breaking through the traditional creative mode

In the previous research context of oil painting creation, the creative path was often artificially divided into two mutually exclusive systems: realism and abstraction. Most creators have long been anchored in the practice of a single path, and it is easy to fall into the solidification dilemma of homogenization of visual language expression. The paradigm of concrete and abstract in symbiotic creation breaks down the traditional barrier between the two systems, deeply embeds the three expression dimensions of realistic modeling accuracy, abstract form tension, and composite material texture, and expands the expression threshold of oil painting ontology language. Creators do not have to make an exclusive choice between the two systems, but can dynamically adjust the proportion of the two elements according to their creative demands, taking into account the ideographic certainty of realistic modeling and the emotional appeal of abstract forms, eliminating the shackles of expression brought by a single creative paradigm, and providing new possibilities for the pluralistic evolution of oil painting visual language ^[8].

4.2. To integrate public aesthetic cognition and create a fault in the spread of refined and popular art

Pure abstract oil painting has stripped off the reference of real objects and images, and it is difficult for ordinary viewers to capture the ideographic core of the creator, which directly opens the cognitive gap between avant-garde creation and mass aesthetics; Traditional realistic oil painting is too obsessed with the accurate reproduction of objects, and it is difficult to match the upgraded aesthetic expectation of

the audience for ingenious form and blank spirit. The works of concrete abstract symbiosis first set up the cognitive steps that are easy for the public to understand with the concrete reality carrier with high recognition, and then pressed the threshold of interpretation to the minimum, and then relied on the nested abstract vocabulary to carry the aesthetic appeal of contemporary people's preference for atmosphere, which can give consideration to both popular communication and artistic professionalism. This kind of work can sink into the aesthetic vision of the general public to complete the transmission of artistic connotation, but also keep the vanguard attribute of modern art, fill in the previous aesthetic fault of refined and popular circles, and help oil paintings achieve a wider range of public communication ^[9].

4.3. Improve the creator's thinking and promote diversified innovation in the oil painting industry

Many oil painting creators have long been trapped in the dilemma of partial creative language: either they are obsessed with the accuracy of realistic modeling and completely let go of the tension shaping at the formal level of the picture; or they stack abstract symbols blindly, and the whole work cannot even find the most basic narrative point. This idea of symbiotic creation can guide the creator to polish the basic skills of figurative modeling and control the abstract form simultaneously, and build a more comprehensive and complete visual creation logic. In repeated practice, the creator gropes for the balance scale between object image reproduction and subjective emotional expression, and slowly precipitates his own recognition style. When more and more practitioners go deep into the path of symbiosis of form and meaning, the overall creative ecology of the oil painting circle will naturally expand, and works with different themes and different expression dimensions will grow synchronously, continuously injecting fresh innovation power into the whole field ^[10].

5. Conclusion

The whole progress of oil painting art is accompanied by the blending and iteration of visual expression techniques. The symbiosis of concreteness and abstraction is not a new concept artificially packaged, but a new creative form that oil painting language grows along its own development logic. He directly broke the old cognition of the default two types of expression paths in the industry. This paper combs through the theoretical context and core aesthetic characteristics of this symbiotic paradigm. This paper summarizes the creative path from four practical dimensions: picture layout, emotional transmission, media adaptation, and narrative dimension upgrading, and dismantles its multiple gains in innovating the expression boundary of oil paintings, breaking through the aesthetic barriers of elegance and vulgarity, and supplementing the comprehensive creative thinking of creators.

The concreteness holds the realistic anchor point for the picture, and the abstraction opens up enough space for the spiritual extension of the work. The two are by no means the rigid splicing of modeling and form, but the deep integration of vision, emotion, and cultural expression. This idea can continuously explore the expression potential of oil painting media, help contemporary oil painting to jump out of the solidified routine, undertake the traditional context to complete language innovation, and provide a feasible new direction for subsequent creation.

Disclosure statement

The author declares no conflict of interest.

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The Application of Gray Tonal Language in Modern and Contemporary Copperplate Prints

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Abstract: The gray tonality is a color language with both neutral characteristics and rich levels. It has something special in the creation of modern and contemporary copperplate prints, and it is easily overlooked. This paper starts with the visual attributes, emotional bearing, and aesthetic characteristics of gray tonality, and analyzes its internal logic of correspondence with the copperplate media technology. Thinking about the creative practice of flying dust, line engraving, color printing, and other different techniques, this paper analyzes the concrete application and spiritual expression function of gray tonal language in copperplate printing. It is considered that the gray tonality can deepen the expression of the spirit of copperplate prints and give a new practical way to explore the diversification of color language in contemporary copperplate prints.

Keywords: Gray tone; Modern and contemporary copperplate prints; Flying dust technique; Line texture; Overcolor printing

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1. Introduction

Copperplate print is regarded as a category with both technical depth and artistic texture, and its various techniques, such as etching, flying dust, and Merotone, jointly support the rich expression space of copperplate. For a long time, monochrome copperplate prints have impressed viewers with their delicate and accurate picture texture and elegant and quiet artistic temperament. The public's cognition of the color of copperplate prints mostly stays in two directions: black and white poles and high saturation color matching. In fact, the gray tonality between black and white has a very delicate expression, and its natural fit with the copperplate technique is far from being fully explored. It is of practical significance to sort out the linguistic characteristics of gray tonality and explore its application path in modern and contemporary copperplate prints, which will enrich the color expression system of copperplate prints and deepen the spiritual core of works.

2. The charm of gray tonal language

2.1. The visual attribute of gray tonality

Gray belongs to the core color gamut of the achromatic color system, and its visual characteristics are determined by three basic elements: hue, purity, and lightness. From the perspective of hue, gray has no obvious color tendency, but due to the difference in harmonic components, it can derive different deviations such as cold gray and warm gray, showing very rich subtle changes. On the purity level, all grays are in the low saturation range, which will not bring strong stimulation to the vision, but can pay more attention to the texture and shape of the picture. Brightness is the most expressive dimension of gray tonality, and the human eye's ability to distinguish between gray and light is far greater than its perception of pure color. From light gray close to white to dark gray close to black, it can be divided into dozens of recognizable levels. The subtle level changes enable gray to carry a lot of picture information, showing rich details in the gentle visual rhythm, which is also the difference between gray tonality and other colors ^[1].

2.2. The emotional expression of gray tonality

The emotional expressive power of color comes from the psychological association formed by the viewer's long-term visual experience, and gray tonality is more inclusive and ambiguous in emotional bearing. Different from the clear direction that red corresponds to passion and blue corresponds to silence, the emotions conveyed by gray are more restrained and implicit. Gray with different lightness and inclination can correspond to completely different emotional experiences. Bright light gray has a calm and soothing temperament, which is suitable for expressing a quiet and indifferent state of mind; Moderate neutral gray has the characteristics of restraint and rationality, and can carry a speculative and quiet mental state; Dark gray has its own gloomy and heavy texture, which can convey dignified and thoughtful emotions. In China's traditional ink painting art, the ink is divided into five colors, which are essentially to bear the artistic conception of mountains and rivers and the interest of literati with different levels of gray. In modern and contemporary artistic creation, gray is more often used to express the individual's calm observation of the world, to avoid the emotional incitement of high saturation color, and to let the viewer sink into a more internal spiritual experience.

2.3. The aesthetic characteristics of gray tonality

The aesthetic value of gray tonality lies in its own sense of tolerance and blank space. This characteristic makes gray have a unique vitality in contemporary art. Highly saturated colors often directly limit the emotional tone of the picture, while gray cannot forcibly render a certain emotion; on the contrary, it leaves more room for the viewer to think and forms an aesthetic blank effect. Gray can reduce visual conflicts and make different elements unified in the whole tonality, but it does not affect the expression of details such as texture and lines. Especially in today's environment where consumerism visual culture prevails, a large number of highly saturated colors are filled with our visual nerves, but the gray tonal and quiet texture forms a sharp contrast, which is in line with modern people's exploration of the inner spiritual world. Because it is unobtrusive and does not cater to the fashion trend, gray tonality is also used as the first choice color language for many artists to express their thoughts.

3. The relationship between modern and contemporary copperplate prints and gray tonal language

3.1. The natural fit between copperplate media and gray language

The creation of copperplate prints depends on the corrosion and printing of metal plates, and the technological attributes of the media itself determine that there is a natural correspondence between it and the gray tonal language. The modeling system of traditional copperplate prints is based on lines and light and dark levels. Artists use the density of lines and the depth of corrosion to express the light and dark relationship of the picture. This process is essentially building different gray levels. The flying dust technique controls the corrosion degree through the granular anti-corrosion layer, and can directly obtain a uniform and delicate gray surface; the Merutin technique controls the light and shade by the density of the printing plate, which can achieve a very smooth gray transition from black to white. Since its birth, these core techniques of copper plate have been linked with the control of gray level, but traditional creation mostly regards gray level as an accessory of black and white modeling, and does not treat it as an independent color language. The powerful presentation ability of copper plate media for gray scale has laid a solid technological foundation for the independent expression of gray tonality.

3.2. Printing process to enrich the expression of gray scale

The final presentation of copperplate prints goes through the printing process, and this indirect creation process gives more variable space and special texture to the gray tonal expression. When printing, artists can change the effect of gray scale on the same page by controlling the thickness of ink, the wiping weight, and the pressure. The gray of thin printing will reveal the background color of the paper, which has a light and transparent texture; Thick printed gray is thicker and more solid, with a strong ink touch. The subtle ink marks left when wiping the plate will make the gray surface have natural texture changes, which is different from the monotonous feeling of flat painting gray. Different materials of paper have different adsorption capacity for ink, which will also cause the same ink to show different gray-scale effects. When overprinting multiple editions, gray overprinting with different tendencies will also produce more subtle intermediate tones, which are not achieved by hand-painted gray. The process characteristics of copperplate printing give gray tonality a richer texture level.

3.3. Gray language turn in modern creation

The creation of modern copperplate prints gradually separated from the function of reproduction and turned to the expression of the artist's subjective spirit, and the status of gray tonality also changed fundamentally in this process. Early color copperplate prints are mostly works that reproduce the color of objective objects, and gray is only a transition and embellishment in the picture. After entering the modern era, more and more artists began to take the gray tonality as the main tone of the picture, and used gray to carry individual life experience and observation and thinking about society. Introspective themes such as the spiritual dilemma of contemporary society, the alienation of urban life, and the absurdity of personal existence are difficult to be accurately expressed with high saturation colors, and the gray introverted colors just meet the expression needs of such themes. Artists no longer regard gray as a transitional color between black and white, but as an independent language of spiritual expression. This change of creative concept makes gray tonality have a broader creative space in modern and contemporary copperplate prints ^[2].

4. The application of gray tonal language in contemporary copperplate prints

4.1. The construction of gray level under the flying dust technique

The flying dust technique is the main technique to shape the surface light and shade in copperplate prints, and it is also the most direct way to present gray tonality. The creator can adjust the thickness, distribution density, and corrosion time of flying dust particles, so as to obtain gray planes with different brightness and realize the continuous transition from bright gray to dark gray. Traditional flying dust techniques are often used as an auxiliary means to sketch the relationship. In modern and contemporary creation, the creators began to make the gray generated by flying dust become the absolute subject of the picture, and directly constitute the mood and space of the picture with different levels of gray.

Fan Min's "Sacrifice to My Couple -9" is a model of this kind of creation. The work takes the humanoid idol wrapped in fabric as the core image, and there is no obvious hard edge of the outer contour. All of them use different levels of flying dust gray and Merotone techniques to construct the body volume and gloomy space atmosphere. The creator uses very fine flying dust particles for shallow corrosion, forming a light gray close to the bright part, outlining the pleated edge of the fabric and the raised figure outline, just like the faint light in the dark space; Moderate density flying dust combined with moderate corrosion time produces soft medium gray, spreads the main structure of fabric and human body, and presents the thick texture of fabric winding and stacking in detail; The dense flying dust and the dark gray formed by long-term corrosion fill the shadow and background of wrinkles, and set off a dignified and depressing overall atmosphere.

There is no obvious boundary between different levels of gray, and the gradual change of corrosion degree makes the gray transition very natural. The whole picture is covered with a unified dark gray tone, but it has extremely rich level changes. The viewer cannot see the strong color contrast, but can feel the tight tension of fabric winding and the mental state of the characters struggling from the delicate gray change. The grainy texture of the gray generated by the flying dust technique will not appear monotonous and boring, and the subtle graininess gives the gray a sense of breathing, which makes the theme of human alienation get rid of the straightforward narrative expression and move towards a more spiritual metaphor expression. Such a creative way breaks the auxiliary orientation of flying dust technique and makes gray itself the expression core of conveying the spiritual core of the work ^[3].

4.2. The gray semantic transformation in line-carving texture

Line engraving is the most basic technique of copperplate engraving. The traditional cognitive function of line engraving is to outline and shape the figure. In fact, the dense arrangement of lines can also build a rich gray level, and this gray generated by lines has its own unique texture. Modern and contemporary artists no longer regard the gray scale of line engraving as an accessory of modeling, but actively transform the arrangement of lines, so that the generated gray bears specific emotions and semantics and conveys the spiritual core of the work with linear gray.

The copperplate figure works of Li Xiaolin have well interpreted the expressive power of line-carved gray. Li Xiaolin's copperplate creation does not use flat painted gray blocks, and all the brightness and volume depend on the dense arrangement of etched lines. When depicting the facial skin of characters, he arranges light gray tones with sparse and gentle curves, and the lines follow the structure of the skin; the soft light gray conveys the temperature and texture of the skin. When representing characters' beards and clothes shadows, he arranged dark gray tones with dense and staggered straight lines, and the heavy lines brought heavy visual weight.

4.3. The application of gray harmony in color printing

Color matching is the core technology of color copperplate prints. Most color matching creations will choose highly saturated colors to form visual contrast. However, some modern and contemporary artists do the opposite, overprinting with different inclinations of gray, and rely on the slight difference between cold and warm gray to build a picture level, forming a low-saturated gray tonal expression. This creative way weakens the visual impact of color, but strengthens the emotional atmosphere and spiritual texture of the picture, which is suitable for expressing the theme of alienation and introversion.

