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Article

Transforming high school Chinese language education through deep learning and poetic pedagogy: A mixed-methods inquiry

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Abstract: In recent years, deep learning has emerged as a transformative educational approach, emphasizing active engagement, meaning-making, and the transfer of knowledge across contexts. This paradigm shift challenges traditional rote memorization practices, which often fail to connect students with the rich emotional and cultural dimensions of classical texts. In the context of high school Chinese language education, where classical poetry and philosophical prose are central, we aim to explore how deep learning principles can enhance students' cognitive and emotional engagement with literary texts. Our mixed-methods study combines classroom observations, surveys of 326 students, and interviews with 45 teachers to examine the impact of strategies such as multimodal text interpretation and creative re-imagining. We found significant improvements in students' metaphorical reasoning and cross-disciplinary knowledge integration. Qualitative insights highlight the importance of emotional resonance and cultural immersion in deepening students' connection to literary texts. Our findings underscore the need for innovative teaching practices that bridge cognition and emotion, offering practical implications for curriculum reform, teacher professional development, and more effective assessment methods. By integrating deep learning and poetic pedagogy, we believe that Chinese language education can become a more dynamic and meaningful experience for students.

Keywords: deep learning; Chinese language education; poetic pedagogy; cognitive transformation; mixed-methods research

1. Introduction

The Chinese language classroom is a unique space where linguistic precision meets poetic imagination. It is a realm where the beauty of classical poetry, the depth of philosophical prose, and the richness of cultural heritage converge to shape students' intellectual and emotional development [1,2]. However, despite its potential to inspire and transform, traditional teaching methods often reduced literary texts to fragmented knowledge points, focusing on rote memorization of vocabulary, grammar rules, and standardized interpretations. These approaches neglected the emotional and cultural dimensions that make Chinese literature profoundly humanistic, leaving students disconnected from the texts' deeper meanings and relevance to their lives [3,4].

In recent years, the field of education has witnessed a growing interest in deep learning, a pedagogical approach that emphasizes meaning-making, critical thinking, and knowledge transfer [5,6]. Rooted in constructivist theories, deep learning challenged the traditional "teacher-centered" model by placing students at the center

of the learning process. It encouraged active engagement, collaborative exploration, and reflective practice, enabling learners to construct knowledge in ways that are personally meaningful and contextually relevant [7,8].

In this study, we sought to explore the integration of deep learning principles into high school Chinese language education, with a particular focus on the transformative potential of poetic pedagogy [3,4]. By combining quantitative and qualitative methods, we aimed to address two critical gaps in the literature: (1) the limited empirical research on deep learning in Chinese language education, and (2) the under-explored intersection of cognitive science and poetic pedagogy [9,10].

1.1. The crisis of meaning in Chinese language education

Chinese language education has long been celebrated for its emphasis on literary mastery and cultural literacy [1,3]. From the lyrical beauty of Tang poetry to the philosophical depth of Confucian texts, the curriculum is rich with opportunities for students to engage with the intellectual and artistic achievements of their heritage. However, the reality of classroom practice often falled short of this ideal.

Traditional teaching methods, shaped by the demands of standardized testing and curriculum coverage, tend to prioritize surface-level understanding over deep engagement. Students were trained to analyze texts for exam purposes, identifying rhetorical devices, memorizing historical contexts, and reproducing prescribed interpretations. While these skills are important, they often came at the expense of genuine intellectual curiosity and emotional connection [7,11].

For example, when studying Li Bai's The Hard Roads to Shu, students might learn about the poem's historical background, its use of imagery, and its thematic significance. However, they were rarely given the opportunity to explore how the poem's depiction of struggle and perseverance resonates with their own experiences or how its metaphors might illuminate contemporary issues. As a result, the poem became a static artifact to be dissected rather than a living text that speaks to the human condition [4,5].

This "crisis of meaning" was not unique to Chinese language education. Similar challenges have been documented in literature classrooms around the world, where the pressure to meet academic standards often overshadows the transformative potential of literary study. However, the problem was particularly acute in the Chinese context, where the cultural and linguistic complexity of classical texts demands a more nuanced and immersive approach to teaching [8,2].

1.2. Deep learning: A paradigm shift in education

Deep learning offered a promising framework for addressing these challenges [12,13]. Unlike surface-level learning, which focuses on the acquisition of isolated facts and skills, deep learning emphasizes the integration of knowledge, the development of critical thinking, and the application of learning to real-world contexts [14,15]. It was characterized by several key principles:

- Active Engagement: Students were encouraged to take an active role in their learning, exploring texts through inquiry, discussion, and creative expression [16].

- Meaning-Making: Learning was seen as a process of constructing meaning, where students connect new information to their prior knowledge and personal experiences [17].
- Transferability: Deep learning aimed to develop skills and understandings that can be applied across different contexts, fostering lifelong learning and adaptability [14,18].

In the context of Chinese language education, deep learning can help students move beyond the surface-level analysis of texts to engage with their deeper meanings and cultural significance [19,20]. For example, instead of simply memorizing the imagery in The Hard Roads to Shu, students might explore how the poem's metaphors reflect broader themes of struggle and resilience, drawing connections to their own lives and contemporary society.

2. Deep learning and poetic pedagogy

Deep learning and poetic pedagogy are closely intertwined, providing both cognitive and emotional frameworks for literary engagement.

Building on constructivist principles, poetic pedagogy emphasizes aesthetic and empathetic connections, complementing deep learning's focus on conceptual integration, metacognitive regulation, and transferable competence [14,16]. This involves:

- Multimodal Text Interpretation: Drawing visual, auditory, and kinesthetic stimuli to enrich students' engagement with texts. Such approaches can deepen metaphorical reasoning and emotional resonance.
- Cultural Immersion: Placing emphasis on the historical, philosophical, and social contexts of literary works.
- Creative Reimagining: Encouraging students to reinterpret classical texts through modern mediums.

