World Journal of Educational Research
ISSN 2375-9771 (Print) ISSN 2333-5998 (Online)
Vol. 13, No. 3, 2026
www.scholink.org/ojs/index.php/wjer

Original Paper

The Effects and Boundaries of Human–AI Collaborative Creation in Language Aesthetic Education: Quasi-Experimental Evidence from 10 Higher Vocational Colleges in the Chengdu–Chongqing Region (Note 1)

Hong Yili[1]

[1] Chengdu Industrial Vocational and Technical College, Chengdu, Sichuan Province, China

Received: May 11, 2026 Accepted: June 05, 2026 Online Published: June 26, 2026

doi:10.22158/wjer.v13n3p89 URL: http://dx.doi.org/10.22158/wjer.v13n3p89

Abstract

*This study explored the facilitating effect and application scope of human-AI collaborative creation on higher vocational students' language aesthetic literacy to provide evidence-based support for AI-empowered language aesthetic education in higher vocational institutions. A quasi-experimental design was used, and the subjects were 600 first-year students from the ten higher vocational colleges in the Chengdu–Chongqing area. A three-group (human-AI collaborative / pure-human / pure-AI) pre-test + post-test + delayed post-test experiment was conducted. The four-dimensional, 26-item self-developed *Higher Vocational Students' Language Aesthetic Literacy Scale* (Cronbach's α = 0.89, CFI = 0.93, RMSEA = 0.06), the AI Self-Efficacy Scale (AISE), the AI Anxiety Scale, the work evaluation scale and the human-AI collaborative creation log were used in this study to systematically examine the impact of language aesthetic education in human-AI collaborative creation and its moderating mechanisms and application scope. The results were as follows: (1) The human–AI collaborative group exhibited significantly higher post-test total scores in language aesthetic literacy than the pure-human group (Cohen's d = 0.72) and the pure-AI group (d = 0.85), with effect sizes for the aesthetic perception and aesthetic appreciation dimensions exceeding those for aesthetic creativity (d > 0.80 vs. d = 0.68). (2) Collaborative depth exhibited an inverted-U curvilinear effect; moderate collaborative depth (AI-assisted ideation + polishing; d = 0.65 vs. low collaboration) represented the optimal range, whereas high collaborative depth (+ evaluation intervention) resulted in attenuated effects (d = 0.58 vs. moderate collaboration). (3) AISE positively moderated the relationship between collaborative depth and aesthetic education effects (β = 0.15, p = 0.020), whereas AI anxiety*

negatively moderated this relationship (β = –0.12, p = 0.039). (4) Technical boundaries, cognitive boundaries, ethical boundaries, and aesthetic boundaries constituted a four-dimensional boundary framework for human–AI collaborative creation in language aesthetic education, systematically demarcating the operable space and non-negotiable bottom lines for AI intervention. Human-AI collaborative creation can effectively promote higher vocational students' language aesthetic literacy, but the extent of this effect depends on how deeply and in what way it is coordinated with the learners' psychological characteristics. A moderate level of collaboration depth (ideation + polishing) is ideal; thus, one must be mindful of AI anxiety interventions and the joint management of the four-dimensional boundary. The "optimal collaborative depth model" and the "four-dimensional boundary framework" built in this study provide a theoretical basis and a practical path for AI-enhanced language aesthetic education in higher vocational schools, and they have good generalizability.

Keywords

human–AI collaborative creation, language aesthetic education, higher vocational students

1. Introduction

1.1 Research Background

Language aesthetic education constitutes a core dimension of language education, bearing the important mission of cultivating students' linguistic perceptual capacity, appreciative capacity, and creative capacity. The Ministry of Education's "Artificial Intelligence + Education" Action Plan has explicitly proposed exploring effective paths for AI-empowered aesthetic education, and the Opinions on Comprehensively Strengthening and Improving School Aesthetic Education Work in the New Era, issued by the General Office of the Central Committee of the Communist Party of China and the General Office of the State Council, have included "aesthetic appreciation and creation" in the core competencies of Chinese language education to provide policy support for the goal-setting of language aesthetic education. Nevertheless, higher vocational students generally have deficiencies in language application ability and weak aesthetic literacy (Zhang & Dai, 2025); at the same time, they exhibit a strong expressive desire for online language in the era of new media. The above contradiction shows that reforms to language aesthetic education in higher vocational schools are needed urgently.

Generative AI (e.g., ChatGPT, Wenxin Yiyan) can provide personalised help for language learning. Qiao and others (2023) conducted a meta-analysis to find that the overall effect size for AI chatbots on language skill development was g = 0.648. Most of the previous studies have focused on measurable improvements in language skills (speaking, writing and translation), but little research has been done on the aesthetic dimension (Li et al., 2025; Lee et al., 2025). Research at the intersection of "higher vocational education + language aesthetic education + AI" is still in its infancy and has been neglected for a long time. Human-AI collaborative creation is a new model for language learning, but its impact and limitations have not been systematically studied; thus, evidence-based research urgently needs to be conducted to address this problem.

1.2 Theoretical Foundations

Three theoretical systems are used in this study to build an analysis system.