The series “What you don’t want to talk about or are talking about gracefully” by printmaker Kong Guoqiao is a model of this kind of creation. The work adopts multi-version color matching technology, and there is no solid color with high saturation in the whole picture. All the color blocks are gray with different tendencies. The face and skin of the characters are expressed in light gray and warm tones. The weak characteristics of warm tones weaken the cold feeling of the characters, but maintain the alienated temperament. The clothes and background of the characters are presented in cold medium gray and dark gray, and there is extremely weak color contrast between cold gray and warm gray, which just distinguishes the spatial relationship between the characters and the background, but it will not destroy the overall gray tonality.

When printing, the artist controls the thickness of each layer of ink, so that the gray of the bottom layer can penetrate to the surface layer weakly, resulting in a subtle color overlapping effect, so that the gray tone will not appear monotonous and rigid. The gray levels with different tendencies are intertwined, forming the sense of alienation and mental distress of urban characters, and the viewer can feel the inner emotional tension of the characters from the gentle gray tone. The creative way of gray color matching broadens the expression range of copper plate color matching technology, and also proves that gray tonality can also have rich color levels, but these color levels are hidden in subtle tone differences, which need the viewer to calm down and slowly experience.

4.4. The development of gray texture under the comprehensive techniques

Modern and contemporary copperplate prints emphasize more and more the integration of techniques. Artists combine various techniques such as soft wax, syrup, engraving, and so on, and use different techniques to generate gray with different textures, which enriches the expression of gray language. Different textures of gray produce contrast in the picture, which can distinguish different objects and convey more complex emotions.

Xu Baozhong’s “Grass on the Original” series is a typical practice of expanding the gray texture with comprehensive techniques. The work shows the natural features of the northern grassland, and the creator uses the flying dust technique to make a delicate and even medium gray to show the open grassland ground, and the flat gray conveys the sense of vastness of the grassland. Soft wax is used to transfer the texture of hay, and after corrosion, it forms rough and mottled dark gray, which is used to express the grass in the foreground. Irregular texture makes gray bring vitality to wild plants. Using the sugar water technique to make irregular light gray marks, which are used to show the clouds in the sky. The mottled feeling of flow makes gray have the effect of clouds.

Three different techniques have completely different gray textures, but they have different modeling and expression functions. The viewer can feel the quietness of the whole picture, and can also read rich levels from the gray with different textures. This creative way breaks the monotonous stereotype of gray and

proves that gray has rich and varied texture and personality. With the addition of comprehensive techniques, the gray tonality is no longer just a change of light and shade, but rises to the category of tactile texture. The technological characteristics of the copperplate media are also brought into full play, which opens up more possibilities for the contemporary practice of gray language^[4].

All in all, the application of gray tonality in modern and contemporary copperplate prints can develop the inheritance of traditional craft genes of copperplate media and meet the needs of contemporary artistic spirit expression. On the one hand, the gray tonality excavates the inherent potential of the copperplate technique itself, which changes the color expression of copperplate from the original black and white and high-saturation color printing to a more delicate and rich expression level. On the other hand, the technological characteristics of the copperplate medium endow the gray language with many means of expression, which makes it richer in texture and hierarchy. Contemporary copperplate creators can continue to enrich the field of gray tonality expression, organically integrate technological exploration with spiritual expression, and create more copperplate works with cultural connotation and ideological depth.

Disclosure statement

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Generative AI and Evidentiary Displacement in Second Language Writing: A Critical Integrative Review of Feedback, Composing Processes, and Assessment Validity

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Abstract: Generative artificial intelligence (GenAI) has become embedded in second language (L2) writing not only as a source of correction, but also as a participant in planning, drafting, translating, revising, evaluating, and genre modeling. This critical integrative review argues that the central pedagogical problem raised by GenAI is evidentiary rather than merely technological. In much classroom and assessment practice, learner texts continue to function as privileged evidence for engagement, authorship, composing decisions, and writing ability. GenAI unsettles this relation because it can produce ideas, structure, language, feedback, and evaluation from minimal input while leaving no reliable trace in the submitted text. This review conceptualizes this problem as evidentiary displacement: evidence of learning is not destroyed, but redistributed across less visible processes of prompting, selecting, evaluating, revising, rejecting, and integrating machine output. Drawing on post-2022 work on GenAI-mediated L2 writing and longer-standing scholarship on feedback engagement, composing processes, and assessment validity, the review examines displacement across three sites: feedback, composing, and assessment. It argues for selective process evidence—revision rationales, decision-point annotations, feedback engagement records, and learners’ accounts of their choices—while also cautioning that documentation can increase workload, reproduce inequities, invite surveillance, and become strategically performed rather than pedagogically meaningful.

Keywords: Second language writing; Generative AI; Evidentiary displacement; Feedback engagement; Composing processes; Assessment validity; Process evidence

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1. Introduction

L2 writing scholarship has long treated writing as more than the production of accurate written products. Process accounts made planning, translating, reviewing, and revising visible as objects of inquiry; later

social, post-process, and classroom-based perspectives connected writing to mediation, audience, genre, identity, institutional context, and language resources ^[1–5]. Feedback research likewise cautions against reading textual revision as a direct measure of learning, since the pedagogical force of feedback depends on how writers notice, interpret, resist, appropriate, and later reuse it ^[6–9]. In assessment, validity work has made a related point in a different register: judgments about writing ability require warranted interpretations of performance, not simply the existence of a text to be scored ^[10–13].

Yet institutional practice has not always absorbed these insights. Teachers still infer engagement from revised drafts, researchers often reconstruct composing from products and process traces, and assessors regularly warrant claims about writing ability from final texts produced under nominally specified task conditions. The text has never been transparent evidence. It has, however, been a practical evidentiary anchor: a stable artifact around which instruction, feedback, research, and certification could be organized. GenAI makes the fragility of that arrangement harder to ignore.

The issue is not that GenAI is wholly unprecedented. Machine translation, automated writing evaluation, dictionaries, corpora, peer review, writing centers, and teacher feedback have all mediated L2 writing in consequential ways. Research on machine translation has already questioned authorship, language learning, translanguaging, and the politics of tool use ^[14–15]. Automated writing evaluation research has similarly shown that machine feedback requires validation of the inferences users draw from it ^[16]. GenAI nevertheless intensifies and consolidates forms of assistance that were previously more distributed, partial, or easier to contextualize. A single conversational interface can generate ideas, organize arguments, translate, draft, revise, evaluate, and polish language from minimal input, often without leaving a reliable signature in the submitted text.

The early JSLW dialogue on AI-generated text therefore framed the issue through tensions rather than simple affordances. Warschauer et al. identified affordances and contradictions for ESL/EFL writers ^[17]; Pecorari, Sasaki, Kubota, Kang and Yi, and Praphan and Praphan extended the discussion to plagiarism, L1 resources, multimodality, equity, and classroom policy ^[18–22]. Recent syntheses have broadened the field further, mapping learner perceptions, feedback practices, prompting strategies, assessment applications, and emerging AI literacies ^[23–28]. These accounts are useful. They also show, however, why another catalog of benefits and risks would add little.

This review advances a more specific claim. One central consequence of GenAI-mediated L2 writing is evidentiary displacement: the learner's final text can no longer, by itself, sustain the same inferences about engagement, authorship, composing decisions, and writing development that L2 writing pedagogy has often drawn from it. Evidence of learning is not eliminated. It is redistributed across less visible and harder-to-interpret activities: prompting, selecting, evaluating, revising, rejecting, adapting, and integrating machine output. The review asks how this displacement operates in feedback, composing processes, and assessment validity, and what kinds of pedagogical evidence might respond to it without turning writing instruction into documentation for its own sake.

This framing deliberately avoids two tempting reductions. One reduction treats GenAI as an integrity problem to be solved mainly through detection and prohibition. Another treats GenAI as a productivity tool whose value can be measured primarily by better scores, cleaner syntax, or more positive learner perceptions. Both positions can be locally reasonable, but neither is adequate for L2 writing pedagogy. Writing instruction is concerned with how learners develop judgment over time: how they formulate meanings, respond to

feedback, revise for readers, and assume responsibility for language choices. GenAI intervenes at precisely those points. The evidentiary question, then, is not a peripheral administrative matter. It reaches into how the field defines learning, authorship, and assessment under conditions of mediated text production.

The contribution is thus intentionally restrained. The review does not propose that all L2 writing pedagogy be reorganized around AI, nor does it treat process documentation as a universal remedy. It offers a conceptual vocabulary for a problem that teachers already encounter when a polished text, a revised draft, or an impressive portfolio no longer gives adequate grounds for knowing what the learner did or learned. By naming this problem as evidentiary displacement, the article brings together debates that often remain separated: feedback uptake, process-oriented composing, AI literacy, authorship, and assessment validity. The value of the concept lies in whether it helps the field ask more precise questions of empirical studies and classroom designs.

2. Review design and positioning

The article is a critical integrative review. This design is appropriate when a developing area contains empirical studies, conceptual commentary, methodological discussion, and policy-oriented work that cannot be reduced to a single effect-size question. Integrative reviews synthesize heterogeneous literatures in order to clarify concepts, identify tensions, and develop a research agenda, rather than to estimate prevalence or aggregate outcomes ^[29–31]. GenAI-mediated L2 writing is such a field: the literature is recent, uneven across educational contexts, and distributed across feedback, AI literacy, writing process, translation, academic integrity, and assessment.

The review uses post-2022 peer-reviewed research on GenAI in L2 writing as its primary corpus, while drawing on foundational scholarship in L2 writing feedback, composing process research, technology-mediated writing, and assessment validity to interpret the implications of that corpus. This layered approach is necessary because GenAI is new as a public-facing technology but not new as a problem of mediation. The purpose is not to claim exhaustive coverage of every study published since the release of ChatGPT. Rather, the review reads a targeted body of recent work through an evidentiary lens and asks what kind of learning, authorship, and ability can be inferred when AI participates in text production.

The organizing logic differs from tool-centered syntheses. Instead of separating ChatGPT feedback, automated evaluation, machine translation, prompt engineering, and AI literacy as adjacent topics, the article treats them as sites where a common evidentiary problem appears. Feedback, composing, and assessment were selected because each depends on a relationship between visible textual evidence and less visible learner activity. In each site, GenAI weakens familiar inferences without making evidence irrelevant. The analytic task is therefore to identify where evidence has moved, what it can and cannot warrant, and how pedagogy might elicit it responsibly.

The review is also positioned against a recurring weakness in fast-moving AI scholarship: the tendency to let the tool define the object of inquiry. In L2 writing, a study of ChatGPT, automated feedback, or machine translation is rarely only a study of a tool. It is also a study of writing tasks, language ideologies, classroom authority, and the evidence through which learning is recognized. This article therefore treats GenAI as a pressure point on existing pedagogical assumptions rather than as an autonomous cause of change.

This methodological stance carries a limitation that should be stated rather than hidden. Because the review is conceptually driven, it does not claim to settle how often particular forms of GenAI use occur, nor does it rank interventions by effect size. The value of the synthesis depends instead on whether the proposed concept clarifies relations that remain dispersed across adjacent literatures. To reduce the risk of conceptual overreach, the analysis repeatedly returns to three questions: what inference is being made from the learner text, what GenAI mediation makes less secure, and what alternative evidence could support a more cautious interpretation. These questions provide the warrant for the selection of studies and the structure of the review.

3. Conceptualizing evidentiary displacement

Texts in L2 writing classrooms are rarely only texts. A revised paragraph may be read as evidence of feedback uptake. A series of drafts may be read as evidence of developing control over genre, stance, organization, or grammar. A polished final essay may be read as evidence of writing ability. These readings are institutionally useful, but they are interpretive acts rather than neutral observations. They depend on assumptions about task conditions, assistance, learner agency, and the relation between product and process.

GenAI changes the evidentiary distribution. A fluent text may reflect independent development, effective use of AI suggestions, full machine generation, translation from the writer's L1, peer support, or a mixture of these. A revision may reflect careful engagement with feedback, mechanical acceptance of an AI rewrite, or a student's attempt to reconcile teacher comments with machine-generated alternatives. A genre-appropriate introduction may show genre learning, a well-designed prompt, or imitation of an AI-generated model. The point is not that learning has disappeared. It is that the final text no longer specifies what sort of learning or decision-making occurred.

Evidentiary displacement has four dimensions. First, it concerns the object of inference: engagement, authorship, rhetorical judgment, linguistic development, or writing ability. Second, it concerns the source of evidence: final text, draft history, interaction log, reflection, conference, classroom observation, or controlled performance. Third, it concerns the site of displacement: prompting, selecting, evaluating, rejecting, revising, and integrating AI output. Fourth, it concerns interpretive authority: learners, teachers, assessors, researchers, and institutions may treat the same trace differently. **Figure 1** summarizes this movement from product-centered evidence to distributed process evidence.

The term displacement is chosen carefully. It does not mean that evidence becomes unavailable, nor that teachers can no longer make any judgments about students' writing. It means that the location and interpretability of evidence change. A product may still reveal audience awareness or textual coherence, but it may not reveal whether those features were planned, adopted, prompted, or understood. A prompt log may reveal interaction, but not necessarily reflection. A student explanation may reveal reasoning, but it may also be retrospective rationalization. Evidentiary displacement therefore names a problem of warrant rather than a simple movement from bad evidence to good evidence. The practical response has to be triangulation, not replacement.