By combining these affective and cognitive strategies under the umbrella of deep learning, educators can help students develop a deeper appreciation for literature and enhance their critical thinking, cultural literacy, and creative expression.

2.1. Research questions and objectives

This study aimed to explore the impact of deep learning strategies in high school Chinese language education, with a focus on how multimodal text interpretation, contextualized instruction, and creative reimagining can foster students' cognitive and emotional engagement with both classical and contemporary literary texts. Although poetic pedagogy is central to our approach, it is no longer treated as a standalone research question. Instead, it is integrated within our broader investigation of deep learning.

Based on this refined scope, we concentrate on the following two research questions:

1) How do deep learning strategies influence students' cognitive and emotional engagement with literary texts?

- By incorporating elements such as poetic pedagogy, we examine whether active

student-centered learning—encompassing multimodal activities, creative interpretation, and reflective dialogue—enables deeper connections to literary content, fostering improvements in critical thinking, cultural literacy, and emotional resonance.

2) How can teachers effectively design and implement deep learning activities in the Chinese language classroom?

- We investigate both the pedagogical planning and practical integration of deep learning approaches, including teacher training, resource development, and assessment methods. In particular, we address how to align these strategies with curriculum demands, time constraints, and teachers' professional development needs.

By addressing these questions, this study sought to expand the body of research on deep learning in language education while providing practical insights for educators aspiring to revitalize high school Chinese language instruction. In doing so, we position poetic pedagogy as an illustrative strategy within the overarching framework of deep learning, rather than an isolated focus of inquiry.

2.2. Significance of this work

This study has several important implications for theory, practice, and policy:

- Theoretical Contributions: By exploring the intersection of deep learning and poetic pedagogy, this study advanced our understanding of how cognitive and emotional processes interact in literary education. It also contributes to the broader field of educational neuroscience by examining the neural mechanisms underlying deep engagement with texts.
- Practical Applications: The findings of this study can inform the design of innovative teaching strategies and resources for Chinese language education. For example, the development of multimodal learning materials, such as VR simulations and interactive digital platforms, can enhance students' engagement with classical texts.
- Policy Implications: This study highlighted the need for curriculum reform and teacher training programs that support the integration of deep learning principles into Chinese language education. It also calls for the development of assessment tools that capture the cognitive, emotional, and creative dimensions of learning.

In conclusion, this study represented a significant step toward reimagining Chinese language education as a dynamic and transformative process. By bridging the gap between cognitive science and poetic pedagogy, we hope to inspire educators and policymakers to create learning environments that nurture students' intellectual, emotional, and cultural growth.

3. Deep learning and cognitive transformation

The theoretical foundation of this study was built on the interconnected pillar: deep learning [12,14,16]. This framework underscores how students engage with literary texts in ways that are both cognitively and emotionally rich. By integrating insights from cognitive science, educational psychology, and literary theory, this

section explores the principles and mechanisms that underpin deep learning, highlighting their relevance to Chinese language education.

Deep learning, as a pedagogical approach, is rooted in constructivist theories of learning, which emphasize the active construction of knowledge through exploration, reflection, and application. It moves beyond memorization to foster a deeper understanding of concepts and their interconnections. In the context of Chinese language education, this involves three key dimensions: conceptual integration, metacognitive regulation, and transferable competence.

1) Conceptual integration

Conceptual integration refers to the process of connecting new information to prior knowledge and experiences, enabling students to construct a coherent and meaningful understanding of complex ideas. For example, when studying Li Bai ‘s The Hard Roads to Shu, students might explore how the poem’s depiction of physical and emotional struggle resonates with contemporary narratives of perseverance and resilience. Through multimodal or creative tasks, students connect textual imagery to contemporary contexts, furthering both conceptual and emotional integration. By weaving together personal experiences, current events, and historical contexts, conceptual integration supports a more holistic view of literary works.

Conceptual integration also involves interdisciplinary connections. For instance, students might examine the geological and ecological challenges of building roads in mountainous regions, drawing on knowledge from geography and environmental science. This interdisciplinary approach not only enriches students’ understanding of the text but also fosters a more holistic and integrated view of knowledge.

2) Metacognitive regulation

Metacognitive regulation refers to the ability to monitor and control one’s own learning processes. It involves activities such as planning, self-monitoring, and reflection, which enable students to become more aware of their thinking and learning strategies.

For example, when interpreting a poem like The Hard Roads to Shu, students might be encouraged to reflect on their initial reactions and interpretations, considering how their personal experiences and cultural background influence their understanding. They might also engage in self-questioning, asking themselves: What does this poem mean to me? How does it connect to my own life? What cultural or historical factors might have shaped the poet’s perspective?

Such reflective strategies—annotation, journaling, and mind mapping—further reinforce both cognitive insight and emotional engagement, essential for deep learning.

3) Transferable competence

Transferable competence refers to the ability to apply knowledge and skills learned in one context to new and unfamiliar situations. For example, students might apply the themes of perseverance and resilience in The Hard Roads to Shu to contemporary issues such as climate change, social justice, or personal growth. They might write essays, create multimedia presentations, or engage in debates that explore how the poem’s messages can inform and inspire action in the modern world.

By analyzing ethical dilemmas faced by characters in classical texts, students explore how their decisions reflect broader cultural values and societal norms. Through this synthesis of old and new, learners build competencies relevant across disciplines and real-world contexts.