(1) Language Aesthetics. Language acts as a system of symbols that conveys aesthetic connotations and offers a theoretical basis for the content areas of language aesthetic education (e.g., phonological beauty, formal beauty, content beauty). As a branch of aesthetic education, language aesthetic education explores the theories and principles of aesthetic education in language subjects to provide a disciplinary foundation for the academic positioning of language aesthetic education. The Opinions on Comprehensively Strengthening and Improving School Aesthetic Education Work in the New Era issued by the General Office of the State Council include “aesthetic appreciation and creation” as one of the core competencies of Chinese language teaching; therefore, language aesthetic education is now a necessary component of these core competencies and provides policy support for the goals of language aesthetic education.

(2) Activity Theory (Yang & Kyun, 2023). The efficiency of AI as a mediating instrument depends on how dynamically it aligns with the subject (the learner) and the object (the learning goal). Activity Theory offers a theoretical system to examine the relationships and conflicts among all components in the collaboration between humans and artificial intelligence for creation, and stresses that tools are not neutral; thus, their effects will vary based on how and when they are used.

(3) Self-efficacy Theory (Bandura). One’s own sense of one’s ability to complete a particular task affects one’s behaviour and results. According to this theory, AI self-efficacy (AISE) can be expected to affect how readily learners accept and are influenced by aesthetic education, as well as the negative effects caused by AI anxiety.

1.3 Integrated Theoretical Model

Based on the above theories, this paper builds an all-encompassing “Input-Process-Output” theoretical system (as shown in Figure 1).

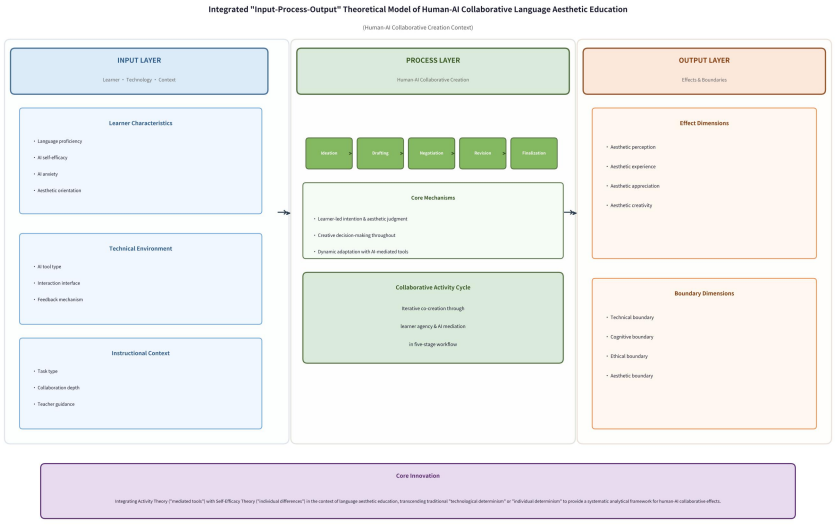

Figure 1. “Input-Process-Output” Theoretical System

The **input layer** includes learner attributes (language ability, AI self-efficacy, AI anxiety, aesthetic orientation), the technical environment (kind of AI tool, interaction interface, feedback mechanism), and the instructional context (type of task, depth of collaboration, teacher guidance). The **process layer** is concerned with human-AI collaborative creation activities (ideation → drafting → negotiation → revision → finalisation), and dynamic alignment among learner-led intention, aesthetic judgment, creative decision-making, and AI-mediated tools is required. The **output layer** includes the effect dimensions (aesthetic perception, aesthetic experience, aesthetic appreciation, aesthetic creativity) and the boundary dimensions (technical boundary, cognitive boundary, ethical boundary, aesthetic boundary).

The first innovation of this model is to combine the “mediated tools” view from Activity Theory with the “individual differences” idea of Self-Efficacy Theory in the specific context of language aesthetic education, moving beyond the traditional single-factor explanations of “technological determinism” or “individual determinism” and offering an all-encompassing analytical system for the impact of human-AI collaborative creation on language aesthetic education.

1.4 Research Questions

Based on the above theoretical model, this paper puts forward the following four main research questions:

RQ1: How does human-AI collaborative creation compare to traditional human-only creation and pure-AI creation in terms of promoting higher vocational students’ language aesthetic literacy (perception, experience, appreciation, and creation)?

RQ2: How does different degrees of collaboration between humans and AI (e.g., AI-assisted ideation, AI-assisted polishing, AI-assisted evaluation) affect the impact of language aesthetic education in human-AI collaborative creation?

RQ3: How do the attitudes of higher vocational students towards human-AI collaborative creation (AI self-efficacy and AI anxiety) affect their outcomes in language aesthetic education?