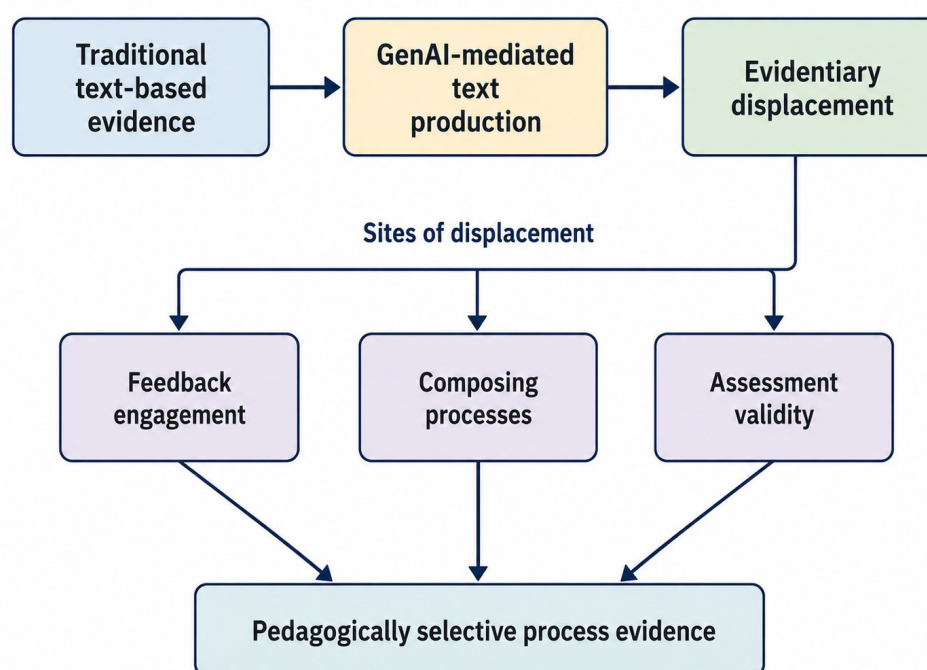


Figure 1. Evidentiary displacement in generative-AI-mediated L2 writing. Final products and revisions remain useful evidence, but GenAI mediation relocates some evidence of learning into process traces and learner explanations.

The concept does not render product evidence obsolete. Final texts still matter: they show rhetorical effects, linguistic choices, genre positioning, and audience orientation. Under AI-mediated composing, however, final products have to be interpreted together with the conditions of their production and with evidence of the learner’s role in decision-making. **Table 1** applies this logic to feedback, composing, and assessment validity.

This qualification matters for classroom feasibility. A theory that makes final texts irrelevant would be unusable and empirically implausible. Teachers do not have unlimited access to students’ mental activity, and most writing assessment will continue to involve products. The more modest claim is that product evidence has become more conditional. Its evidentiary value depends on task design, declared and permitted assistance, opportunities for explanation, and the relationship between the text and other artifacts. In this sense, GenAI does not create the need for process-oriented pedagogy; it makes the cost of ignoring process evidence more visible.

Table 1. Evidentiary displacement across feedback, composing processes, and assessment validity

Site	Conventional evidence	GenAI displacement	More defensible evidence
Feedback	Revision is often read as uptake.	Textual change may result from machine rewriting rather than learner engagement.	Learner interpretations, accepted/rejected suggestions, revision rationales.
Composing	Drafts and final texts are treated as traces of writer decisions.	Planning, wording, structure, and revision may move into human-AI interaction.	Prompt comparisons, decision-point annotations, draft commentary, oral explanations.
Assessment	Final text quality supports claims about writing ability.	Production conditions become opaque, weakening text-to-ability inference.	Triangulated product-process evidence aligned with the assessment purpose.

Note: The table identifies the inference that becomes less secure when GenAI participates in text production.

4. Feedback: From textual uptake to evidenced engagement

Feedback has always depended on inference. Teachers comment on texts, students revise, and the revised draft is often treated as evidence that feedback was understood. L2 writing research has complicated that assumption. Hyland and Hyland describe feedback as interpersonal and contextual^[8]; Ferris links corrective feedback to development rather than immediate correction alone^[6]; Han and Hyland show that engagement has cognitive, behavioral, and affective dimensions^[7]. Feedback literacy scholarship reaches a similar conclusion from another direction: learners must appreciate feedback, judge its relevance, manage affect, and take action^[32–34]. A changed text, then, is only partial evidence of feedback engagement.

GenAI makes this partiality more visible. AI feedback can be fast, extensive, personalized, and available outside class. Students may prefer it for proofreading and editing because it is immediate and less socially exposing than peer response^[35]. Comparative work also shows that GPT-assisted feedback can be useful but uneven, especially when it offers fluent reformulations without pedagogically precise explanation^[36]. Recent reviews of GenAI feedback studies identify recurring concerns about prompt transparency, relevance, reliability, learner dependence, and the thinness of product-only measures^[24, 26].

The evidentiary issue is sharper than the question of whether AI feedback improves writing quality. When a student submits a revised draft after consulting GenAI, textual improvement may not indicate feedback engagement. It may show that the student accepted a machine rewrite. Conversely, limited textual change may conceal careful evaluation, selective rejection, and emerging rhetorical judgment. Yeung's study is instructive because it combined drafts, screen recordings, stimulated recall, and interviews to examine behavioral, cognitive, and affective engagement with GenAI-supported automated writing evaluation feedback^[37]. Such designs show that evidence of engagement often lies in interpretation and justification, not only in the changed surface of the text.

The same difficulty affects the teacher's work. If AI feedback supplies extensive correction before a teacher sees the draft, the teacher may be responding to an already mediated text. Some errors may have disappeared, but the underlying developmental need may remain. Other features may have been improved in ways the learner cannot reproduce or explain. This changes the diagnostic value of drafts. A teacher may need to ask not only what is wrong with the text, but what the student did with available feedback and what kind of support produced the observed quality. That question is uncomfortable because it complicates efficient grading routines. It is nevertheless central if feedback is to remain developmental rather than merely editorial.

Pedagogy should therefore move from textual uptake to evidenced engagement. This does not require collecting every prompt or policing every revision. A more defensible approach is to identify a small number of consequential feedback decisions. Students might annotate AI suggestions they accepted and rejected, compare teacher and AI feedback on the same passage, or write a short rationale explaining how a revision addressed audience, genre, evidence, or stance. These artifacts do not prove learning in a simple sense, and they can be performed strategically. Still, they provide better grounds for pedagogical inference than the revised text alone. They also teach students that feedback is not information to be consumed, but advice to be interpreted.

Such practices also help distinguish different kinds of improvement. A grammar correction may indicate local editing; a restructuring of evidence may indicate rhetorical reconsideration; a rejected AI suggestion may indicate that the student has detected a mismatch between generic advice and task-specific purpose.

These distinctions are often flattened when feedback studies focus only on pre- and post-revision quality. They matter because L2 writing development is not exhausted by textual improvement in a single draft. It also involves the growth of criteria, judgment, and metalinguistic awareness. GenAI can support these capacities, but only when students are required to make their reasoning available for response.

5. Composing processes: From product traces to accountable authorship

Process-oriented L2 writing research already provides a language for the second site of displacement. Writing involves planning, formulation, monitoring, reviewing, and revision; it is also shaped by discourse communities, collaboration, material tools, and institutional purpose ^[1–5, 38–39]. In conventional process research, draft histories, keystrokes, screen recordings, stimulated recall, and interviews are used because the final product cannot display the route by which it was made. GenAI widens the gap between route and product.

Recent process-rich studies illustrate the point. Hwang et al. found that learners used ChatGPT differently across the composing process, with early uses for idea generation and later uses for checking, polishing, examples, and continued development ^[40]. Yang and Lin show how EFL students used GenAI in translanguaging practices, drawing on L1 resources for planning and problem solving before transforming ideas into English ^[41]. Michel et al. document revision and deliberation in collaborative writing with GenAI model texts, while de Oliveira and dos Santos show how AI-generated mentor texts can support genre-based pedagogy when they become objects of analysis rather than templates for imitation ^[42–43]. Ou et al. and Wang and Wang extend the discussion to critical GAI literacy, emphasizing evaluation, ownership, and ethical positioning ^[44–45]. These studies suggest that AI-mediated composing is not a single activity. It is a shifting set of negotiations among linguistic resources, machine output, task demands, and the writer's emerging judgment.

Authorship consequently becomes an empirical and pedagogical question. It is not enough to ask whether a human or a machine wrote a sentence. Textual authorship concerns the origin of words and clauses; rhetorical authorship concerns who shaped purpose, audience, organization, stance, and emphasis; accountable authorship concerns whether the learner can explain, revise, and take responsibility for those choices. These dimensions may diverge. A learner may rely on AI wording while retaining rhetorical control. Another may type every sentence but outsource the conceptual structure. A third may use AI heavily and still learn from comparing alternatives. The submitted text cannot adjudicate these cases alone.

This account complicates familiar classroom binaries. A handwritten or AI-free draft is not automatically evidence of mature authorship, just as an AI-assisted draft is not automatically evidence of outsourcing. The relevant pedagogical issue is the distribution of decision-making. Which problems did the learner identify? Which resources were consulted? Which alternatives were considered? What was rejected, and why? These questions are more demanding than asking whether AI was used, but they are closer to the intellectual work of writing. They also avoid reducing multilingual writers' tool use to suspicion, a risk that becomes especially acute when polished English is treated as improbable for some students but normal for others.

This is also where equity enters the argument. Sasaki warns against treating EFL writers' L1 resources as deficits, and Jiang et al. similarly caution that machine translation should not be treated as politically neutral ^[14, 19]. Darwin pushes the analysis toward critical digital literacies, where platform access, interface design, language hierarchies, and institutional policy shape what writers can do ^[46]. Sandstead and Kibler add

that voice itself must be reconsidered when AI-generated language enters multilingual writing ^[47]. Broader AI literacy frameworks can support this discussion, but L2 writing requires domain-specific attention to rhetorical choice, language learning, and textual responsibility ^[48–49].

The pedagogical implication is not that students should produce an audit trail of every interaction. More useful is decision-point evidence: moments where writers identify a consequential choice, describe available alternatives, explain the option selected, and reflect on its rhetorical or linguistic effects. Such evidence might include a short prompt comparison, an AI-output critique, an annotated revision, a draft history with commentary, or a brief oral explanation. The aim is not to reconstruct a total composing history. It is to make visible enough of the writer's judgment to support learning-oriented inference.

For research, this means that methods must be matched to the kind of authorship being investigated. Screen recordings and interaction logs can document textual movement, but they do not by themselves reveal ownership or understanding. Stimulated recall and interviews can elicit reasoning, but they are retrospective and shaped by what learners think researchers or teachers want to hear. Text analysis can identify differences between student and AI output, but it cannot settle the pedagogical meaning of those differences. A stronger design would combine traces, accounts, and products, while treating all three as partial. This methodological modesty is especially needed in a field where technologies and user practices change faster than research cycles.

6. Assessment validity: From integrity policing to validity argument reconstruction

The assessment implications of GenAI are often framed as academic integrity. That concern is real, but it is too narrow. In validity theory, scores and judgments are warranted only when evidence supports the intended interpretation and use ^[10–12]. A writing sample can support a claim about ability only if the construct, task conditions, forms of assistance, scoring criteria, and consequences are sufficiently specified. This is why automated writing evaluation, even before GenAI, required argument-based validation rather than simple claims of efficiency ^[13, 16].

GenAI weakens the inference from text quality to writing ability when the conditions of text production are opaque. Studies comparing AI-generated and student writing show that textual features alone may not reliably settle questions of provenance ^[50]. Work on AI statements and institutional policies also shows that generic declarations do not necessarily address the realities of linguistically diverse writers ^[51]. Research on ChatGPT as an assessment companion suggests potential for accuracy assessment and rating support, but also raises questions about reliability, construct representation, and appropriate use ^[52–53]. The problem, therefore, is not only whether students used AI. It is what the submitted performance can validly be taken to mean.

Rubrics are affected as well. Criteria such as grammar, lexical range, organization, and coherence were never pure measures of independent competence, but under AI-mediated conditions they become still more ambiguous. A student may receive high marks for language accuracy because the text has been polished by AI, while another may demonstrate stronger developing control through a less polished but more independently reasoned draft. This does not imply that accuracy and organization should be abandoned as criteria. It does suggest that criteria need to be linked to task conditions. If AI editing is allowed, assessment must decide whether it values the resulting text, the learner's ability to evaluate the edit, or both.

Detection-based responses are especially weak from a validity perspective. Even where detection tools appear administratively attractive, they do not explain what the writer understood, how the text was

produced, or whether assistance was permitted by the task. They also risk shifting attention from construct representation to suspicion management. A detector may claim that a passage is likely AI-generated, but the pedagogical question is more specific: did the learner make the rhetorical and linguistic decisions the assessment is intended to capture? If that question cannot be answered from the text, the assessment design needs better evidence, not simply a stronger detection instrument.

A validity-oriented response begins with assessment purpose. If the goal is to assess independent timed writing, AI is construct-irrelevant assistance and should be controlled. If the goal is to assess writing development in a course where AI use is taught, AI may be part of the instructional context and should be documented. If the goal is to assess academic or professional writing under contemporary conditions, the construct may include the ability to prompt, evaluate, revise, verify, and take responsibility for AI-mediated text. **Table 2** summarizes these distinctions. The categories are not exhaustive, but they make explicit a point often lost in policy discussions: the same AI use can be construct-irrelevant in one assessment and construct-relevant in another.

Table 2. Assessment purposes, GenAI status, and evidence needed for validity arguments

Assessment purpose	Construct claim	GenAI status	Evidence needed
Independent L2 writing	Learner can plan, draft, and revise without AI.	Controlled or prohibited.	Supervised writing; comparison with coursework.
AI-supported development	Learner can use AI to revise and learn from feedback.	Permitted under defined conditions.	Drafts, feedback records, revision rationales.
AI-mediated academic writing	Learner can compose responsibly with AI in authentic tasks.	Integrated into the construct.	Final text, AI-use disclosure, decision-point notes, explanation of choices.
Diagnostic instruction	Teacher identifies needs and next steps.	Varies by diagnostic focus.	Short in-class writing, reflective comparison, targeted conference.

Note: The table treats GenAI use as construct-relevant or construct-irrelevant depending on the intended score interpretation.

This perspective does not make process evidence a simple solution. AI-use statements, prompt logs, reflection notes, and oral explanations can all be incomplete, fabricated, or performed for the teacher. They may also increase workload and anxiety. Still, when aligned with a clear assessment purpose, they can provide better support for interpretation than a final text alone. The task is to triangulate rather than to detect. A final essay, a short in-class diagnostic sample, a revision rationale, and an oral explanation may together warrant a more cautious claim about development than any single artifact. Wang, Tian, and Christiansen call for critically and humanely grounded experimentation in GenAI-era L2 writing; validity reconstruction is one way to make that call operational ^[54].