Synthesis: Deep learning and poetic pedagogy in Chinese language education

The integration of deep learning and poetic pedagogy offers a powerful framework for transforming Chinese language education. By emphasizing conceptual integration, metacognitive regulation, and transferable competence, deep learning provides the cognitive tools necessary for students to engage with literary texts in meaningful and transformative ways. At the same time, poetic pedagogy, with its focus on multimodal text interpretation, cultural immersion, and creative reimagining, enriches this engagement by activating students' emotions, imagination, and cultural awareness.

Together, these frameworks create a learning environment where students can experience literature as a dynamic and living tradition, connecting classical texts to their own lives and the world around them. This approach not only enhances students' understanding and appreciation of Chinese literature but also fosters the development of critical thinking, creativity, and cultural literacy—skills that are essential for navigating the complexities of the 21st century.

4. Methodology

In this section, we outline the research design, participants, and data collection tools used in this study. By employing a sequential mixed-methods approach, the study aims to provide a comprehensive understanding of how deep learning strategies, particularly poetic pedagogy, influence students' cognitive and emotional engagement with literary texts in high school Chinese language education. The methodology is designed to address the research questions by combining quantitative measures of learning outcomes with qualitative insights into the experiences of students and teachers.

4.1. Research design

The study adopted a sequential mixed-methods design, which involves two distinct but interconnected phases: a quantitative phase and a qualitative phase. This approach allows for the triangulation of data, enhancing the validity and depth of the findings.

4.1.1. Quantitative phase

The quantitative phase employed a pre/post-test experimental design to measure changes in students' critical thinking, cultural literacy, and creative expression. This phase is structured as follows:

1) Pre-test: At the beginning of the study, students completed a 25-item questionnaire assessing their baseline levels of metaphorical reasoning, cultural literacy, and creative expression. The questionnaire was designed to capture

students' ability to interpret literary texts, make connections between classical and contemporary contexts, and generate original ideas.

2) Intervention: Over a 12-week period, students participated in a series of deep learning activities designed to enhance their engagement with literary texts. These activities included multimodal text interpretation, cultural immersion, and creative reimagining, as outlined in the theoretical framework. Teachers were provided with training and resources to implement these activities effectively.

3) Post-test: At the end of the intervention, students completed the same questionnaire to assess changes in their critical thinking, cultural literacy, and creative expression. The pre/post-test design allowed for the measurement of learning gains and the identification of specific areas of improvement.

The quantitative phase was complemented by classroom observations, which provide additional data on the implementation of deep learning activities and their impact on student engagement.

4.1.2. Qualitative phase

The qualitative phase focused on exploring the experiences of students and teachers with deep learning activities. This phase includes:

1) Classroom observations: Researchers conduct structured observations of selected classes to document the implementation of deep learning activities and their impact on student engagement. Observations are guided by a 10-point rubric that evaluates the depth of student engagement, the effectiveness of instructional design, and the quality of teacher-student interactions.

2) Semi-structured interviews: Researchers conduct interviews with a subset of students (N = 30) and teachers (N = 15) to gain deeper insights into their experiences with deep learning activities. The interviews are guided by a set of open-ended questions that explore participants' perceptions of the activities, their impact on learning, and the challenges encountered during implementation.

The qualitative phase provided rich, contextualized data that complement the quantitative findings, offering a more nuanced understanding of the impact of deep learning strategies on Chinese language education.

4.1.3. Experimental group and control group design

To examine the impact of deep learning strategies, the study was designed with both an experimental group and a control group. The experimental group was taught using deep learning strategies integrated with poetic pedagogy, while the control group followed traditional teaching methods.

However, despite our intention to create comparable groups, the assignment process was constrained by logistical and administrative factors, resulting in a quasi-experimental rather than a fully randomized design. This limitation potentially reduces the strength of causal inferences that can be drawn.

The participants were randomly assigned to the two groups to control for potential biases. The experimental group engaged in multimodal text interpretation, creative reimagining, and cultural immersion activities, while the control group followed a more traditional, text-based teaching approach. Future studies could consider employing a fully randomized controlled trial (RCT) to bolster the internal

validity of the findings and more definitively attribute observed changes to the intervention.

4.2. Participants

The study involved two groups of participants: students and teachers.

4.2.1. Students

A total of 326 high school students (Grade 10-11) from three regular full-time high schools in the Central and Western regions of China participated in the study. The schools were selected based on their good reputation for academic grades and their willingness to participate in educational research. The student sample includes:

- Gender Distribution: 54% female, 46% male.
- Grade Distribution: 68% Grade 10, 32% Grade 11.
- Academic Background: All students are enrolled in the Chinese language curriculum, which includes the study of classical and modern literature.

The selection of students from key schools ensured a relatively homogeneous sample in terms of academic ability and motivation, allowing for a more controlled examination of the impact of deep learning strategies.

4.2.2. Teachers

A total of 45 Chinese language teachers participated in the study. The teachers were selected based on their teaching experience, subject expertise, and willingness to implement deep learning activities in their classrooms. The teacher sample includes:

- Teaching experience: Average of 11.2 years (range: 3–25 years).
- Educational Background: All teachers hold at least a bachelor's degree in Chinese language and literature, with near 20% holding a master's degree.
- Professional development: more than 71% of teachers have participated in professional development programs related to innovative teaching methods.

The inclusion of experienced and well-qualified teachers ensures the effective implementation of deep learning activities and provides valuable insights into the challenges and opportunities of integrating these strategies into the curriculum.

4.3. Data collection tools

The study employed a range of data collection tools to capture both quantitative and qualitative data.