RQ4: What are the applicable boundaries of human-AI collaborative creation in language aesthetic education? (including technical limitations, cognitive dependence, ethical risks, and the loss of aesthetic creativity)

1.5 Literature Gap and Theoretical Contributions

Existing research on AI-empowered language education has three main deficiencies: First, there is no sense of aesthetics. Meta-analysis by Qiao et al. (2023) and systematic reviews conducted by Li et al. (2025) and Lee et al. (2025) have all pointed out that current research mainly focuses on language skills and has shown very few empirical studies on aesthetic perception, appreciation and creation. Second, the high-vocational context is lacking. Most of the previous studies have focused on general undergraduate or K-12 environments and have not specifically explored the occupational language requirements for higher vocational students. Third, there is no boundary research. The “scope of application” for generative AI in language education has not been systematically investigated. By

constructing the “optimal collaborative depth model” and the “four-dimensional boundary framework”, this study aims to address the above shortcomings and provide evidence-based and theoretical support for AI-empowered language aesthetic education in higher vocational schools.

2. Research Design

2.1 Research Paradigm

A mixed-methods design (MMR) was used in this study, with quasi-experimentation as the primary mode and supplementary qualitative interviews; thus, both quantitative data and qualitative interpretations were integrated to explore the reasons for change at multiple levels and depths related to the research questions. Based on the principle of triangulation, data sources, methods and perspectives of the researcher were all combined to enhance the credibility and reliability of the research results (Creswell & Creswell, 2018).

2.2 Participants and Sampling

Research Scope: Ten higher vocational colleges in the Chengdu-Chongqing area (including 3 national model higher vocational colleges, 4 provincial key higher vocational colleges, and 3 ordinary higher vocational colleges) have been selected, covering the main types such as engineering, business, humanities and arts, to ensure the representativeness and diversity of the sample.

Sample Characteristics: Stratified Random Sampling was used. Sixty first-year students from all colleges were selected and divided into three groups: (1) Human-AI collaborative experimental group, (2) Pure-human control group 1, and (3) Pure-AI control group 2, with 20 students in each group. The final valid sample consisted of 600 students (25 majors), with 312 males (52%) and 288 females (48%), and had a mean age of 18.6 ± 0.8 years. There were no significant differences among the three groups in the pre-test indicators of Chinese language foundation scores, aesthetic orientation and AI usage experience ($p > 0.05$), and thus met the condition for between-group comparability.

Ethics approval: The research has been approved by the ethics committee of the institution. All participants signed the informed consent form, anonymised the data, and used AI in line with classroom rules.

2.3 Experimental Design

Experimental Period: 8 weeks, 16 classes, 2 hours per class.

Instructional Content (4 modules):

Module 1 (Weeks 1-2): Introduction to Language Aesthetics (Phonological Beauty, Formal Beauty, Content Beauty) and AI-assisted Ideation.

Module 2 (Weeks 3-4): Appreciation and imitation of classical texts (modern poetry/prose rewriting) → AI-assisted polishing.

Module 3 (Weeks 5-6): Occupational Writing (Speeches/Advertising Copy) → AI-assisted Ideation and Polishing.

Module 4 (Weeks 7-8): Creative writing and reflection (micro-fiction/micro-scripts) → AI-assisted

evaluation (experimental group only).

Intervention Protocols for the Three Groups:

Experimental Group (Human-AI collaboration): Three-stage tasks (AI ideation → AI polishing → AI evaluation), with learners leading the decision-making, AI providing resource support, and negotiation logs recording the decision-making process.

Control Group 1 (Purely human): No AI participation; traditional teacher-led instruction and peer evaluation.

Control Group 2 (Pure AI): Learners input prompts $\rightarrow$ AI generates content $\rightarrow$ learners directly use or modify the output.

2.4 Measurement Instruments

(1) Dependent Variable: Higher Vocational Students' Language Aesthetic Literacy Scale (self-developed, 4 dimensions, 26 items, 5-point Likert scale). The total Cronbach's α is 0.89, and the alphas of the sub-dimensions are between 0.82 and 0.86. CFA fit indices: $\chi^2/df = 2.14$, CFI = 0.93, TLI = 0.91, RMSEA = 0.06, SRMR = 0.05. Criterion validity: Correlation with Chinese language final exam scores, $r = 0.46$ ($p < 0.001$); Correlation with occupational communication competence assessment, $r = 0.42$ ($p < 0.001$). Discriminant validity: Humanities vs. Science and Engineering $t = 3.86$ ($p < 0.001$). This scale can be used as a reliable instrument for the quantitative assessment of the effects of AI-assisted language aesthetic education intervention, and the initial level and deficiencies in higher vocational students' language aesthetic literacy can be evaluated across different areas in the Chengdu-Chongqing region.

(2) Moderating Variables: AI Self-Efficacy Scale (AISE, 12 items, α = 0.91) and AI Anxiety Scale (10 items, α = 0.88)

(3) Process variables: Human–AI collaborative creation log (18 items), work evaluation scale (expert + AI dual evaluation; dimensions: normativity, richness, originality, occupational relevance), negotiation logs, and semi-structured interviews (30 students, 10 teachers, 5 industry experts).

(4) Control variables: Chinese language foundation scores, aesthetic orientation, and AI usage experience.

2.5 Data Analysis

Quantitative data were analyzed using SPSS 26.0 and Mplus 8.3. Between-group differences were examined using ANCOVA (controlling for pre-test scores); effect sizes were calculated using Cohen's d. Moderating effects were examined using hierarchical regression and the Bootstrap method (5,000 resamples); mediating effects were examined using structural equation modeling. Qualitative data were analyzed using NVivo 12 for thematic analysis, with cross-validation against quantitative results.