A validity argument also needs to consider consequences. If institutions respond by moving all assessment to closed-book, AI-free timed writing, they may protect one inference while narrowing the construct of writing to a decontextualized performance. If they respond by allowing unrestricted AI use without process evidence, they may produce attractive portfolios with little basis for judging development. Neither response is adequate across purposes. The more defensible path is plural: some tasks should diagnose independent control; others should assess supported revision, genre learning, and responsible AI-mediated composing. The validity question is not whether AI is present, but whether its presence is specified, taught, and aligned with the claim being made.

7. Pedagogical reconstruction around selective process evidence

Reading feedback, composing, and assessment through evidentiary displacement reframes the problem for pedagogy. The question is not whether GenAI should be banned, permitted, or celebrated in the abstract. Institutions that teach, respond to, and certify writing still need warranted evidence of learner development. The more difficult question is where such evidence now resides, how it can be elicited without excessive monitoring, and how it can be interpreted with attention to context.

Selective process evidence offers a practical but limited response. It is selective because not every interaction should be recorded. It is process evidence because it focuses on decisions, not merely products. It is pedagogical because its purpose is to develop judgment, not only to protect assessment. In feedback, students can be asked to explain how they interpreted a small number of comments from teacher, peer, or AI sources. In composing, they can annotate a decision point where AI changed their plan, language, or stance. In assessment, they can provide an AI-use disclosure that specifies the functions used—idea generation, translation, feedback, genre modeling, editing—and then explain responsibility for the final text.

This approach can be built into ordinary assignments without making the course revolve around AI. A process note might be limited to 150 words. A revision rationale might ask for two accepted suggestions and one rejected suggestion. A conference might last five minutes and focus on one paragraph rather than the whole paper. A portfolio might include one AI-assisted artifact and one short supervised diagnostic sample. Small designs of this kind are less spectacular than comprehensive digital tracking, but they are more likely to survive the conditions of real teaching. They also keep the focus on writing decisions rather than on technological display.

These practices need to be designed with restraint. A classroom that requires exhaustive logs may reward students who are adept at curating process records rather than those who are developing as writers. It may also place heavier burdens on teachers and disadvantage learners with limited access, weaker metalinguistic vocabulary, or less familiarity with institutional expectations. Documentation is not neutral. It can become surveillance, and it can reproduce inequity. For this reason, process evidence should be short, task-specific, and directly tied to the construct being taught or assessed.

Teacher judgment remains central. Process evidence does not interpret itself, and AI tools should not be positioned as neutral arbiters of student development. Teachers need criteria for reading process notes, for distinguishing explanation from compliance, and for responding to students who use AI in different ways. They also need institutional support. Without time, policy clarity, and professional discussion, process evidence can become another layer of uncompensated labor. The conceptual argument of this review therefore has a practical edge: evidentiary displacement cannot be addressed by asking individual teachers to monitor more. It requires task designs and policies that make interpretation feasible.

Policy language should therefore be tied to pedagogy rather than written only as compliance rules. A statement that AI is allowed, banned, or must be disclosed says little unless students know what kinds of help are legitimate for a particular task and why. For one assignment, translation may be prohibited because the purpose is to diagnose independent sentence-level control; for another, translation may be allowed because the purpose is to develop argument and genre awareness. Policies that do not name the learning purpose behind restrictions are unlikely to guide students' decisions. They may also encourage strategic concealment, which further displaces evidence from teacher view.

The conceptual shift is from product policing to accountable authorship. Students should not learn merely to hide or disclose AI use. They should learn to question AI output, compare alternatives, revise

for audience and purpose, notice language patterns, and justify decisions. Prompting is not inherently educational; it becomes educational when it supports inquiry into meaning, genre, evidence, and style. AI literacy is similarly insufficient if detached from writing development. What matters for L2 writing is whether learners can use AI without outsourcing the rhetorical and linguistic judgment that writing instruction is meant to cultivate.

8. Research agenda and conclusion

Evidentiary displacement suggests several lines of inquiry. The field needs more process-rich studies that combine draft histories, screen recordings, interaction logs, stimulated recall, interviews, and classroom observation, while recognizing that these traces remain partial and socially shaped. Product-score studies and perception surveys are still useful, especially in early mapping work, but they cannot explain how learners negotiate AI output during composing. Research on feedback should examine engagement, not only feedback quality or revision outcomes. Research on authorship should distinguish textual, rhetorical, and accountable authorship rather than treating AI use as a binary problem. Assessment research should build and test validity arguments for different purposes: independent writing, AI-supported development, AI-mediated academic writing, and diagnostic classroom assessment.

Longitudinal work is particularly needed. Many current studies capture initial encounters with tools whose novelty may affect both enthusiasm and anxiety. The field knows less about whether repeated GenAI use changes writers' tolerance for difficulty, their willingness to revise without machine assistance, their sense of voice, or their ability to transfer feedback into later writing. Research should also examine teachers' interpretive practices. If process evidence is to be used, how do teachers read it, what do they trust, and how do their judgments differ across contexts? These questions are not merely methodological. They concern the social life of evidence in classrooms.

Contextual breadth is also needed. Much current work is concentrated in higher education and in contexts where students and teachers have relatively stable access to commercial tools. Evidentiary displacement will look different in large compulsory writing classes, secondary schools, vocational programs, exam-oriented systems, multilingual classrooms, and lower-resource institutions. In such settings, the demand for process evidence may conflict with class size, grading load, institutional policy, or uneven access to paid AI services. A theory of AI-mediated L2 writing that does not account for these conditions risks mistaking the practices of well-resourced classrooms for general pedagogy. Future studies should therefore examine not only what learners do with AI, but also what forms of evidence teachers can realistically request and interpret.

The agenda also requires attention to limits. Process evidence can be fabricated. It may become administrative work that displaces writing itself. It may be easier to implement in well-resourced universities than in large classes, vocational settings, or under-supported programs. It may also privilege students who already know how to narrate their learning in institutionally valued terms. These concerns do not invalidate process evidence, but they prevent it from becoming a new orthodoxy. Pedagogical design should ask how much evidence is enough, whose evidence counts, and what forms of documentation are proportionate to the instructional purpose.

GenAI does not make final texts meaningless. It makes their evidentiary status more conditional. In feedback, textual revision cannot be read straightforwardly as uptake. In composing, the product is an

incomplete trace of decision-making. In assessment, text quality cannot warrant claims about writing ability unless the conditions of production and the intended construct are specified. Evidence of learning has not disappeared; it has moved. The task for L2 writing pedagogy is to design conditions under which that evidence can be elicited, interpreted, and used with care. The goal is not to police final texts into purity, nor to perfect them through machine assistance. It is to cultivate writers who can make, explain, evaluate, and take responsibility for rhetorical and linguistic decisions when composing with GenAI.

Disclosure statement

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Research on the Integrated Path and Practical Exploration of Ideological and Political Education in Vocational Education: A Case Study of Zhejiang Institute of Communications

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Abstract: In the new era, vocational education shoulders the vital mission of cultivating socialist builders and successors with all-round development of morality, intelligence, physical fitness, aesthetics, and labor skills. Ideological and political (I&P) education serves as the fundamental guarantee for vocational education to stay true to its educational mission and strengthen connotative development. Taking Zhejiang Institute of Communications as the research object and based on the strategic background of building a powerful transportation country in the new era, this paper focuses on the core proposition of deep integration between vocational education and I&P education. It systematically analyzes the college's I&P education model featuring "ideological guidance, industry empowerment, cultural immersion and practical education" from four dimensions: educational connotation, practical paths, guarantee mechanisms and achievement transformation. The study shows that establishing a vocational education system integrating "transportation characteristics and red genes" and building a cultural education brand of "Five Actions Fulfill Five Educations" (cultivate morality, intelligence, physical health, aesthetics and labor through practice), as well as innovating a trinity education field covering "classroom-practice-online", can effectively realize coordinated development of vocational education and I&P education. It provides practical references for vocational colleges to implement the fundamental task of fostering virtue through education in the new era.

Keywords: Vocational education; Ideological and political education; Powerful transportation country; Integrated path

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1. Introduction

The Report to the 20th National Congress of the Communist Party of China clearly proposed to "integrate vocational education with general education and integrate industry with education as well as science and education, and optimize the type positioning of vocational education", charting the course for high-quality development of vocational education in the new era ^[1]. The Fourth Plenary Session of the 20th Central

Committee put forward core requirements for vocational education, including serving national strategies, deepening industry-education integration, and cultivating high-quality technical and skilled talents ^[2]. As the main platform for training technical and skilled personnel, vocational education should not only impart professional knowledge and practical abilities, but also strengthen ideological and political guidance, cultivate students' patriotism, craftsman spirit and sense of social responsibility, so as to cultivate builders with firm political stances and fulfill the mission of educating people for the Party. As the core driving force of university education, ideological and political work plays an irreplaceable role in integrating educational resources, pooling educational synergy and standardizing educational directions.

Transportation is a basic, leading and strategic industry as well as an important service sector of the national economy, acting as the pathfinder and foundation for Chinese modernization ^[3]. As an important birthplace and practice ground of the President of the CPC Thought on Socialism with Chinese Characteristics for a New Era, Zhejiang has achieved landmark results in building a powerful transportation country, including integrated development of Ningbo Zhoushan Port, full coverage of well-built rural roads, and completion of a comprehensive transportation network with six vertical and six horizontal corridors ^[4-5]. As an important carrier for cultivating industrial talents, transportation vocational colleges provide core talent support and internal driving force for high-quality transportation development. It has become an urgent task to integrate I&P education into the whole process of vocational education and transform the great achievements and spiritual wealth of the transportation industry into vivid materials for I&P education. Based on the practical exploration of Zhejiang Institute of Communications, this paper deeply analyzes the integration logic and realization paths of I&P education in vocational education, and offers replicable and promotable experience for similar colleges.

Some vocational colleges in Zhejiang have carried out educational practices combining industrial characteristics. Zhejiang Police Vocational College developed a "Five-in-One" practical model centered on safety prevention, giving full play to the fighting role of I&P education in industry-education integration, faculty development, student management, training infrastructure, and social services ^[6]. Zhejiang Finance Vocational and Technical College proposed that I&P education should focus on fostering virtue through education and regard training of "dual leaders" as a key measure for professional development ^[7]. Zhejiang University of Mechanical and Electrical Engineering implemented an integration project of I&P education and majors to boost high-quality development in the era of the "Double High-level Plan" by enhancing leadership, support, and contribution capacity ^[8]. Jinhua Polytechnic built a one-stop student community demonstration brand relying on I&P classrooms and explored one-stop student services via the "Four Guidance Project" ^[9].

2. Core connotation and integration logic of vocational education under ideological and political education

2.1. Educating for the party and the country as the core connotation of vocational education

Essentially, I&P education in vocational education transforms the Party's political and organizational advantages into educational strengths. It equips students with the Party's innovative theories, nurtures their minds with industrial practical achievements, and shapes their souls with red cultural genes, realizing the organic integration of consolidating Party building, prioritizing education, empowering industries, and all-

round development, and ultimately achieving the goal of educating for the Party and the country.

Its core connotation is reflected in three dimensions. First, the dimension of political guidance: we adhere to the socialist orientation of running schools, implement the fundamental task of fostering virtue through education throughout the whole process of vocational education, and cultivate technical and skilled personnel who uphold the leadership of the Communist Party of China and meet the needs of national development. Second, the dimension of industry integration: based on industrial characteristics, we deeply integrate the industry's development history, major achievements, and spiritual inheritance with ideological and political work, so that professional education and ideological and political education can advance in tandem. Third, the dimension of practical education: taking ideological and political activities as the carrier, we guide students to strengthen their ideals and convictions and hone solid capabilities through the construction of on-campus and off-campus practical bases, volunteer services, social surveys, and other forms of practice.

2.2. Establishment of integration logic: Value guidance – resource integration – cultural inheritance

Logic of Value Guidance: Party building provides fundamental political guarantee for vocational education. The type positioning of vocational education closely links it with industrial development and industrial upgrading. Through clarifying educational orientation and strengthening value guidance, I&P work ensures vocational education always serves national strategies and industrial demands, avoiding the one-sided tendency of valuing skills over morality.

Logic of Resource Integration: I&P education pools diversified resources for vocational education. It effectively integrates resources from governments, industries, enterprises, and society to build a school-local-enterprise collaborative education mechanism, providing practical venues, teaching staff, and technical support, and enriching the forms and contents of I&P education.

Logic of Cultural Inheritance: I&P education injects red cultural genes into vocational education. By organically integrating red culture, industrial culture, and campus culture and constructing red education bases and cultural inheritance activities, vocational characteristic campus culture can be cultivated to realize educating people through culture and morality.

3. Practical paths of ideological and political education in vocational education

Based on Zhejiang's transportation industrial characteristics, Zhejiang Institute of Communications has built an all-round, multi-level and three-dimensional I&P education system centered on the construction of a powerful transportation country (**Figure 1**). The model addresses three core questions: what to integrate, how to integrate, and where to integrate.

What to integrate: Develop high-quality comprehensive ideological courses themed on building a powerful transportation country, carrying out serial activities including "writing about transportation, traveling transportation routes, building ports and constructing transportation networks."

How to integrate: Build a cultural education system of "Five Actions Fulfill Five Educations" — cultivate morality, intelligence, physical health, aesthetics and labor through practice.

Where to integrate: Integrate I&P education into main teaching positions, ideological practice activities

and online campus platforms to realize integrated online and offline education.