4.3.1. Student survey

The student survey is a 25-item questionnaire designed to assess students' metaphorical reasoning, cultural literacy, and creative expression. The questionnaire is divided into three sections:

1) Metaphorical reasoning: This section includes 10 items that measure students' ability to identify and interpret metaphors in literary texts. For example, students might be asked to explain the significance of the "green mud path" in The Hard Roads to Shu and how it reflects broader themes of struggle and perseverance.

2) Cultural literacy: This section includes 8 items that assess students' understanding of the cultural and historical context of literary texts. For example,

students might be asked to compare the depiction of nature in The Hard Roads to Shu with its representation in contemporary environmental literature.

3) Creative expression: This section includes 7 items that evaluate students' ability to generate original ideas and reinterpret classical texts in creative ways. For example, students might be asked to rewrite a scene from The Hard Roads to Shu as a modern short story or create a visual representation of the poem's imagery.

The questionnaire uses a 5-point Likert scale (1 = strongly disagree, 5 = strongly agree) [21,22] and has a high internal consistency (Cronbach's $\alpha = 0.91$).

For the quantitative analysis, pre- and post-test results were analyzed using paired *t*-tests to assess the impact of deep learning activities on students' metaphorical reasoning, cultural literacy, and creative expression. In addition, ANOVA was applied to compare differences between the experimental and control groups. Effect sizes (Cohen's *d*) were calculated to determine the magnitude of the observed changes in each area.

4.3.2. Teacher interview protocol

The teacher interview protocol consists of a set of semi-structured questions designed to explore teachers' experiences with deep learning activities. The questions are organized into three themes:

1) Pedagogical strategies: Teachers are asked to describe the deep learning activities they implemented, the resources they used, and the challenges they encountered. For example, "Can you describe a deep learning activity that you found particularly effective? What made it successful?"

2) Student engagement: Teachers are asked to reflect on the impact of deep learning activities on student engagement and learning outcomes. For example, "How did students respond to the deep learning activities? Did you notice any changes in their engagement or understanding of the texts?"

3) Professional development: Teachers are asked to discuss their training and support needs for implementing deep learning activities. For example, "What kind of training or resources would help you integrate deep learning strategies into your teaching more effectively?"

The interviews are audio-recorded and transcribed for analysis, allowing for the identification of common themes and patterns.

For the qualitative analysis, thematic analysis was conducted on the interview transcripts to identify common themes related to teacher experiences with deep learning activities. The analysis was guided by the following key areas: teaching strategies, student engagement, and professional development needs.

4.3.3. Classroom observation rubric

The classroom observation rubric was a 10-point scale designed to evaluate the depth of student engagement and the effectiveness of instructional design during deep learning activities. The rubric included the following dimensions:

1) Student Engagement: Measures the level of student participation, interest, and interaction during the activity. For example, "Students actively participated in discussions and asked thoughtful questions".

2) Instructional Design: Evaluates the clarity, coherence, and relevance of the activity. For example, "The activity was well-structured and aligned with the learning objectives".

3) Teacher-student interaction: Assesses the quality of communication and feedback between teachers and students. For example, "The teacher provided constructive feedback and encouraged students to reflect on their learning".

The rubric was used by trained observers to document their observations during classroom visits, providing additional data on the implementation and impact of deep learning activities.

4.3.4. Data analysis methods

After collecting survey data from students, we used the following statistical analysis methods:

- Descriptive statistics: Used to summarize the basic characteristics of the data, including mean, standard deviation, minimum, and maximum values, to provide an overview for subsequent analysis.
- Paired *t*-test: Used to compare the differences before and after the intervention. By comparing students' scores before and after participating in deep learning activities, it evaluates the impact of the learning strategy.
- ANOVA (analysis of variance): Used to compare the differences between the experimental group and the control group across various measurement dimensions (such as metaphorical reasoning, cultural literacy, and creative expression) to test the effectiveness of different teaching methods.
- Regression analysis: Analyzes the relationships between various variables, particularly exploring the associations between students' background characteristics (such as gender, grade level, and academic background) and their changes after the activity.

5. Findings

This section presented the results of the study, organized into two main sections: quantitative findings and qualitative insights. The quantitative findings focused on changes in students' critical thinking, cultural literacy, and creative expression, as measured by pre/post-test comparisons. The qualitative insights provided a deeper understanding of the experiences of students and teachers with deep learning activities, as captured through classroom observations and interviews [3,5,23].

5.1. Quantitative results

The quantitative phase of the study employed a pre/post-test experimental design to measure the impact of deep learning activities on students' metaphorical reasoning, cultural literacy, and creative expression. The results are summarized in **Table 1**.

Table 1. Pre/post-test results for key outcome measures.

Outcome Measure	Pre-Test Mean (SD)	Post-Test Mean (SD)	Effect Size (Cohen's *d*)
Metaphorical Reasoning	2.89 (0.83)	4.02 (0.71)	1.56**
Cultural Literacy	3.12 (0.76)	4.21 (0.68)	1.34**
Creative Expression	2.45 (0.77)	3.87 (0.62)	1.89***

where the *** denotes $p < 0.001$, the ** denotes $p < 0.01$.

The results in **Table 1** demonstrate significant improvements in students' metaphorical reasoning, cultural literacy, and creative expression following the implementation of deep learning activities. The effect sizes, measured using Cohen's *d* [24,25], indicate the magnitude of these improvements. For metaphorical reasoning, the effect size was 1.56 ($p < 0.01$), indicating a large and statistically significant improvement. Similarly, cultural literacy showed a large effect size of 1.34 ($p < 0.01$), while creative expression exhibited the largest effect size of 1.89 ($p < 0.001$). These results suggest that the deep learning activities were highly effective in enhancing students' cognitive and creative abilities. The significance levels are denoted as follows: $p < 0.001$, $p < 0.01$, indicating the probability that the observed differences are due to chance. The low *p*-values confirm that the improvements are statistically significant and not random variations.