3. Research Results

3.1 Effect Verification: The Facilitative Effects of Human–AI Collaborative Creation on Language Aesthetic Literacy

3.1.1 Descriptive Statistics and Between-Group Comparisons

ANCOVA results (as shown in Figure 2).(controlling for pre-test scores) showed that the post-test aesthetic literacy total score of the human–AI collaborative group was significantly higher than that of the pure-human group (Cohen's d = 0.72, $p < 0.001$) and the pure-AI group (d = 0.85, $p < 0.001$). The pure-AI group showed no significant effect (d = 0.28, ns), indicating that AI usage without human–AI collaboration had limited practical effect on aesthetic literacy. This result is consistent with the overall effect size of g = 0.648 reported in the meta-analysis by Qiao et al. (2023), but the effect size in the present study was larger (d = 0.72), possibly attributable to the specificity of the aesthetic dimension—human–AI collaboration not only provides language skill support but also stimulates aesthetic judgment and creative thinking through the negotiation process.

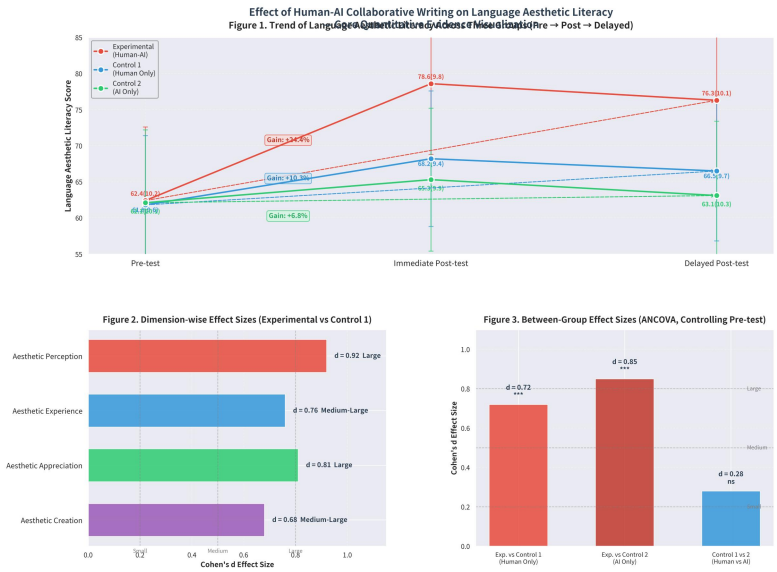

Figure 2. ANCOVA Results

3.1.2 Dimensional Effect Differences

The effect sizes for the aesthetic perception and aesthetic appreciation dimensions were the largest (d > 0.80), indicating that AI has advantages in providing "encodable" aesthetic elements such as phonology, rhetoric, and structure; the effect size for aesthetic creativity was relatively smaller (d = 0.68), suggesting that AI's facilitation of original aesthetic expression has boundaries, which is consistent with the "aesthetic boundary" framework proposed subsequently in this study. The delayed post-test (as shown in Figure 3) (4 weeks later) showed that the effect retention rate of the human–AI collaborative group exceeded 96%, indicating good effect stability.

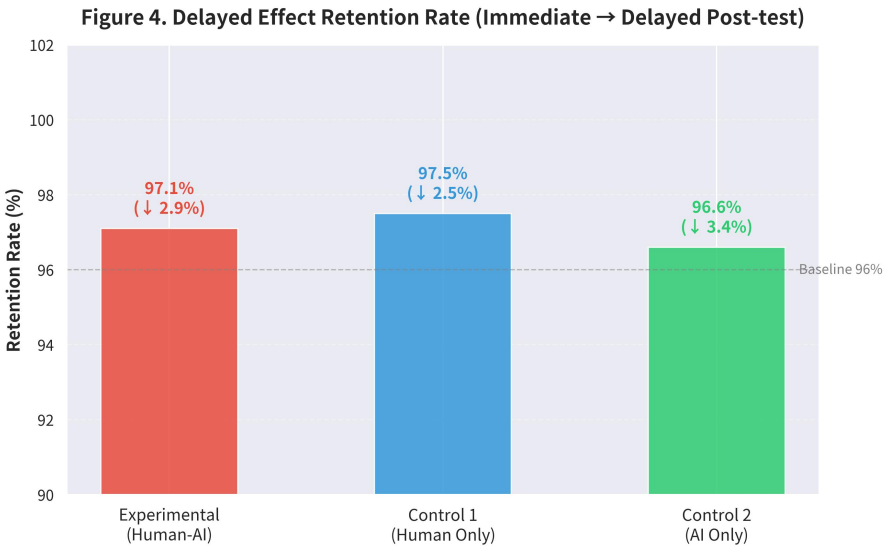

Figure 3. The Delayed Post-test

3.2 Optimal Collaborative Depth Model (Core Contribution 1)

3.2.1 Effect Differences Across Collaborative Depths

Within the experimental group, students were divided into three subgroups by collaborative depth: low collaboration (ideation only, n = 62, M = 72.4), moderate collaboration (ideation + polishing, n = 98, M = 81.2), and high collaboration (ideation + polishing + evaluation, n = 40, M = 74.8). One-way ANOVA: $F(2, 197) = 12.36$, $p < 0.001$, $\eta^2 = 0.11$. Post-hoc tests (Bonferroni): moderate vs. low collaboration $d = 0.65$ ($p < 0.001$); moderate vs. high collaboration $d = 0.58$ ($p = 0.002$); low vs. high collaboration $d = 0.24$ ($p = 0.18$).