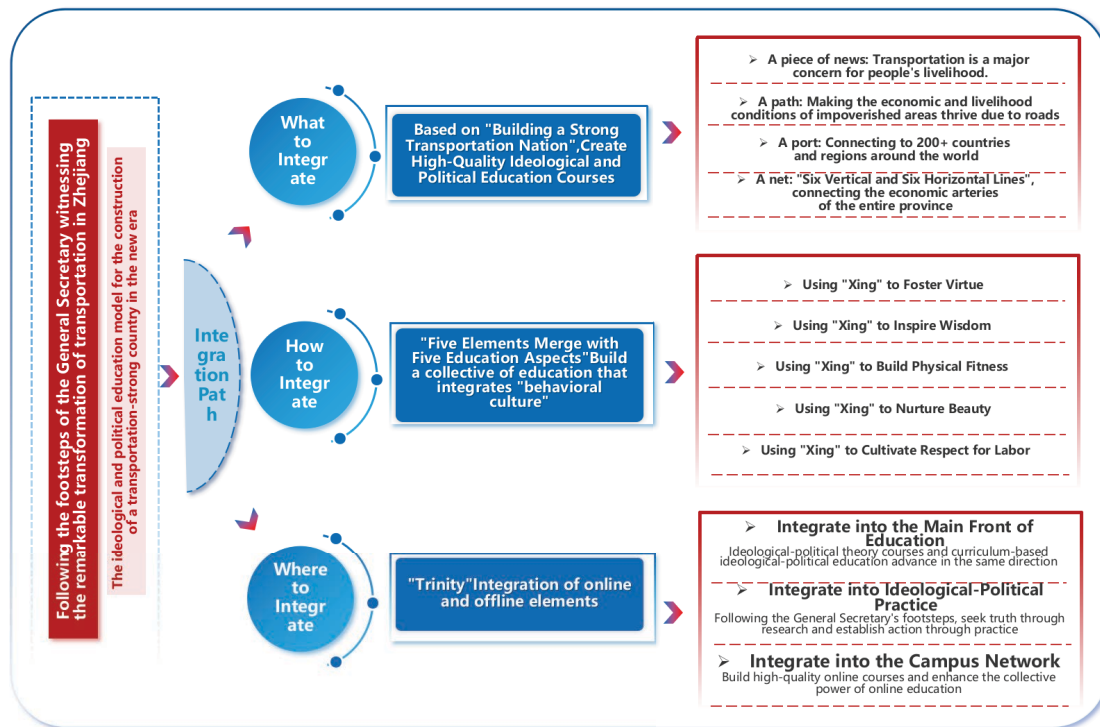


Figure 1. The ideological and political education model for building a powerful transportation country in the new era

On the basis of constructing the ideological and political education model for building a powerful transportation country in the new era, practical approaches to ideological and political education in vocational education shall be implemented. The specific practical approaches are as follows:

3.1. Build an “ideology + industry” education system to strengthen political guidance

Clarify educational orientation: The Party Committee of the college attaches great importance to I&P education, establishing leading groups for campus cultural construction and ideological theory courses. A comprehensive ideological education pattern has been formed featuring unified leadership of the Party Committee, overall coordination of the Academic Affairs Office, linkage of relevant departments, and implementation by secondary colleges. Important speeches and instructions of the President of the CPC on building a powerful transportation country are incorporated into theoretical study groups of the Party Committee, Party member training, and ideological courses to ensure education advances along the correct political direction.

Enrich educational connotation through industry empowerment: Relying on Zhejiang’s transportation advantages, landmark achievements including integrated development of Ningbo Zhoushan Port, full coverage of well-built rural roads and the six vertical and six horizontal comprehensive transportation network are transformed into I&P teaching materials. The college launches thematic I&P education themed “a road, a port, a network and a sentiment.” Industry model workers, great craftsmen and outstanding alumni are invited as moral tutors to carry out activities such as “Model Workers Enter Campus”, passing on the transportation spirit of forging ahead and the pursuit of excellence embodied in the craftsman spirit.

3.2 Forge an “ideology + culture” education brand to deepen cultural heritage

Construct red cultural education positions: The college integrates internal and external resources to build an integrated red practical teaching base consisting of six venues: school history museum, Party history museum, Party leadership exhibition hall, Zhejiang Transportation Museum, Liu Yuan Memorial Hall and Long March Spirit Inheritance Hall, covering a total area of 2,100 square meters. The base integrates exhibition, teaching, reading and research to deliver immersive red education. Other characteristic practical bases, including a low-altitude economy popular science base, an ancient bridge culture base, a multi-modal transportation and logistics base, and a transportation safety virtual simulation platform, are also built. Red cultural knowledge is embedded in all professional teaching. Cultural facilities such as the “Red Footprints of the President of the CPC ” gallery and Red Book House are constructed on campus to create a strong red education atmosphere.

Form the educational culture of “Five Actions Fulfill Five Educations”: Rooted in the school motto of “Aspiration and Practice” and transportation industrial characteristics, the college develops a “Practice Culture” brand with the connotation of cultivating morality, intelligence, physical health, aesthetics and labor through practice. Absorbing Liangzhu culture and Zhejiang’s pioneering transportation culture, the brand integrates the fundamental task of fostering virtue through education into campus culture. It incorporates the Two-Road Spirit, Hong Kong-Zhuhai-Macao Bridge builders’ spirit, Paving Stone Spirit and craftsman spirit to promote students’ all-round development. A series of sports, aesthetic and volunteer activities are held to carry forward the transportation spirit and labor awareness, with experiential and immersive labor practice bases built.

Characteristic activities including micro-video contests themed “Roads in Hometown”, photography competitions for the most beautiful rural roads, mini marathons of bridges and ports, volunteer programs where thousands of students visit villages to promote well-built rural roads, and lectures delivered by outstanding figures such as post-95 delivery rider Yang Yanghui and war veteran Luo Baogen integrate I&P education into cultural activities to achieve holistic development of morality, intelligence, physical fitness, aesthetics and labor skills.

3.3. Innovate the “ideology + practice” education model to boost educational effectiveness

Build a trinity education field of classroom – practice – online: In classroom teaching, ideological elements of the transportation industry are integrated into professional courses to realize coordinated development of ideological courses and curriculum-based I&P education, forming a teaching feature where professional courses contain ideological value and ideological courses cover professional knowledge. In practice, brand volunteer activities are organized, such as thousands of students visiting villages to promote rural roads and assisting enterprises in solving technical problems. Online high-quality ideological courses, including Current Politics, are launched on Zhejiang Online Open Course Platform to expand teaching coverage and gather online educational synergy.

Deepen school-local-enterprise collaborative practical education: Long-term cooperation mechanisms are established with enterprises such as ZEEKR Intelligent Technology and Zhejiang Communications Construction Group, as well as local governments and transportation authorities including Songyang, Changxing and Jingning. Students participate in rural road maintenance and rural logistics construction to

improve professional skills and service awareness in practice, linking small classrooms to the greater society.

3.4. Improve the “ideology + guarantee” education mechanism to consolidate educational foundations

Organizational and institutional guarantee: Documents including Work Plan for Comprehensively Promoting Comprehensive Ideological Courses and Implementation Plan for Deepening the Reform of Teaching Staff, Teaching Materials and Teaching Methods are formulated to clarify objectives and requirements. A daily communication mechanism is established to coordinate functional departments and ensure full implementation of all work.

Human resource and hardware support: More than 20 cadres and staff are dispatched to transportation authorities every year for temporary training. Industry experts, model workers, and great craftsmen are invited to join the teaching team. A fund of 2.5 million RMB is invested in the red cultural practical teaching base and 20 million RMB in the digital transportation port to provide sufficient hardware support for I&P education.

Financial guarantee: An annual special fund of 360,000 RMB is allocated for comprehensive ideological course construction, with separate budgets for the operation of red education venues and the digital transportation port to sustain Party-led I&P education.

4. Conclusion and prospects

Ideological and political education is the key for vocational colleges to fulfill the fundamental task of fostering virtue through education, as well as an important guarantee for high-quality vocational education development. The practical exploration of Zhejiang Institute of Communications proves that constructing an integrated education system combining ideology, industry, culture and education can effectively solve the problem of separation between ideological education and professional teaching, and realize the organic unification of political guidance, knowledge transmission, skill training and value shaping.

At present, vocational education is at a critical stage of improving quality, fostering excellence, elevating value and empowering development, and ideological and political education is also facing new opportunities and challenges. Going forward, vocational colleges should further strengthen the role of ideological and political education and continuously optimize the education system. First, deepen theoretical consolidation, continue to study and implement the President of the CPC Thought on Socialism with Chinese Characteristics for a New Era, especially the President of the CPC’s important expositions on vocational education and the development of a country with strong transportation infrastructure, and enrich the theoretical connotation of ideological and political education. Second, innovate education methods, fully apply digital and intelligent technologies to build more integrated online and offline platforms for ideological and political education, and enhance the appeal and effectiveness of education. Third, expand the scope of collaborative education, further strengthen cooperation with governments, industries, enterprises and communities, and build an all-round and three-dimensional educational ecosystem. Fourth, boost the transformation of practical achievements, timely summarize practical experience in ideological and political education led by Party building, form replicable and promotable models, and contribute more wisdom and strength to the ideological and political work of vocational education in the new era.

Disclosure statement

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Practical Exploration and Optimization Path of AI-empowered Personalized Mathematics Teaching in Higher Vocational Colleges

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Abstract: Based on the Chaoxing AI Workbench, this paper targets the long-standing structural bottlenecks in higher vocational mathematics teaching, including diversified student demands, crude learning diagnosis, and insufficient teaching resources. A “Four-dimensional Linkage” enabling mechanism is constructed, which realizes precise stratification through student learning portrait diagnosis, solves the problem of homogeneous resource supply via stratified resource adaptation, runs through three classroom links with full-process teaching implementation, and guarantees personalized learning outcomes through dynamic diversified evaluation, forming a complete closed loop of “Diagnosis — Resource Supply — Teaching Implementation — Evaluation.” Practice results show that this mechanism achieves remarkable effects in improving teaching quality, narrowing gaps between students and optimizing learning experience. Aiming at practical shortcomings such as insufficient resource reserves, insufficient teachers’ digital literacy, poor technical adaptability and imperfect institutional guarantees, this paper further puts forward optimization countermeasures including inter-collegial co-construction and sharing, three-dimensional teacher transformation driving, collaborative tackling of technical defects and perfecting supporting systems, so as to provide useful reference for the intelligent transformation of public basic courses.

Keywords: Artificial intelligence; Higher vocational mathematics; Personalized teaching; Teaching students in accordance with their aptitude; Teaching reform

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1. Introduction

In recent years, documents such as the Overall Layout Plan for the Construction of Digital China and the Outline of the Plan for Building a Powerful Country through Education (2024–2035) have been issued successively, clearly requiring vigorous implementation of the national digital education strategic initiative and comprehensive promotion of education transformation empowered by artificial intelligence^[1]. As a

public basic course in higher vocational colleges, higher vocational mathematics plays an important role in cultivating students' scientific literacy, comprehensive ability, and sustainable development capacity ^[2]. However, due to the significant differences in mathematical foundations among multiple student sources, including general high school graduates, secondary vocational graduates, and single-admission students, the traditional “one-size-fits-all” teaching mode cannot help underachieving students consolidate basic knowledge ^[3]. How to realize genuine “teaching students in accordance with their aptitude” with the aid of artificial intelligence technology has become a practical issue facing higher vocational mathematics teaching reform. Relying on the Chaoxing AI Workbench and taking the national high-quality online course Applied Advanced Mathematics as the carrier, this paper systematically explores the internal mechanism and practical path of AI-enabled personalized higher vocational mathematics teaching, offers useful references for higher vocational mathematics to break away from the dilemma of failing to meet diversified student needs and advance the intelligent transformation of public basic courses, and helps comprehensively improve talent training quality ^[4].

2. Practical exploration of AI-enabled personalized higher vocational mathematics teaching

2.1. Practice overview

2.1.1. Description of research samples

In this comparative teaching practice, two parallel classes of Railway Engineering Technology majors with students from general high schools in the Grade 2025 are selected as research samples, with 40 students in each class. The control class adopts conventional traditional teaching throughout the whole semester, while the experimental class introduces AI tools to build personalized learning paths. Before the formal practice, a mathematics placement test and learning demand questionnaire are distributed to all students. After comprehensive comparison of the mathematical foundation, autonomous learning ability, and curriculum learning demands of the two groups, there is no statistically significant difference in all indicators, which meets the basic conditions for comparative research. Applied Advanced Mathematics is selected as the experimental course for the first semester of the 2025–2026 academic year, with a total of 16 weeks and 64 class hours.

2.1.2. Platform and tools

The whole teaching practice takes the Chaoxing Xuexitong intelligent teaching platform as the online carrier, and two generative AI tools, Doubao and iFLYTEK Spark, are used to assist daily teaching.

2.2. Teaching implementation process

2.2.1. Preparatory work

All preparatory work is completed one week before the course starts. First, learning assessment tests and online questionnaires are organized for students in the experimental class. The AI system automatically analyzes collected learning data and generates exclusive learning files for each student, based on which students are divided into initial learning levels. Mathematics teachers cooperate with railway engineering professional teachers to build a stratified course resource library covering core chapters including limits, derivatives, integrals, and probability and statistics, uploading basic-level micro-lessons and courseware,

intermediate variant exercises, and extended professional application cases. Matching classroom objectives, in-class exercises, and assessment standards are set separately for students with three different types of learning weaknesses^[5-7].

2.2.2. Teaching implementation stage (Week 1 to Week 15)

Pre-class, in-class, and post-class stratified learning arrangements with different focuses are arranged for each class.

Pre-class: The online platform pushes preview micro-lessons, knowledge summary lists, and pre-class self-test exercises with matching difficulty according to students' previously divided learning levels. For example, students at the basic level focus on mastering fundamental concepts and proficient basic calculations, while students at the extended level need to sort out application ideas of knowledge points in professional scenarios combined with railway engineering cases in advance.

In-class: Teachers uniformly explain core chapter knowledge and sort out common problems arising from preview in the first half of class. In the second half, stratified targeted exercises are arranged with different tasks for different levels: the basic group consolidates basic question types, the intermediate group completes variant questions and simple applications, and the extended group solves comprehensive application questions integrated with railway engineering professional backgrounds^[8]. Five minutes are reserved before class dismissal for free Q&A. Fragmented questions are answered instantly by AI teaching assistants, while teachers focus on responding to common difficult problems and organizing learning groups of different levels to exchange and comment on assignments.