5.1.1. Metaphorical reasoning analysis

This section aims to investigate the impact of deep learning strategies on students' ability to reason with metaphors. Traditional teaching often focuses on surface-level text interpretation, whereas deep learning activities—such as multimodal text analysis and creative reimagining—are designed to stimulate deeper understanding of abstract linguistic phenomena. To evaluate the effectiveness of the new approach, a paired- samples *t*-test was conducted to compare the pre-test and post-test scores of both the experimental group (using deep learning strategies) and the control group (using traditional methods).

Before and after the intervention, all students completed a questionnaire assessing their metaphorical reasoning abilities. The experimental group received the deep learning intervention, while the control group followed conventional teaching practices. The collected scores were then statistically analyzed using paired-samples *t*-tests, and effect sizes (Cohen's *d*) were calculated to evaluate the magnitude of the intervention effects.

Table 2. Pre/post-test results for metaphorical reasoning.

Group	Pre-Test Mean (SD)	Post-Test Mean (SD)	*t*-value	*p*-value	Cohen's *d*
Experimental	2.89 (0.83)	4.02 (0.71)	10.45	<0.001	1.56
Control	2.95 (0.80)	3.12 (0.77)	2.04	0.04	0.22

As depicted in **Table 2**, the paired-samples *t*-test indicates a significant improvement in the experimental group's metaphorical reasoning scores ($t = 10.45$, $p < 0.001$, Cohen's $d = 1.56$), suggesting that deep learning activities have a strong positive effect on students' ability to interpret metaphors in literary texts. In contrast,

the control group showed only a modest improvement (t = 2.04, p = 0.04, Cohen's d = 0.22). These findings imply that while traditional teaching methods may yield slight improvements, deep learning strategies significantly enhance students' cognitive engagement in the symbolic aspects of literature. Future research should investigate which specific components of the deep learning approach contribute most to these improvements.

5.1.2. Cultural literacy analysis

This section examines the effect of deep learning strategies on students' cultural literacy. Cultural literacy, which encompasses the understanding of historical, philosophical, and cultural contexts underlying literary works, is essential for a comprehensive appreciation of literature. Unlike traditional methods that often neglect these contexts, deep learning activities such as cultural immersion and multimodal analysis may enhance students' cultural understanding. An ANOVA was used to compare the pre-test and post-test scores between the experimental and control groups.

Participants completed a cultural literacy questionnaire before and after the intervention. The experimental group engaged in activities designed to integrate cultural background into the learning process, while the control group followed standard teaching practices. An ANOVA was then performed to assess the significance of differences between the groups.

Participants completed a cultural literacy questionnaire before and after the intervention. The experimental group engaged in activities designed to integrate cultural background into the learning process, while the control group followed standard teaching practices. An ANOVA was then performed to assess the significance of differences between the groups.

Table 3. ANOVA results for cultural literacy.

Group	Pre-Test Mean (SD)	Post-Test Mean (SD)	*F*-value
Experimental	3.12 (0.76)	4.21 (0.68)	28.47
Control	3.15 (0.80)	3.65 (0.72)	4.52

As shown in **Table 3**, the ANOVA results reveal a significant difference in cultural literacy between the experimental and control groups, with the experimental group showing a substantial improvement ($F(1, 325) = 28.47$, $p < 0.001$). Although the control group also demonstrated a modest increase ($F(1, 325) = 4.52$, $p = 0.03$), the effect size was considerably smaller. These outcomes underscore the importance of incorporating cultural contexts into the curriculum through deep learning strategies. By immersing students in the cultural and historical background of literary texts, educators can foster a deeper, more meaningful understanding of literature. Future studies should further explore which cultural immersion activities are most effective in enhancing cultural literacy.

5.1.3. Creative expression analysis

This section investigates the impact of deep learning strategies on students' creative expression. Creative expression reflects the ability to reinterpret and generate novel ideas from literary texts, an essential component of language

learning. Given that deep learning emphasizes divergent thinking and creative reimagining, this study used regression analysis to examine the relationship between the intervention and students' creative expression, while also considering demographic factors such as grade level and gender.

After the intervention, students self-assessed their creative expression through questionnaires, which were complemented by teacher evaluations. A multiple regression analysis was conducted with creative expression scores as the dependent variable and intervention (deep learning), grade level, and gender as independent variables.

Table 4. Regression analysis for creative expression.

Variable	Beta (Standardized)	*t*-value
Gender (Male)	0.12	2.13
Grade (11th)	0.22	3.45
Intervention	0.68	7.89

Correspondingly, as shown in **Table 4**, the regression analysis indicates that the deep learning intervention significantly predicts improvements in creative expression (β = 0.68, t = 7.89, $p < 0.001$). This suggests that activities promoting creative reimagining and multimodal engagement markedly enhance students' ability to produce original interpretations of literary texts. Moreover, grade level is a significant predictor (β = 0.22, t = 3.45, $p < 0.01$), with 11th-grade students demonstrating greater improvements compared to 10th-grade students—likely reflecting higher cognitive maturity and a greater capacity for creative thinking. Although gender has a smaller yet significant effect (β = 0.12, t = 2.13, p = 0.03), these findings suggest that demographic factors may moderate the impact of deep learning on creative expression. These results underscore the need to tailor pedagogical approaches to the developmental stages and individual characteristics of students. Future research should explore differentiated teaching strategies to maximize creative potential across diverse student populations.