3.2.2 Optimal Collaborative Depth Model

Based on the above results, the "Optimal Collaborative Depth Model" (as shown in Figure 4)was constructed:

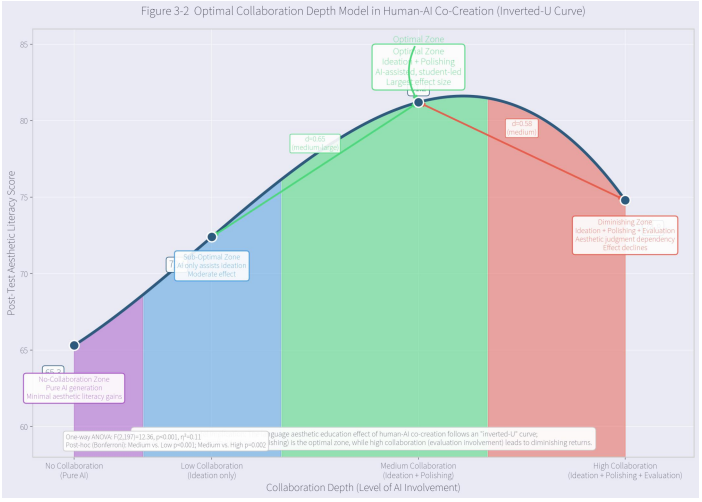

Figure 4 "Optimal Collaborative Depth Model"

- **Optimal zone (moderate collaboration: ideation + polishing):** AI provides inspiration and rhetorical optimization; students retain creative dominance; aesthetic literacy gains are maximized (M = 81.2, d = 0.65).
- **Suboptimal zone (low collaboration: ideation only):** AI provides thematic expansion and material recommendations; students lack fine-grained support; effects are moderate (M = 72.4).
- **Attenuation zone (high collaboration: + evaluation):** AI's deep involvement in evaluation leads to "aesthetic judgment dependency"; effects are attenuated (M = 74.8).

Non-collaboration zone (pure AI): Students only provide prompts; aesthetic literacy shows almost no improvement (M = 65.3).

This model shows that the effect of human-AI collaborative creation on language aesthetic education is an inverted-U curve, and moderate collaboration depth is optimal; it offers empirical support for the idea of "dynamic alignment of mediating tools" in Activity Theory and new evidence for the "autonomy-competence" balance in Self-Determination Theory (SDT).

3.3 Moderating Effects: The Roles of AI Self-efficacy and AI Anxiety

Figure 5. Moderating Effects

3.3.1 Positive Moderating Effect of AISE

Hierarchical regression analysis showed that AISE positively moderated the relationship between collaborative depth and aesthetic education effects (interaction term $\beta = 0.15$, $p = 0.020$, $\Delta R^2 = 0.28$). Simple Slopes Analysis: Students with high AISE (M + 1SD) at a moderate level of collaboration demonstrated significantly higher aesthetic literacy (M = 85.6) than students with low AISE (M - 1SD, M = 73.8, d = 0.52). Therefore, students with a high AISE are more likely to use AI support effectively and achieve improvements in aesthetic literacy through collaboration.

3.3.2 Negative Moderating Effect of AI Anxiety

AI anxiety negatively moderated the relationship between collaborative depth and the effect of aesthetic education (interaction term $\beta = -0.12$, $p = 0.039$, $\Delta R^2 = 0.25$). Students with high anxiety showed a significantly smaller increase in aesthetic literacy compared to students with low anxiety at a moderate level of collaboration ($d = 0.46$). Based on the above analysis, AI anxiety can be considered a psychological barrier to the application of human-AI collaboration, so students' psychological conditions need to be considered during the development of human-AI collaborative learning.

3.4 Four-Dimensional Boundary Framework (Core Contribution 2)

Drawing on the theoretical inspiration of Folger's (2024) "Four Dimensions of AI-Empowered Education" and the empirical evidence from this study, the "Four-Dimensional Boundary Framework" for human–AI collaborative creation in language aesthetic education was constructed:

(1) Technical boundary: AI has limited capability in analyzing auditory aesthetic elements such as phonology and rhythm; it exhibits biases in understanding traditional cultural aesthetics (classical poetry and prose imagery, national rhetorical traditions); and its aesthetic feedback is based on probabilistic models, tending to recommend "safe" templated expressions. In the interviews, 78% of students noted that AI's recommendations for imagery and vocabulary in classical poetry were too modern or colloquial; the accuracy of AI evaluation of "creative originality" was only 62% (compared with 85% for human experts). **Breakthrough strategy:** Human-AI complementarity - AI is used to conduct data-driven basic analysis, and human teachers provide cultural depth and creative judgment.