Post-class: The platform adaptively assigns stratified homework and review materials according to students' learning status. Objective exercises are automatically graded by the system, while subjective questions are graded by teachers according to student levels. AI tools integrate all error data of students to generate exclusive error notebooks, and push explanation micro-lessons and similar variant exercises targeting weak knowledge points. The platform generates a learning analysis report every week: personalized learning optimization suggestions are pushed to all students, and overall weak modules and abnormal individual status of the class are fed back to teachers for dynamic adjustment of teaching strategies.

2.2.3. Assessment stage

The 16th week is set as the final review and assessment stage. Two completely different comprehensive assessment schemes are adopted for the two groups. The experimental class adopts a three-dimensional differentiated evaluation system: process evaluation accounts for 40%, differentiated final examination accounts for 40%, and value-added evaluation accounts for 20%. The control class follows the traditional evaluation system: usual performance accounts for 50% and the final examination accounts for 50%. After all final assessments, satisfaction questionnaires are distributed to all participating students to collect genuine subjective feedback as reference for subsequent optimization of the AI personalized teaching model.

2.3. Analysis of practical results

2.3.1. Comparison of assessment scores

Comparison of final scores directly reflects the differences between the two teaching modes. The average score of the control class is 72.36 with a pass rate of 81.55%, and excellent students account for 18.37%; the average score of the experimental class reaches 81.52 with a pass rate of 95.88%, and the proportion

of excellent students rises to 36.73%. It is obvious that students at the basic level in the experimental class achieve much higher score improvement than students with equivalent foundation in the control class, and the polarization of grades in the class is significantly alleviated.

2.3.2. Student satisfaction analysis

40 satisfaction questionnaires are distributed to the experimental class, and all 40 valid questionnaires are recovered. The results show that 91.8% of students recognize the stratified resource pushing mode and think the resource difficulty matches their cognitive level; 87.7% of students hold the view that the personalized error review function helps them quickly make up knowledge deficiencies; 85.2% are satisfied with the differentiated assessment and believe value-added evaluation can fairly reflect their learning outcomes; only 8.1% feel unadapted to the operation process. The satisfaction rate of all dimensions remains above 85%, which proves high acceptance and recognition of this teaching model among students.

2.3.3. Existing problems

Combined with teaching practice, four prominent problems exist in the current model: first, the reserve of high-quality stratified resources is insufficient, and high-level project-based teaching resources matching Railway Engineering Technology major are scarce; second, teachers' digital literacy needs to be improved, and some middle-aged and elderly teachers cannot skillfully use functions such as learning portraits and data review to carry in-depth personalized teaching design; third, technical adaptability has shortcomings — the AI cannot grade subjective advanced mathematics questions, and the intelligent Q&A system has insufficient accuracy in analyzing complex calculation and proof questions of advanced mathematics with occasional biased answers; fourth, supporting institutions are imperfect, and there is no matching performance appraisal system to support the regular promotion of personalized teaching^[9–11].

3. Optimization strategies for AI-enabled personalized higher vocational mathematics teaching

3.1. Co-construction and sharing of stratified resources to solve insufficient resource reserves

Establish an inter-collegial collaborative resource co-construction mechanism. Restricted by the limited resource development capacity of a single college, it is proposed that the Provincial Vocational Mathematics Society takes the lead to unite multiple higher vocational colleges in the region to form a “Higher Vocational Mathematics Stratified Resource Co-construction Alliance.” In accordance with the principle of unified standards, division of labor, and achievement sharing, stratified resource packages covering basic remediation, college-upgrading examination, and professional application are jointly developed^[12]. Each college undertakes the construction of corresponding modules based on its advantageous majors, and all alliance colleges share the completed resources to improve overall resource quality.

Dynamically update resources with generative artificial intelligence. Make full use of the content generation capacity of generative AI to assist teachers in quickly drafting stratified exercises, variant training and cases, with teachers responsible for review and improvement to greatly boost development efficiency. Establish a resource usage monitoring mechanism to mark and warn resources with low usage and poor feedback, and push such resources to the management terminal for developers to optimize, realizing dynamic

iterative updating.

3.2. Three-dimensional drive for teachers' transformation to address insufficient digital literacy

Build a progressive digital literacy training system. Primary training focuses on basic platform operations to ensure teachers skillfully complete routine tasks such as preview release, classroom interaction, and homework grading; intermediate training centers on interpretation of learning portraits, data review, and design of stratified resource pushing strategies; advanced training covers AI-assisted teaching design, personalized learning path planning, and improvement of teaching research capabilities^[13].

Build an integrated teacher practice community for research, training, and application. Relying on the Chaoxing AI Workbench, build an in-school digital teaching practice community for mathematics teachers. Invite professional teachers, off-campus experts, and enterprise technical staff to provide regular guidance, and hold regular seminars on personalized teaching case sharing, classroom observation, and lesson evaluation. Encourage teachers to publish stratified teaching designs and experience of AI tool application as well as learning analysis reports in the community, and solve practical difficulties through peer review and group discussion to form a benign ecosystem of learning through research, practicing through learning, and researching through practice.

Set up special incentives for AI teaching innovation. Incorporate teachers' capacity for AI-enabled personalized teaching design into the teaching ability evaluation system, and set special honors such as "AI Teaching Innovation Award" and "Excellent Personalized Teaching Case Award." Commend teachers with remarkable reform and provide resource preference to stimulate their internal motivation for active learning and innovation.

3.3. Collaborative tackling of technical deficiencies to improve technical adaptability

Optimize the adaptability of AI Q&A and grading in the mathematics field. Higher vocational colleges shall cooperate with platform technical service providers to carry out technical iteration targeting pain points of higher vocational mathematics. Open typical question banks, common error sets, and standard analysis templates of calculation and proof questions to technical teams for targeted fine-tuning of large mathematical models, so as to improve recognition accuracy of complex calculation steps and proof logic chains. Prioritize tools supporting mathematical dedicated functions, including formula recognition, step derivation, and graph drawing, to avoid maladaptation of general AI in mathematics teaching.

Continuously optimize AI models based on student learning data. Regularly classify and analyze wrong cases of AI Q&A, and feed back data of frequently incorrect and biased answers to technical teams for targeted optimization of model algorithms. Collect student satisfaction evaluations on AI Q&A, categorize feedback into three levels: fully helpful, partially referential, and ineffective, and gradually polish Q&A functions to make intelligent tools better fit the real scenarios of daily higher vocational mathematics teaching^[14].

3.4. Improve supporting institutions to guarantee regular implementation

Establish supporting management systems matching personalized teaching. First, optimize class hour allocation according to teaching demands, appropriately increase higher vocational mathematics class hours and reserve time for stratified teaching, AI operation and one-on-one tutoring; second, reform performance

appraisal and incorporate digital personalized teaching design, resource development and teaching effects into teachers' performance indicators to stimulate teaching reform enthusiasm; third, set up a long-term supervision mechanism, with the Academic Affairs Office conducting regular inspections and collecting feedback to dynamically optimize implementation plans ^[15].

Build a long-term operation mechanism for a stable teaching mode. Mathematics teaching and research offices of all colleges may take AI-assisted stratified teaching as core annual teaching research tasks. Directors of teaching and research offices coordinate overall work, while course leaders and backbone teachers take the lead in demonstration classes followed by young teachers. Implementation plans and schedules are formulated at the beginning of each semester; special teaching research meetings are held every 2–3 weeks during the semester; teaching effects are assessed and experience summarized at the end of each semester. Regular communication mechanisms with the Academic Affairs Office and Information Center as well as secondary colleges are established to ensure smooth resource docking and technical support.

4. Conclusion and reflections

Based on the practical difficulties of realizing “teaching students in accordance with their aptitude” in higher vocational mathematics, this paper constructs a four-dimensional linkage AI-enabled personalized learning mechanism. Verified by teaching practice, this mechanism achieves remarkable results in improving teaching quality, narrowing student gaps, and optimizing learning experience. Teaching reform cannot be accomplished overnight. At present, insufficient resource reserves, inadequate teachers' digital literacy, poor technical adaptability, and imperfect institutional guarantees still restrict the full release of AI teaching efficiency. In the future, on the basis of optimizing the personalized teaching system, key measures including inter-collegial co-construction and sharing of high-quality resources, three-dimensional drive for teachers' digital transformation, collaborative tackling of technical defects and complete supporting institutions shall be solidly promoted to fully unleash the precise empowering advantages of artificial intelligence, realize differentiated adaptation and integration with vocational posts, carry out student-centered personalized teaching, support student development and provide solid support for cultivating high-quality technical and skilled talents.

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Application of Blended Teaching in English Cross-Cultural Classrooms

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Abstract: Blended teaching combines the self-study mode of the Internet with the offline classroom to offer a new way of doing English cross-cultural teaching. At present, there are many restrictions on the integration of resources, forms of interaction, and assessment systems in English cross-cultural classrooms, so it is difficult to fully achieve the practical effect of cultivating cross-cultural competence. According to the values embedded in blended teaching, this paper will identify the actual problems of English cross-cultural classroom teaching and put forward three stages of optimization paths for the construction of resource banks, interactive scenario creation, and evaluation mechanisms, etc., to provide a reference for reforming English cross-cultural classroom teaching.

Keywords: Blended teaching; Cross-cultural teaching; English classroom; Teaching strategies

Online publication: August 13, 2026

1. Introduction

The two goals of English classes are to train students' language skills and cultivate their sense of cross-cultural awareness; thus, the quality of English teaching has begun to be evaluated based on cross-cultural communication ability. The popularization of information technology has provided conditions for the transformation of teaching methods, and blended teaching has broken through the limitations of traditional classrooms in terms of time, space, and resources; thus, the inheritance of cross-cultural knowledge is no longer restricted by the length of a forty-five-minute class. Based on English teaching practice, it has been found that blended teaching still has many practical problems in terms of cross-cultural content presentation, organization of classroom interaction, and learning outcome evaluation, which urgently need to be systematically sorted out and improved. Based on the analysis of relevant literature and reflection on teaching practice, this paper aims to put forward some practical and feasible optimization suggestions for addressing the above problems in frontline English teaching of cross-cultural education.

2. Value implications of blended teaching in English cross-cultural classrooms

2.1. Increase the path for collecting cross-cultural knowledge by solving the issue of only having one classroom

Due to the fixed selection of textbooks and limited class time, traditional English classes have mainly presented cross-cultural knowledge in the form of simple vocabulary annotations and brief introductions to cultural backgrounds; therefore, students cannot form an organized and three-dimensional sense of culture. Blended teaching can take advantage of platforms for online learning, digital resource banks, and mobile terminals to extend the space of cross-cultural study beyond the classroom and enable students to access more foreign cultural materials outside of class freely, such as customs and etiquette, historical origins, social habits, etc. When the boundaries of time and space are broken, students will be able to acquire cross-cultural knowledge without being restricted by the speed of the teacher's explanation or the length of the textbook; according to their own interests and level of understanding, they can select a specific cultural topic for in-depth study and form a personalized cognitive path. Therefore, the classroom instruction section will no longer be solely about the transmission of knowledge but will focus on clarifying key points and difficulties and the collision of ideas to enhance both the overall teaching efficiency and the depth of cultural literacy, thus creating more space for the cultivation of cross-cultural literacy ^[1].

2.2. Integration of online and offline resources: Expanding the forms of cross-cultural teaching materials

The effectiveness of cross-cultural teaching is determined to a large extent by how rich and attractive the materials themselves are; if it is only text descriptions, students will be unable to experience the concrete expressions of foreign cultures. Blended teaching will use various forms to present cross-cultural teaching materials, such as online audio-visual materials, virtual scenarios, and multimedia courseware; at the same time, offline physical displays, situation re-enactments, and teacher-student discussions will also be applied. Online resources can directly show authentic scenes of foreign festivals, daily life, and language exchange to address the lack of sensory experience in the classroom; at the same time, the offline part is guided by teachers and peer interaction to have students organize, compare, and analyze the cultural information obtained online, thus integrating it into their own knowledge structure ^[2]. The two types of resources are in harmony and support each other to make the abstract ideas of culture tangible and easier to comprehend. Students' understanding of foreign cultures increases at the level of symbols and also reaches the level of values and ways of thinking; thus, the educational function of cross-cultural teaching materials is fully realized ^[3].

2.3. Motivate students to study on their own and improve their cross-cultural communication skills

The development of cross-cultural communicative competence is not only achieved through passive practice of language and cultural experience by students but also by using language to recognize differences and resolve misunderstandings in real life ^[4]. Blended teaching gives students more time for independent study, so they can set their own study plans and repeatedly apply communicative strategies in various ways, such as role-playing, situation simulation, and cross-cultural case studies, to test and improve their own understanding of foreign cultures through practice. Self-study is also a way for students to develop cross-cultural sensitivity; through repeated attempts and reflections, they learn to view problems from various

cultures, become aware of cultural differences in communication, and respond appropriately to such differences ^[5]. The classroom section can focus on the communication problems that occur during students' independent study, provide concentrated practice and teacher feedback to help solve these problems, so that the cultivation of cross-cultural communicative competence is based on practical language application and cultural practice, and does not stop at learning theoretical knowledge ^[6].

3. Current application status of blended teaching in English cross-cultural classrooms

3.1. Lack of integration between online and offline resources, fragmentation of cross-cultural content

Many English classes have introduced online teaching platforms, but there is a lack of unified planning and connections between the online resources and the offline classroom. There is no connection between the cultural materials teachers present before class and the focus areas of classroom teaching; after students have reviewed the online materials, classroom instruction does not link to or expand upon this content, and thus cross-cultural knowledge remains at the level of superficial information accumulation and cannot form a systematic system of cultural understanding ^[7]. The selected materials by some teachers are random; there is no in-depth, continuous research, nor do they offer the same cultural topic from multiple perspectives, which results in disconnected cross-cultural content for students and cannot create a connection among various pieces of knowledge. Currently, there is a problem of fragmented resource integration; thus, the advantages of time and space expansion in blended teaching cannot be fully utilized to promote in-depth cross-cultural understanding, and students' awareness of foreign cultures is at a superficial level, failing to achieve the aim of systematic cultivation of cross-cultural literacy ^[8].