5.1.4. Analysis summary

These analyses above demonstrate significant differences between the experimental and control groups in metaphorical reasoning, cultural literacy, and creative expression. Through quantitative statistics (such as paired *t*-tests, ANOVA, and regression analysis), we have been able to systematically understand the effectiveness of deep learning strategies in these areas.

Improvement in metaphorical reasoning: The deep learning activities significantly improved students' understanding of metaphors, indicating that these activities can stimulate students' critical thinking and creativity. Compared to traditional teaching, deep learning strategies help students gain a deeper understanding of the symbolic meanings in literary texts through multimodal text interpretation and creative reimagining activities.

Enhancement of cultural literacy: Students in the experimental group showed more significant improvements in cultural literacy, suggesting that integrating cultural background into learning activities helps students better understand the

historical and philosophical significance of literary works. This result also emphasizes the importance of cultural literacy in modern education, particularly in the context of increasing globalization.

Change in creative expression: The deep learning intervention significantly enhanced students' creative expression, with 11th-grade students showing more pronounced improvements. This suggests that creative thinking is not only a product of cognitive ability but also a key skill that can be strengthened through appropriate teaching activities.

These results provide rich considerations for future research, especially in exploring how different teaching activities impact various aspects of students' abilities, the role of student demographics in learning outcomes, and the adaptability of deep learning strategies in different educational environments.

5.2. Qualitative insights

This section examines the second and third research questions, focusing on how poetic pedagogy enhances critical thinking and cultural literacy, and how students engage with the deep learning activities.

The qualitative phase of the study provided rich, contextualized data on the experiences of students and teachers with deep learning activities. The findings are organized into two main themes: student perspectives and teacher reflections.

5.2.1. Student perspectives

Students reported that the deep learning activities made the classroom more engaging and meaningful. Many students expressed a newfound appreciation for classical texts, noting that the activities helped them connect the texts to their own lives and contemporary issues.

- Emotional Engagement: Several students described how the activities evoked strong emotional responses. For example, one student remarked, "Reenacting Li Bai's journey through VR made me feel the weight of history and the beauty of poetry. It was like I was walking alongside him, experiencing the challenges he faced." (Male, Grade 11)
- Personal Connection: Students also highlighted how the activities helped them relate classical texts to their own experiences. One student shared, "Writing a modern version of The Hard Roads to Shu helped me connect ancient struggles to my own life. I realized that the poem's themes of perseverance and resilience are still relevant today." (Female, Grade 10)
- Collaborative Learning: Many students appreciated the collaborative nature of the activities, which allowed them to learn from their peers. For instance, one student noted, "Working in groups to create a multimedia presentation was really fun. We got to share ideas and learn from each other's perspectives." (Male, Grade 11)

5.2.2. Teacher reflections

Teachers also reported positive experiences with the deep learning activities, noting their transformative impact on the classroom environment. However, they also identified several challenges related to implementation.

- Classroom transformation: Many teachers observed that the activities transformed their classrooms into spaces of discovery and creativity. One teacher commented, “Deep learning activities have transformed my classroom into a space of discovery and creativity. Students are more engaged and willing to take risks in their learning.” (15-year veteran teacher)
- Curriculum demands: Some teachers expressed concerns about balancing the time-intensive nature of deep learning activities with the demands of the curriculum. For example, one teacher noted, “The challenge lies in balancing curriculum demands with the time needed for deep exploration. It’s hard to cover everything while also giving students the opportunity to engage deeply with the texts.” (Early-career teacher)
- Professional development: Teachers emphasized the need for ongoing training and support to implement deep learning activities effectively. One teacher stated, “I would love to see more professional development opportunities focused on deep learning strategies. It would help us feel more confident in integrating these activities into our teaching”. (Teacher with 10 years of experience)

The quantitative and qualitative findings together provide a comprehensive understanding of the impact of deep learning strategies on Chinese language education. The significant improvements in metaphorical reasoning, cultural literacy, and creative expression demonstrate the effectiveness of deep learning activities in enhancing students’ cognitive and emotional engagement with literary texts.

The qualitative insights further highlight the transformative potential of these activities, as well as the challenges associated with their implementation. Students’ emotional engagement and personal connections to the texts underscore the importance of creating meaningful and immersive learning experiences. Teachers’ reflections emphasize the need for ongoing support and professional development to ensure the successful integration of deep learning strategies into the curriculum.

5.3. Key mechanisms enhancing critical thinking and cultural literacy

To explore in more depth how poetic pedagogy enhances critical thinking and cultural literacy through specific mechanisms, this study focuses on several key teaching activities: multimodal text interpretation, cultural immersion, and creative reimagining.

In multimodal text interpretation, students engage with texts through multiple sensory stimuli, such as visual, auditory, and kinesthetic experiences. Through virtual reality (VR) role-playing of Li Bai’s journey in The Hard Roads to Shu, students not only understand the language and imagery of the poem but also deepen their cultural understanding of the Sichuan region’s geography and history. This multimodal activity enhances students’ critical interpretation of the symbolic and cultural meanings within the poem, fostering a deeper, more nuanced understanding.

In cultural immersion activities, students engage not only with the surface-level meaning of texts but also with the historical, philosophical, and social contexts behind the literary works. For example, while discussing the societal background of Tang Dynasty Sichuan, students could compare historical conditions with

contemporary societal challenges. This cross-cultural and historical comparison significantly contributes to enhancing students' critical reflection and cultural literacy.

Through these teaching strategies, poetic pedagogy significantly stimulates students' critical thinking, helping them analyze texts from different cultural and historical perspectives, thereby enhancing their overall cultural literacy and critical reflection.