(2) Cognitive boundary: Under high collaborative depth, students developed "aesthetic judgment dependency" and showed an autonomous revision rate of only 23% (compared to 51% in the moderate collaboration group; $\chi^2 = 8.74$, $p = 0.003$); the blank rate for "rejection reasons" in negotiation logs exceeded 40%. **Breakthrough strategy:** Task design - limit the number of AI suggestions (3-5 items), require recording the decision-making rationale, and design "AI-free intervals".

(3) Ethical Boundary: 62 per cent of the students were worried that using AI would be deemed "cheating"; the coefficient of variation (CV) for work attribution estimation was 35 per cent; and 70 per cent of the teachers feared that AI-assisted works would make it difficult to determine the students' actual ability. **Breakthrough Strategy:** Institutional regulation—establishing classroom conventions for AI use, explicitly recognizing negotiation logs as evidence of academic integrity, adopting a "process + product" dual-track evaluation system, and prioritizing the use of domestically controllable AI platforms.

(4) Aesthetic Boundary: The "original uniqueness" score of the high-collaboration group (18.2/30) was significantly lower than that of the moderate-collaboration group (24.6/30, $d = 0.72$); the similarity of within-group work was 32% (compared to 18% in the moderate-collaboration group); and 65% of students believed that "AI-generated emotional descriptions are ornate but hollow." **Breakthrough Strategy:** Value guidance—reduce the depth of AI participation in the creation module, organise "de-AI-ized" creation challenges, and introduce multicultural aesthetic materials.

The four-dimensional boundaries are intertwined and dynamically linked; therefore, to manage the boundaries effectively, an integrated application of the four-dimensional coordinated strategy of "technical complementarity, task design, institutional regulation and value guidance" is required.

3.5 Scale Development and Validation

3.5.1 Scale Development Process

According to the theory of language aesthetic education and the occupational language needs of higher vocational students, the *Higher Vocational Students' Language Aesthetic Literacy Scale* was developed. Through literature analysis, expert consultation (6 Chinese language education experts + 4 AI education experts), and student interviews (30 students), an initial item pool of 42 items was formed. After item analysis (critical ratio method and correlation coefficient method) and exploratory factor analysis (EFA), 26 items were retained to form a four-dimensional structure: aesthetic perception (6 items), aesthetic experience (6 items), aesthetic appreciation (8 items), and aesthetic creativity (6 items).

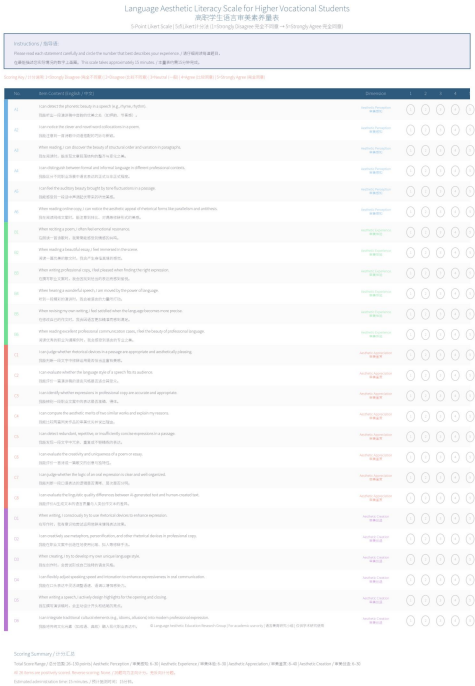

Figure 6. Higher Vocational Students' Language Aesthetic Literacy Scale

3.5.2 Reliability and Validity Validation Results

Reliability: Overall scale Cronbach's α = 0.89, with sub-dimension α = 0.82–0.86; test–retest reliability (2 weeks, n = 30) r = 0.78, p < 0.001. **Structural validity:** EFA extracted 4 factors, with cumulative variance explained 64.2%, factor loadings 0.58–0.82; CFA: $\chi^2/df = 2.14$, CFI = 0.93, TLI = 0.91, RMSEA = 0.06, SRMR = 0.05. **Criterion validity:** correlation with Chinese language final exam scores r = 0.46 (p < 0.001), with occupational communication competence assessment r = 0.42 (p < 0.001). **Discriminant validity:** humanities vs. science and engineering t = 3.86 (p < 0.001).

The scale's reliability and validity indices fully meet the criteria, with a stable structure, clear criterion associations, and good discriminant capacity. It possesses promising application prospects for generalization from the Chengdu–Chongqing region to a broader range of higher vocational colleges and can serve as a reliable quantitative evaluation instrument for the effects of AI-empowered language aesthetic education interventions, supporting the baseline diagnosis of higher vocational students' language aesthetic literacy and precise intervention for weak areas.