3.2. Monotonous forms of classroom interaction and a lack of cross-cultural scenario construction

The classroom part of blended teaching should be used to help students practice cross-cultural knowledge through language application, but most of the classroom interaction is still in the traditional model of teachers asking questions and students answering, and there is a lack of scenario design that can motivate students to communicate cross-culturally. Teachers often have students merely recite the cultural knowledge they have learned online when planning classroom activities and do not design scenarios that require students to apply cross-cultural knowledge for judgment and response; thus, they are unable to convert cultural cognition into communicative competence ^[9]. Class discussion segments are also frequently shallow, and the students' answers are often just simple restatements of what they have learned; there is little exchange of ideas or cultural comparisons. The uniformity of interaction forms cannot fully achieve the goal of classroom teaching, and situation sensitivity and adaptability are needed for cross-cultural communication, but they cannot be cultivated in such an environment; thus, students' cross-cultural learning remains at the cognitive level and never reaches a practical communication stage ^[10].

3.3. Lagging construction of evaluation mechanisms and lack of a cross-cultural competence assessment system

At present, the English curriculum's assessment system is dominated by tests of vocabulary, grammar, and

reading; cross-cultural communication skills are still considered secondary in terms of assessment, and there is no specific or regular evaluation system for them. Although blended teaching has expanded the scope of cross-cultural learning for students, due to the slow speed of the evaluation mechanism, it is impossible to objectively record and provide feedback on students' level of engagement, depth of thinking, and degree of cultural understanding during the online autonomous study period, thus preventing teachers from assessing the development of students' cross-cultural literacy^[11]. There are no formal assessment criteria for how well classrooms are conducted in cross-cultural teaching, and teachers often just give general praise based on their own feelings; they do not specify how students have demonstrated cultural sensitivity or employed communicative strategies. The evaluation system is too slow to respond; as a result, it cannot accurately reflect the actual effects of blended teaching. Teachers are unable to revise their teaching plans promptly in response to this information, and thus, the overall quality of cross-cultural competence education is declining^[12].

4. Practical paths for optimization of English cross-cultural classrooms with blended teaching

4.1. Reconstruction of online and offline resources and construction of a systematic cross-cultural content bank

In light of the problem of scattered cross-cultural content, educators need to break down the wall separating the online and offline spheres and create an all-encompassing cultural-themed content hub. Teachers should take the topics of textbook units as the framework, unify the background knowledge, language expressions, and communicative examples under the same cultural theme in the resource bank, ensure that the content pushed online and the focal points of classroom instruction are always in line with this main thread, and avoid disconnected content. The construction of the resource bank should also pay attention to hierarchical design; according to the cognitive patterns of students, cultural materials should be divided into different levels, such as basic cognition, deep understanding, and comparative reflection, to lead students to learn gradually from shallow to deep and from the surface to the essence^[13]. The classroom teaching part should serve to organize, refine, and elevate the online resources; teachers need to integrate the cultural information that has already been introduced in class, guide students to discover the internal connections among various materials, so that the originally scattered knowledge points can form a complete, systematic picture of cultural understanding and improve the completeness and coherence of cross-cultural teaching^[14].

4.2. Innovative blended interactive forms and the creation of immersive cross-cultural scenarios

To enhance the quality of classroom interaction, educators should have students genuinely apply cross-cultural knowledge in specific situations rather than just repeating and restating what they have learned. Teachers can make full use of the technical conditions of blended teaching to create communicative situations that require students to make judgments and choices based on cross-cultural cognition, such as forms of situational dialogue, role reversal, and viewpoint debates; thus, students will be motivated to use their own cultural knowledge in interactions and experience the differences in language application and communication methods in different cultures^[15]. The creation of scenarios should have a certain level of complexity and openness; they should not be simple questions with only one correct answer, but rather lead students to consider and choose among several ways to answer in order to cultivate their ability to flexibly

adapt to cross-cultural communication^[16]. At the same time, teachers should also take on the role of guides in the interaction, promptly identify students' misunderstandings of the culture in the scenario response, and through follow-up questions and pointers, prompt them to think; thus, the classroom interaction serves as a vital way to stimulate and improve cross-cultural communicative competence, rather than just a place for memorizing language knowledge^[17].

4.3. Expansion of the diversity of the evaluation system and construction of a good cross-cultural competence assessment system

The cultivation results of cross-cultural competence should be reflected in a reasonable evaluation system that is in line with reality and truly shows this situation. Teachers should construct an all-round evaluation system for the whole process of online learning and offline practice, considering the time and effort students spend on learning online resources, the depth of their thinking, and their communication in offline classes in the assessment^[18]. In addition to examining how well students master language knowledge, other specific indicators should be added to the evaluation, such as cultural sensitivity, the depth of cross-cultural understanding, and the use of communicative strategies; thus, the evaluation results will better reflect the development level of students' cross-cultural literacy^[19]. Evaluation methods should also be varied; in addition to teacher assessment, other ways can be used to have students evaluate themselves and their peers, thereby enhancing students' awareness of what has been achieved and what needs to be strengthened in cross-cultural communication through joint reflection. Teachers should adjust the focus of teaching and the design of interaction in response to specific information from evaluation feedback in a timely manner; thus, evaluation should be used as a basis to drive improvements in teaching, rather than simply being a final assessment at the end of the semester, and through continuous evaluation feedback, the overall quality of cross-cultural competence cultivation will gradually be enhanced^[20].

5. Conclusion

Blended teaching is a new way to reform the teaching of English in cross-cultural classrooms. It is to extend the scope of teaching time and space, to provide conditions for the systematic construction of cross-cultural knowledge, to conduct practical training in communicative competence, and to carry out scientific assessment of learning outcomes. The problems with current teaching are that resources are scattered, the forms of interaction are monotonous, and there is no evaluation system; teachers should work together to unify the content, create scenarios, and enhance assessments. Only through the true integration of online and offline resources, the transformation of classroom interaction into genuine cross-cultural communicative practice, and the embedding of the evaluation mechanism in the whole teaching process can the educational value of blended teaching be fully realized in English cross-cultural classrooms, and students' cross-cultural communicative literacy will achieve solid development.

Disclosure statement

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Exploring the “Four Collaborations and Four Integrations” Collaborative Cultivation Model for the Design Majors Driven by the Demands of the Digital Design Industry

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Abstract: With the development of China’s digital economy and the accelerating intelligent transformation of the design sector, design education faces great pressure to restructure its talent development systems. Local universities, in particular, struggle with curricula that lag industry practice, shallow university–enterprise partnerships, and assessment methods that bear little relation to professional standards. Drawing on theories of industry — education integration, constructivism, and design thinking, this study proposes a “Four Collaborations and Four Integrations” model. The collaborative dimensions (co-construction, co-management, co-creation, and co-evaluation) establish a governance framework, while the integrative dimension merges curricula with industry capabilities, faculty expertise with professional practice, teaching spaces with production platforms, and academic evaluation with industry benchmarks. The model starts from a dynamic mapping of regional digital design competency needs. It introduces agile pedagogies such as project-based flipped classrooms (PBL 2.0) with live industry briefs and design sprints and builds a hybrid practice environment combining on-campus digital workshops with enterprise project sites. A multi-component value-added assessment system (drawing on portfolios, process logs, employer feedback, and competition results) completes the loop. A two-year action research cycle in the institution indicates that the model has improved students’ integrated professional readiness, strengthened faculty members’ dual-qualified profiles, and deepened the discipline’s regional embeddedness. The findings offer a workable, adaptable blueprint for reform in applied design education, with both theoretical relevance and practical transferability.

Keywords: Digital design; Industry-education integration; Four Collaborations and Four Integrations; Collaborative education; Design education; Teaching model reform

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1. Introduction

Digital technologies such as artificial intelligence and extended reality are fundamentally reshaping the definition, production mode, and value of designs ^[1–5]. Digital design competence has become a cornerstone of national cultural competitiveness and a driver of the so-called “new quality productive forces.” China’s “Digital China” initiative and the cultural development goals of the 15th Five-Year Plan both emphasize deeper convergence between digital tools and creative industries. This context places new demands on higher education: educators must produce graduates who combine aesthetic sensibility and design thinking with digital fluency, technical understanding, collaborative skills, and project management ability.

However, a number of local universities find it difficult to keep pace. The curricula often remain wedded to older tools and methods, while the digital design industry has moved on to BIM, AIGC, real-time rendering, and interactive prototyping ^[2]. University–industry cooperation, where it exists, tends to be superficial (occasional guest lectures, internships, or sponsorship of final-year projects) without touching core aspects like curriculum design, pedagogical delivery, or quality assurance. Assessment still relies heavily on static skill tests and final portfolio presentations, whereas employers value problem-solving under constraints, team communication, and delivery discipline. These mismatches are intertwined and self-reinforcing between what is taught and what is needed, between partnership rhetoric and reality, and between academic grading and professional judgment.

Breaking this impasse calls for a new collaborative education model that is deeply engaged with the industry, spans the entire student journey, and can renew itself over time ^[4–5]. This paper draws on the reform experience at Tangshan Normal University to present the “Four Collaborations and Four Integrations” model as a systematic, evidence-based response to these challenges.

2. Core challenges and theoretical grounding: the rationale behind the “Four Collaborations and Four Integrations” model

The difficulties that design education in local applied universities faces can be understood as a failure of coupling between a relatively closed academic system and an open, fast-moving industrial system. Industry–education integration is not simply resource exchange; it involves different actors (universities, firms, professional bodies) with different logics (educational vs. commercial) and different values (cultivation of persons vs. market returns). A sustainable integration requires a stable governance structure and clear interaction pathways.

The “Four Collaborations” refer to the co-construction, co-management, co-creation and co-evaluation, which address the partnership’s governance and sustainability. Specifically, co-construction means that curricula and development plans are jointly designed, based on a shared understanding of skill needs. Co-management brings industry experts into routine teaching oversight and milestone reviews, establishing a recurring “dual-mentor” pattern. Co-creation involves shared investment in and operation of realistic practice platforms, aligning interests and resources. Co-valuation integrates industry standards and market feedback into the final judgment of student outcomes, closing the quality loop. Together, these four mechanisms create a stable foundation for collaboration—one that moves beyond the typical asymmetry of university-led or enterprise-passive cooperation, towards a genuine community of shared responsibility and benefit.

The “Four Integrations” (curriculum with industry capabilities, faculty with professional practice, teaching spaces with production environments, and assessment with industry metrics) focus on the

operational layer. They specify how and where fusion should happen. For instance, educators embed toolchain workflows and digital project management into course modules; educators foster mutual learning between academic staff and industry practitioners; educators design physical and virtual learning spaces that resemble real design studios; and educators bring external validation (certifications, project sign-offs, client satisfaction) into the grading system. These four threads carry the logic of integration into every corner of the educational process, moving from ceremonial partnership to substantive educational reform.

Conceptually, the model is not a checklist of measures but a closed-loop system in which governance mechanisms (the Four Collaborations) enable the integration pathways (the Four Integrations), and the pathways, in turn, reinforce the mechanisms. The “Regional Digital Design Industry Capability Spectrum” serves as the compass — a living document that keeps all initiatives aligned with actual, emerging industry demands, rather than with abstract trends or technological fads. This framework offers both a theoretical map and a practical guide for deep, enduring industry-education synergy.

3. Implementation pathways and key actions: From capability mapping to diversified assessment

Translating the framework into classroom practice requires a sequence of linked steps. Over two years, educators piloted the model in the courses Environmental Design and Visual Communication Design, which follows four phases: precise-needs diagnosis, project-based curriculum redesign, ecosystem-based platform development, and comprehensive-assessment reform.

First, educators mapped the regional industry’s capability needs. Working with a dozen firms and industry bodies in the Beijing-Tianjin-Hebei region specializing in digital culture, smart cities, and virtual exhibitions, educators used job analysis, interviews, and graduate tracking to produce a competency framework. The framework distinguishes foundational skills, core technical skills, and higher-order competencies. The findings confirmed that local employers had moved decisively away from traditional rendering and layout work towards AIGC-assisted concept generation, BIM-based collaborative data management, interactive prototyping, and cross-functional coordination. This map not only exposed gaps in the existing curriculum but also gave the educators precise targets for new module design, ensuring that their efforts would be focused and efficient.

Second, educators restructured selected core courses (Architectural Design Methods and Exhibition Design) around real-industry projects. Educators abandoned the conventional tool-by-tool or knowledge-category sequence. Instead, educators adopted a flipped, project-based model (PBL 2.0). For example, students worked on a live brief: a digital immersive guide for the Tangshan Industrial Heritage Museum. Before class, they studied micro-modules (GIS basics, Unity interface, prompt engineering) through online resources. In class, interdisciplinary teams worked under dual mentors through a full iteration cycle, intensively applying and combining multiple digital skills, which included brief interpretation, concept generation, rapid prototyping, and user testing. After class, they refined and documented their solutions. Educators also introduced the “Design Sprint” method, condensing a typical multi-week design process into five intense workshop days. This sharpened students’ abilities to learn quickly, make decisions under time pressure, and innovate collaboratively. Course content thus became a series of project modules, each anchored in a real problem and mapped to the competency framework, with knowledge acquisition occurring organically through problem-solving.

Third, educators built a hybrid practice ecosystem including an on-campus “digital workshop” and an off-campus “enterprise enclave.” The on-campus workshop was fitted with industry-grade workstations, VR/AR equipment, 3D scanners, and licensed software. The layout and workflow mimicked a professional design firm. It serves as both a teaching space and a “pre-incubator” for small enterprise projects and competition briefs. The enterprise enclave, based at partner firms, hosts selected student teams for 4- to 8-week residencies, where they are fully embedded in commercial project teams. A shared information system connects the two sites, synchronizing project workflows, personnel schedules, and data. This arrangement creates a virtuous cycle: students train in a simulated environment and then test their skills in the real world, breaking down the physical and psychological barriers between campus and industry.