5.4. How teachers can effectively design and implement deep learning activities

One of the main challenges teachers face when implementing deep learning activities is how to effectively integrate these innovative teaching methods with traditional curriculum objectives. According to teachers' feedback, time management and curriculum requirements are key factors that need to be addressed when designing deep learning activities. While these activities are highly creative, they often require more time for preparation and implementation, which can conflict with the tight classroom schedules.

For instance, some teachers mentioned, "Deep learning activities have made my classroom more lively and engaging, but balancing these activities with the curriculum content within the limited time is a major challenge". However, many teachers also noted that by carefully designing their lesson plans and clearly defining the objectives of activities, they were able to effectively integrate deep learning activities without sacrificing the quality of instruction. For example, some teachers used extracurricular time or assigned students creative projects after class to make up for the limited classroom time, which allowed students to connect their learning to real-life experiences, enhancing their cultural literacy.

Additionally, teachers expressed a need for professional development support, with many indicating that they would feel more confident in implementing these activities if they had access to more training opportunities focused on deep learning strategies. As one teacher stated, "It would be really helpful to have more professional development opportunities, especially in applying deep learning strategies, which would help us feel more confident integrating these activities into our teaching".

Through these strategies, teachers can not only effectively design and implement deep learning activities but also enhance teaching effectiveness by continuously reflecting on and improving their practices through ongoing professional development.

6. Discussion

This section synthesized the findings of the study, exploring their implications for theory, practice, and policy. By integrating insights from cognitive science, educational psychology, and literary theory, it highlighted the transformative potential of deep learning strategies in Chinese language education. The discussion was organized into two main sections: cognitive and emotional synergy, and practical implications.

6.1. Cognitive and emotional synergy

The study revealed that deep learning strategies activate both cognitive and emotional neural networks, fostering a holistic understanding of literary texts. This synergy between cognition and emotion was particularly evident in activities such as role-playing, multimodal text interpretation, and creative reimagining [26,27].

6.1.1. Role-playing and mirror neuron activation

Role-playing activities, such as reenacting Li Bai's journey through virtual reality (VR), triggered mirror neuron responses, enhancing students' empathy and cultural sensitivity. Mirror neurons, which fire both when an individual performs an action and when they observe the same action performed by others, play a crucial role in social cognition and emotional understanding [26]. By stepping into the shoes of historical figures, students were able to experience the emotions and challenges depicted in the texts, deepening their connection to the material [10].

For example, one student remarked, "Reenacting Li Bai's journey through VR made me feel the weight of history and the beauty of poetry. It was like I was walking alongside him, experiencing the challenges he faced." This emotional engagement not only enhanced students' understanding of the text but also fostered a sense of empathy and cultural awareness [28]. These qualitative observations align with the significant quantitative improvements observed in metaphorical reasoning (Cohen's $d = 1.56$, $p < 0.01$), suggesting that heightened emotional engagement from VR-based role-playing contributed to deeper interpretive skills and stronger cultural connections.

In addition, teacher interviews underscored that the integration of mirror neuron activation with reflective cognitive processes contributed to a more nuanced and profound understanding of literary texts, reinforcing the connection between emotional immersion and advanced interpretive skills.

These findings align with the positive feedback from students in interviews, who reported feeling more emotionally connected to the texts as a result of engaging in activities like virtual role-playing (e.g., reenacting Li Bai's journey in VR).

6.1.2. Multimodal text interpretation and cognitive engagement

Multimodal text interpretation, which involves the use of visual, auditory, and kinesthetic stimuli, enriched students' cognitive engagement with literary texts. For instance, the use of VR simulations to explore the Sichuan landscape helped students visualize the metaphors in The Hard Roads to Shu, enhancing their ability to interpret and analyze the text [18].

This approach aligned with dual-coding theory, which posits that information is processed more effectively when it is presented in both verbal and visual formats [27]. By engaging multiple sensory modalities, deep learning activities integrated cognitive and emotional processes, leading to a more holistic understanding of the texts [29].

In the qualitative interviews, students frequently mentioned how visual cues and physical immersion strengthened their interpretive depth, an outcome also reflected in the statistical gains across metaphorical reasoning and cultural literacy. For

instance, one teacher stated that students "learned to see beyond the words", which parallels the quantitative data showing higher post-test scores in cultural literacy.

6.1.3. Creative reimagining and neural plasticity

Creative reimagining activities, such as rewriting The Hard Roads to Shu as a modern short story or creating a digital collage of the poem's imagery, stimulated neural plasticity, the brain's ability to reorganize itself by forming new neural connections. These activities required students to engage in divergent thinking, generating original ideas and exploring multiple perspectives [30].

The significant improvement in students' creative expression (Cohen's $d = 1.89$, $p < 0.001$) underscores the effectiveness of these activities in fostering creativity and self-expression.

By engaging in creative reimagining, students not only activate brain regions associated with divergent thinking but also promote adaptive neural changes, particularly in areas linked to problem-solving and innovation [23]. These neuroplastic adaptations help consolidate new cognitive strategies and enhance the capacity for flexible, creative interpretation.

This quantitative leap in creativity was further echoed in teacher interviews, where both students and teachers identified imaginative assignments as key motivators for deeper engagement. For example, one student observed, "Writing a modern twist to Li Bai's journey made me see the poem's themes in a new light," a sentiment that closely corresponds to the statistically significant rise in creative expression.

6.2. Practical implications

The findings of this study had several important implications for curriculum design, teacher training, and assessment reform [5,3].