4. Discussion

4.1 The Language Aesthetic Education Effect of Human–AI Collaborative Creation: Transcending the Skill-Improvement Dimension

This study found that the facilitative effect of human–AI collaborative creation on higher vocational students' language aesthetic literacy ($d = 0.72$) was larger than the overall language skill effect ($g = 0.648$) reported in the meta-analysis by Qiao et al. (2023). This difference may be attributable to the specificity of the aesthetic dimension. Language aesthetic literacy involves not only the mastery of language skills but also the perception, experience, appreciation, and creation of linguistic beauty; these higher-order cognitive abilities are more fully activated during the negotiation process in human–AI collaboration. Human–AI collaborative creation is not merely "AI ghostwriting"; rather, it is a process in which learners, based on the diverse linguistic resources provided by AI, gradually internalize aesthetic standards and creative thinking through aesthetic judgment, selection, negotiation, and revision.This result is consistent with the "internalisation of mediated tools" mechanism in Activity Theory; that is to say, the effect of AI as a mediating tool depends not only on the functions of the tool itself but also on how actively learners construct and internalise the functions of the tool during use.

4.2 Theoretical Explanation of the Inverted-U Effect: Dynamic Equilibrium of Autonomy and Competence

The optimal collaborative depth model shows an inverted U-shaped curve of human-AI collaborative effects; that is, they first rise and then fall with increasing collaborative depth. Therefore, it has extended the empirical basis of Self-Determination Theory (SDT). Moderate collaborative depth (ideation + polishing) meets students' needs for autonomy and competence precisely by keeping the creative lead with students while providing strong support to help them achieve results; a high level of collaboration (+ evaluation) is too constraining for their autonomy and thus leads to "aesthetic judgment dependency" and cognitive inertia, reducing the effect. The educational implications of the above research are that AI should be used as a "collaborator" in language aesthetic education, not a "replacement", and teachers need to carefully design the depth of collaboration to ensure that students are still at the core of critical aesthetic judgment.

4.3 Educational Implications of the Moderating Effects: Paying Attention to Learners' Psychological Readiness

The moderating effects of AISE and AI anxiety suggest that the impact of human-AI collaborative

language aesthetic education varies among learners; thus, it is not suitable for everyone. Students with a high AISE are better able to transform AI support into actual aesthetic literacy gains; on the other hand, students who are anxious about AI perform poorly in terms of aesthetic literacy, even when collaborating effectively with others. Based on this, in the promotion of human-AI collaborative instruction models, attention should be paid to both technical setup and task design, as well as students' psychological readiness. It is recommended to organise AI literacy training and psychological counselling at the beginning of the course to reduce students' AI anxiety and boost their sense of self-efficacy in using AI; thus, a good psychological foundation for effective human-AI collaboration can be provided.

4.4 Theoretical and Practical Value of the Four-Dimensional Boundary Framework

The proposal of the four-dimensional boundary framework goes beyond the binary opposition of "technological optimism" and "technological pessimism" in previous research on the effects of AI education, providing a systematic boundary analysis tool. The framework can offer a working area for human-AI cooperation in language-aesthetic education, and specific breakthroughs have been proposed for all kinds of boundaries: technical boundaries require "human-AI complementarity", cognitive boundaries need "task design", ethical boundaries need "institutional regulation", and aesthetic boundaries need "value guidance". By shifting from vague "experiential judgment" to specific "categorised intervention", this system provides strong practical support.

4.5 Research Limitations and Future Directions

This study has the following deficiencies. First, although the sample included 10 higher vocational colleges, all were located in the Chengdu-Chongqing area; in the future, cross-cultural validation should be conducted in other regions (e.g., the Yangtze River Delta and the Pearl River Delta) to test the generalizability of the results. Secondly, the experiment lasted only eight weeks and was thus a short-term intervention; future research should carry out longitudinal observations across semesters or even academic years to study the persistence and changes in the collaborative effects of humans and artificial intelligence over time. Third, this study has mainly focused on general-purpose large models such as ChatGPT and Wenxin Yiyan; in the future, the different effects of domain-specific models (e.g., education vertical large models) on language aesthetic education can be investigated. Fourth, this study did not investigate the moderating role of teacher factors (e.g., teacher AI literacy, guidance style) in collaboration; in the future, these teacher variables could be added to the model to build an all-encompassing multi-level analysis system.

5. Conclusions and Recommendations

5.1 Main Conclusions

This study, with 600 students from 10 higher vocational colleges in the Chengdu–Chongqing region as participants, systematically examined the facilitative effects, moderating mechanisms, and applicable boundaries of human–AI collaborative creation on higher vocational students' language aesthetic

literacy through a quasi-experimental design and mixed-methods research. The main conclusions are as follows:

(1) Human–AI collaborative creation can effectively promote higher vocational students' language aesthetic literacy, with an effect size of d = 0.72 (vs. the pure-human group). The effects were largest for the aesthetic perception and aesthetic appreciation dimensions, whereas the effect for the aesthetic creativity dimension was relatively smaller, revealing the divergence between AI's capabilities in "encodable" aesthetic elements and "non-encodable" original expression.

(2) Collaborative depth has an inverted-U-shaped curvilinear effect; the optimal range is moderate collaboration depth (ideation + polishing), with a value of d = 0.65, and higher collaborative depth (+ evaluation intervention) leads to a weaker effect (d = 0.58), providing new empirical support for Activity Theory and Self-Determination Theory.