Finally, educators introduced a diversified, process-oriented assessment system. Educators also designed a four-pillar model with portfolio, process data, employer evaluation, and competition/certification outcomes to move beyond final-product grading. A dedicated learning management platform automatically captures iteration logs, team communication records, and reference search trails. Industry mentors review milestone deliverables online, and their scores and comments count toward the final grade. Students earn bonus credits for professional certifications (e.g., Autodesk Revit) or awards in recognized competitions. For graduation projects, a joint university-industry panel conducts the defense, with enterprise experts holding substantial voting weight, and commercial viability or innovation becoming key criteria. This system redirects assessment towards capability development and value creation, rather than mere knowledge recall.

4. Results, reflections, and future directions

After two complete action-research cycles (plan-act-observe-reflect), the model has produced tangible, multi-faceted improvements in the pilot programs. Both quantitative and qualitative evidence show positive impacts on students, faculty, the discipline, and the wider regional ecosystem.

Student outcomes: Proficiency in key digital skills such as BIM, interaction tools, and AIGC rose from below 30% to over 75% among pilot cohorts. The share of project submissions rated by industry partners as “highly promising and worth further development” increased from 5% to nearly 30%. More importantly, the 2026 pilot graduates enjoyed starting salaries 25% higher than their non-pilot peers within the same university. Employers consistently noted that these graduates were technically competent, quickly productive, collaborative, and displayed a nascent project-management mindset.

Faculty and curriculum development: The five participating faculty members renewed their knowledge and enriched their teaching cases through their stints in enterprise workstations and ongoing co-teaching with industry mentors. They have evolved into “dual-qualified” instructors. Four modularized courses (Architectural Design Methods, Exhibition Design, and two others) have been standardized, and educators have built a repository of 12 complete real-project cases, plus an open digital-tools resource platform—all now used across all year levels. The discipline’s ties with local industry have grown substantially; educators have jointly submitted multiple municipal research proposals and delivered feasible plans for urban renewal and industrial-heritage digitization. This has enhanced the regional service profile, creating a positive feedback loop: contribution begets support, and support enables further contribution.

Discipline-ecosystem synergy: The relationship has shifted from a one-way resource flow in which enterprises provide inputs, to a co-creative partnership. Through the physical hubs (workshop and enclave), the design department has become a local node for incubation of small-scale digital culture and

urban-regeneration projects. Over two years, faculty-student teams produced more than 20 solutions—two of which were adopted by municipal authorities. This has raised the visibility and regional relevance, initiating a virtuous cycle of talent cultivation, applied R&D, and community service.

Challenges and caveats: The stability of the Four Collaborations depends on the strategic trust and long-term benefit-sharing between universities and firms. Therefore, it requires institutional flexibility in areas like faculty workload recognition and intellectual-property arrangements. The Four Integrations also strain traditional academic scheduling; aligning the fixed semester calendar with fluid project timelines is an ongoing management issue. Moreover, the success of this pilot owes much to the project team’s pre-existing relationships and resourcefulness; transferring the model to other institutions or disciplines will demand local adaptation rather than rote replication.

Looking ahead: As generative AI continues to evolve, design education will inevitably shift its focus from tool proficiency to higher capabilities like critical judgment, aesthetic discernment, ethical reasoning, and human-AI collaboration. The next steps include weaving modules on AI ethics, sustainable design, and systems thinking into the existing integrative framework. Educators also plan to use learning analytics to track student growth trajectories more precisely and to enable more personalized interventions, pushing the model towards greater intelligence and customization. Ultimately, educators believe this approach (industry-driven, collaboration-centered, and systemically implemented) offers valuable lessons not only for design education but also for broader applied disciplines in engineering and the humanities, as higher education actively responds to and helps shape socio-economic transformation.

5. Conclusion

The “Four Collaborations and Four Integrations” model addresses the three core dilemmas of digital-design education, referring to the curriculum–industry gaps, shallow partnerships, and misaligned assessment. Such a model owns a dual strategy of governance innovation (co-construction, co-management, co-creation, co-evaluation) and operational integration (curriculum, faculty, platform, evaluation). The experience shows that the model has successfully shifted students from passive recipients to active project-based learners and co-creators, repositioned faculty as learning-ecosystem designers and industry connectors, and redefined the discipline’s relationship with the regional economy as mutually constitutive and symbiotic.

As a dynamic and open system, the model’s real strength lies in its built-in capacity for iteration and adaptation. The Four Integrations provide natural entry points for emerging topics like AI ethics and human-machine co-creation, while the Four Collaborations offer a sturdy governance foundation for expanding the industry-education community. The underlying principle through which deep collaboration can align the educational and industrial systems around shared value carries lasting practical wisdom, not only for design but for applied education more broadly.

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Class Culture Construction in Universities and an Analysis of Ideological and Political Education for College Students

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Abstract: As an important venue for students' daily lives, university classes serve as the core carrier and critical channel for carrying out ideological and political education. This paper aims to explore the interrelationship between class culture construction and ideological and political education for college students, address existing deficiencies in university class culture construction, and advance the sustainable development of ideological and political education for college students.

Keywords: Class culture construction; College students; Ideological and political education

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1. The interrelationship between university class culture construction and ideological and political education for college students

Class culture "forms the foundation for the formation and development of a class collective. Centered on the class collective with teachers and students as its main participants, it consists of the institutional, spiritual and material culture of the class, and is embodied collectively as the uniquely recognized values, ideologies, work styles and codes of conduct within the class collective"^[1-2]. A sound class culture fosters a positive and healthy atmosphere within the class, subtly cultivating students' abilities to conduct themselves and handle affairs, and boosting the development of ideological and political education.

University class culture construction and ideological and political education for college students are closely intertwined. Overall, they complement and interact with one another. Specifically, class culture construction creates a favorable environment for ideological and political work. Meanwhile, effective ideological and political education for students lays a solid foundation for building a sound class culture and greatly facilitates class culture development.

Class culture, an organic integration of material, institutional, and spiritual culture, jointly creates favorable conditions and a positive atmosphere for the smooth implementation of ideological and political education for college students.

First, university class culture construction lays a material foundation for ideological and political education for college students. Class material culture refers to the venues and living conditions for college students' study and daily life, mainly including classrooms, teaching facilities, dormitories, and the corresponding study and living environments formed therein. The implementation of ideological and political education for college students relies on specific venues and environments. By keeping classrooms clean, maintaining teaching equipment, and building harmonious dormitory atmospheres, universities can create a tidy, pleasant, and harmonious study and living environment for ideological and political education. In such a positive environment, ideological and political education for college students can achieve more effective educational outcomes.

Second, university class culture construction provides organizational guarantees for ideological and political education for college students. Class institutional culture embodies school rules and requirements as behavioral norms applied to study, work, and daily life within the class, as well as codes of conduct recognized and voluntarily followed by all class members. Smooth ideological and political education requires orderly class operation. Combined with the actual conditions of students in each class, class institutional development can formulate tailored class rules, cadre assessment standards, reward and punishment mechanisms, and other regulations for class management. By participating in the formulation of these rules, college students gain an understanding of the importance of class democracy. By abiding by class rules, they recognize how regulations cultivate self-management and autonomous learning habits. Guiding college students to participate actively in class management transforms compliance with mandatory rules into conscious practice.

In addition, establishing learning groups and Party organizations on a class basis and launching various activities in small groups enables ideological and political education to reach college students more deeply, thus delivering effective organizational guarantees for the smooth progress of ideological and political education.

Finally, university class culture construction offers spiritual support for ideological and political education for college students. As the core of class culture construction, class spiritual culture consists of shared values, cultural concepts, and life philosophies recognized by most students through practical experience. Prioritizing the development of class spiritual culture through activities such as designing class emblems and mottos strengthens students' sense of belonging and responsibility to the class, thereby boosting class centripetal force and cohesion.

The process of building class culture itself constitutes implicit ideological and political education. It inspires college students with spiritual motivation and encouragement, and participating in class cultural activities serves as a form of receiving ideological and political education. It subtly cultivates students' teamwork and collaboration awareness, fosters a love for the collective and a strong sense of collective honor, which eventually translates into practical actions to safeguard class reputation. The positive mental outlook cultivated through class culture construction provides solid spiritual support for all ideological and political education work.

2. Ideological and political education for college students powerfully promotes class culture construction in universities

Ideological and political education for college students boosts university class culture construction mainly in three aspects:

2.1. Ideological guidance

The primary role of ideological and political education in class culture construction lies in guiding students' ideology. By leveraging the value orientation and exemplary role models of ideological and political education, educators can cultivate shared beliefs, values, class spirit, and codes of conduct consistent with mainstream social culture within the class, subtly shaping college students' ideologies, psychological qualities, behaviors, and value orientations aligned with the core socialist value system^[3]. Integrating core socialist values into university class culture construction establishes correct public opinion and value orientation within the class. Taking merit students as role models generates profound educational influence, guiding college students' thoughts and behaviors to align with national and social expectations.

2.2. Institutional standardization

The institutional standardization function of university class culture operates through class institutional culture. In developing class institutional culture, various rules and regulations directly regulate and restrict college students' thoughts and behaviors, enhancing their ability to distinguish right from wrong, restraining improper conduct, and gradually guiding them toward behaviors advocated by the state and society until such conduct becomes habitual.

Built on institutional standardization, ideological and political education transforms students' external behavioral restrictions into internal self-discipline, shifting from mandatory compliance to voluntary awareness and unifying students' thoughts and behaviors.

2.3. Cohesion building

The cohesive effect of university class culture manifests in linking students' personal interests closely to the destiny and future of the class, creating a shared sense of honor and disgrace between individuals and the collective. College students possess strong self-awareness. Ideological and political education integrates individual self-awareness to form shared group psychology and values. Such shared cognition fosters students' recognition of class goals and norms, a strong sense of belonging to the class, and generates powerful centripetal force, cohesion, and collective consciousness, motivating all students to strive jointly for the development of class culture construction.

3. Effective paths to strengthen class culture construction and advance ideological and political education for college students

To address deficiencies in university class culture construction and promote sustained progress in ideological and political education for college students, targeted measures can be implemented from three dimensions as follows.

3.1. Build distinctive class material culture

Class environments constitute the core carrier of material culture construction, covering classrooms, dormitories, and online communication platforms within the class.

First, enrich classroom environments. Classrooms serve as key positions for ideological education and edification. Class emblems, mottos, class style displays, and honor certificates can be posted to enrich interior spaces; class bulletin boards and exhibition boards can be created to beautify external classroom surroundings. Such measures fill classrooms with ideological and political educational elements, realizing educational influence “like silent moistening rain.”

Second, beautify dormitory environments. Dormitories are the primary living spaces for college students. Hosting dormitory culture festivals and star-rated dormitory evaluation activities improves the material conditions of dormitories and builds harmonious living atmospheres. These activities showcase students’ individuality while enhancing their sense of honor toward dormitories and the whole class.

Third, innovate class communication platforms. Post-00 college students are avid users of short-video platforms such as Douyin, WeChat, and QQ. Establishing class homepages, QQ groups, and exclusive class QR codes enables real-time updates of class news, greatly facilitating communication between teachers and students. Meanwhile, counselors and class teachers can promptly track students’ ideological trends and behavioral dynamics, respond to emergencies efficiently, and improve the effectiveness of ideological and political work for college students.

3.2. Establish and improve class institutional culture

Class institutions cover class management frameworks and comprehensive rules and regulations.

On one hand, optimize the class management system. Build a management team centered on counselors and class teachers with student cadres as the backbone. Smooth class operation relies on collaboration and dedication among class managers, which embodies class institutional culture and serves as an important channel for improving ideological and political work for college students.

On the other hand, perfect comprehensive class rules and regulations. Through democratic and scientific procedures, formulate attendance rules, leave application regulations, comprehensive student evaluation standards, merit evaluation and reward systems to standardize assessment and management of all class members. Well-established class rules cultivate positive class atmospheres. Within such harmonious environments, ideological and political education guides college students to voluntarily abide by class rules, safeguard collective interests and strengthen their sense of class honor.

3.3. Cultivate and practice sound class spiritual culture

As the soul of class culture construction, class spiritual culture constitutes a core component of ideological and political education for college students.

First, leverage thematic class meetings to nurture class spiritual culture. Thematic class meetings act as a vital vehicle for class culture construction. Through such meetings, teachers and students jointly design and collect class emblems and mottos, which embody the essence of class spiritual culture. Meetings can also cover integrity examination education, student loan integrity education, safety education, and other topics, serving as an effective supplementary form of ideological and political education distinct from theoretical ideological courses. Tailored to different majors, thematic meetings can also finalize class management

frameworks and rules, forming major-specific class spiritual culture.

Second, carry out social practice activities to disseminate and practice class spiritual culture. Class social practices represent an important channel for cultivating and practicing class culture. Students can develop activities that embody class spiritual culture: on campus, host core socialist value lectures and knowledge contests featuring class and major characteristics, enabling students to engage in self-education and continuously elevate their ideological and political literacy. Off-campus, organize voluntary visits to nursing homes and summer social practice programs to translate the spirits advocated by class culture into real-world practice, gradually forming stable and enduring class spiritual culture over time.

4. Conclusion

“A sound class culture cultivates a strong collective awareness among students, promotes mutual assistance and friendship between peers, and greatly improves students’ interpersonal communication skills. These outcomes further advance class culture construction, creating a virtuous cycle that effectively boosts ideological and political education for students”^[4]. Constructing a positive class culture enables college students to develop correct world outlooks, outlooks on life, and values. Through long-term subtle influence, students receive patriotic, collectivist, and socialist ideological and political education. Cultural education delivered through class collectives drives new progress in ideological and political education for college students.

Disclosure statement

The author declares no conflict of interest.

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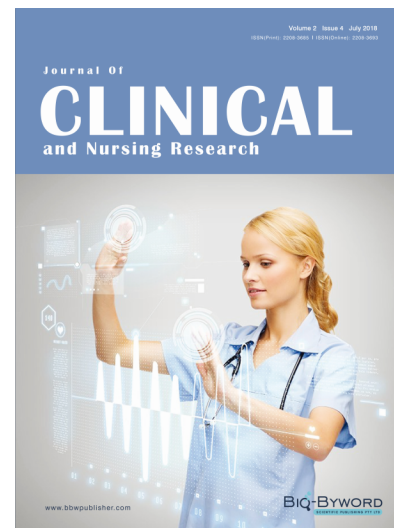
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