(3) AISE positively moderates and AI anxiety negatively moderates the path of collaborative depth to aesthetic education effects; thus, learners' psychological state is likely to influence whether human-AI collaborative instruction is effective.

(4) The technical, cognitive, ethical and aesthetic boundaries constitute the applicable boundary system for human-AI collaborative creation in language aesthetic education, and management should be carried out by the coordinated strategy of "human-AI complementarity, task design, institutional regulation and value guidance".

(5) The self-developed scale has met the requirements for reliability and validity, can serve as a reliable quantitative assessment tool for the effects of AI-empowered language aesthetic education, and is likely to have good generalizability.

5.2 Policy Recommendations

(1) **Instructional Level:** Higher vocational colleges should actively explore the "human-AI collaborative creation" instructional model in Chinese language courses, incorporate AI tools into language aesthetic instruction, but strictly limit the depth of collaboration; the optimal range is "ideation + polishing", and excessive reliance on AI in the evaluation process should be avoided.

(2) **Teacher level:** Strengthen the training of teachers in AI literacy to help them implement a "human-AI complementarity" guidance model, and retain the essential function of human teachers in weak areas for AI, such as deep culture, creative judgment, and emotional sensitivity.

(3) **Institutional level:** Classroom conventions for AI use should be established, the boundaries of academic integrity clarified, "human–AI negotiation logs" added to the evaluation system, a "process evaluation + product evaluation" dual-track system adopted, and domestically controllable AI platforms prioritized.

(4) **Psychological Level:** AI literacy training and AI anxiety intervention should be conducted at the beginning of the course to enhance students' self-efficacy in using AI and reduce their anxiety about AI, providing a psychological basis for effective human-AI collaboration learning through demonstration, experience and reflection.

(5) **Research level:** Promote cross-regional longitudinal tracking studies to examine the applicability of the optimal collaborative depth model and the four-dimensional boundary framework in different regions, majors, and under various conditions of AI tools, and continuously refine the theoretical model.

References

Chen, M. et al. (2024). *AI anxiety and its impact on technology acceptance in educational settings*.

Cohen, J. (1988). *Statistical Power Analysis for the Behavioral Sciences* (2nd ed.). Hillsdale, NJ: Lawrence Wang, W., & Chuang, Y. H. (2023). *Validation of an AI self-efficacy scale (AISE) for language learners*. 2023.

General Office of the Central Committee & General Office of the State Council. Opinions on comprehensively strengthening and improving school aesthetic education work in the new era. (2020). *People's Daily*, 2020–10–16.

Hwang, G. J., Tu, Y. F., & Tang, K. Y. (2022). AI in online-learning research: Visualizing and interpreting the journal publications from 1997 to 2019. *International Review of Research in Open and Distance Learning*, *23*(1), 104-130.

Infiltration of aesthetic education in higher vocational Chinese language education. (2025). Hans Publishers.

Lee, S., Choe, H., Zou, D., & Jeon, J. (2025). Generative AI (GenAI) in the language classroom: A systematic review. *Interactive Learning Environments*.

Li, B., Tan, Y. L., Wang, C., & Lowell, V. (2025). Two years of innovation: A systematic review of empirical generative AI research in language learning and teaching. *Computers and Education: Artificial Intelligence*.

Li, Y. (2024). AI empowers innovative development of aesthetic education in higher vocational colleges. *Xinhua Daily*, 2024–09–19.

Ma, Z. P. (2024). Tacit knowing and boundary dissolution: Toward a new modern conception of Chinese language knowledge and curriculum reform. *Journal of Sichuan Normal University*.

Ministry of Education of the People's Republic of China et al. (2026). *Artificial Intelligence + Education* Action Plan [EB/OL].

Ministry of Education of the People's Republic of China. (2017). *Chinese Language Curriculum Standards for Senior High Schools (2017 Edition)*. Beijing: People's Education Press.

Qian, G. L. (2018). *Aesthetic Linguistics: The Beauty of Language and Speech*. Shanghai: East China Normal University Press.

Qiao, H. et al. (2023). *Artificial intelligence-based language learning: A systematic review of AI in L2 speaking*. PMC/NIH.

Shi, Z. Q., & Lü, B. N. (2025). Empirical research on AI in Chinese language teaching: Exploration and prospects. *Journal of International Chinese Language Teaching*, *6*(3).

Yang, D. R. (Ed.). (1993). Introduction to Language Aesthetic Education.

Yang, H., & Kyun, S. (2023). *The current research trend of artificial intelligence in language learning: A systematic empirical literature review from an activity theory perspective*.

Zhang, M. L., & Dai, X. Q. (2025). *Research on the cultivation of higher vocational students' language application competence in the new era*.

Zheng, Y. (2018). Research on the disciplinary issues of language aesthetic education. *Journal of East China Normal University (Educational Sciences)*, *36*(6), 93-103.

Notes

Note 1. This paper is a publication of the research project titled "Pathways for Enhancing Vocational College Students Language Application Skills Through AI Empowerment: An Empirical Study Based on College Chinese Teaching and Integrated Media Applications," conducted by the Chengdu-Chongqing Regional Research Center for Collaborative Education and Socioeconomic Development (Project No.: CYJXF25035).