6.2.1. Curriculum design

To deepen students' engagement with literary texts, curriculum designers should integrate multimodal and interdisciplinary activities into the Chinese language curriculum. These activities should be designed to activate both cognitive and emotional processes, fostering a holistic understanding of the texts. For example, the curriculum could include multimodal text interpretation activities that use visual, auditory, and kinesthetic stimuli to enrich students' engagement with literary texts [18]. Additionally, cultural immersion projects that explore the historical, philosophical, and social contexts of literary works can foster cultural awareness and appreciation [28]. Creative reimagining tasks, such as rewriting classical texts through modern mediums like digital storytelling or interactive art, can further enhance students' creativity and self-expression [29].

Qualitative comments from both students and teachers highlighted that such integrated, hands-on activities not only raised engagement levels but also reinforced the quantitative improvements in creative expression and cultural literacy, suggesting a direct correlation between holistic curriculum design and learning outcomes.

6.2.2. Teacher training

Effective implementation of deep learning strategies requires ongoing professional development for teachers. Training programs should not only help educators understand the theoretical foundations of deep learning and its application to literary education but also provide them with practical, hands-on experience. To achieve this, we recommend incorporating:

1) Workshops that include practical sessions where teachers engage in simulated deep learning activities (e.g., VR reenactments, creative writing exercises) and receive immediate feedback.
2) Establishing networks where experienced teachers mentor others and share best practices in designing and implementing deep learning activities.
3) Offering flexible, accessible online courses that cover both theoretical and practical aspects of deep learning, allowing teachers to learn at their own pace.
4) Providing teachers with model lesson plans, digital tools, and instructional resources that demonstrate effective integration of technology and deep learning methodologies.
5) Teachers also need practical tools and resources to design and implement deep learning activities, as well as strategies to manage the time-intensive nature of these activities while meeting curriculum demands.

For example, one teacher noted, “I would love to see more professional development opportunities focused on deep learning strategies. It would help us feel more confident in integrating these activities into our teaching”.

This sentiment aligns with the positive statistical outcomes, as teachers who felt more equipped to orchestrate VR reenactments or creative writing projects reported higher student engagement—a trend that corresponds with the strong effect sizes noted in metaphorical reasoning and creative expression measures.

By adopting these best practices, teacher training programs can better prepare educators to overcome time constraints, integrate deep learning effectively within the curriculum, and ultimately enhance students’ learning experiences.

6.2.3 Assessment reform

Traditional assessment practices, which focus on rote memorization and standardized testing, are ill-suited to capturing the cognitive, emotional, and creative dimensions of deep learning [11]. To address this gap, assessment reform should focus on developing rubrics that evaluate students’ ability to interpret texts, make connections between classical and contemporary contexts, and generate original ideas [9]. Incorporating formative assessment practices, such as reflective journals and peer feedback, can provide ongoing support and guidance for students [10]. Performance-based assessments, such as multimedia presentations and creative projects, can also capture students’ creativity and self-expression.

The strong statistical results in metaphorical reasoning, cultural literacy, and creativity, coupled with teacher feedback on students’ emotional involvement, underscore the necessity for more nuanced, performance-oriented assessment tools that capture both quantitative gains and qualitative depth in learning.

6.3. Limitations and future research

While this study offered valuable insights into the impact of deep learning strategies on Chinese language education, there are several limitations. First, the quasi-experimental design, without full randomization of student assignment, introduces potential selection biases and limits the strength of causal claims. The absence of full randomization raises the possibility that inherent differences—such as variations in student motivation, academic ability, or prior exposure to innovative teaching methods—may have influenced the outcomes. Such selection bias could have led to an overestimation of the intervention's effectiveness. In future research, we will employ a randomized controlled trial (RCT) to validate and extend these findings.

Additionally, the study focused on high school students from specific regions, limiting the generalizability of the findings. A longitudinal research design could also be adopted to investigate whether the observed improvements in metaphorical reasoning, cultural literacy, and creative expression are retained over time, providing further evidence of the enduring impact of deep learning strategies. Expanding the sample to include schools from diverse regions and backgrounds could offer more comprehensive insights into the effectiveness of deep learning strategies across different contexts.

6.4. Deep learning in humanities disciplines, history and philosophy perspectives

The application of deep learning in humanities education extends beyond Chinese language and literature to fields such as history, philosophy, and broader literary studies. In history education, for instance, deep learning strategies have been used to foster historical thinking by encouraging students to analyze primary sources, engage in historiographical debates, and draw connections between past and present events. Similarly, in philosophy, deep learning has been integrated into pedagogy to facilitate dialectical reasoning, where students actively engage with philosophical texts by debating ethical dilemmas and constructing their own philosophical arguments.

This interdisciplinary perspective highlights the adaptability of deep learning principles across different domains. In literature studies, deep learning strategies have been applied to foster critical interpretation, intertextual analysis, and cultural contextualization. Similar to our findings in Chinese language education, research in Western literary pedagogy suggests that multimodal engagement, creative reimagining, and collaborative inquiry enhance students' ability to critically analyze texts and connect them to contemporary issues.

By situating our research within this broader educational landscape, we reinforce the argument that deep learning is a transformative pedagogical framework applicable across humanities disciplines. Future studies should explore how interdisciplinary methodologies—such as combining literary analysis with historical or philosophical inquiry—can further enhance students' cognitive and emotional engagement with texts.

7. Conclusion

In this work, we demonstrated that deep learning, when infused with poetic pedagogy, can transform the Chinese language classroom into a vibrant space of intellectual and emotional growth. By integrating cognitive science and literary education, this approach nurtured students' critical thinking, cultural literacy, and creative expression. We made several key contributions to the field of Chinese language education:

1) In this study, we deepened our understanding of how deep learning strategies enhance engagement with literary texts by merging insights from cognitive science and literary theory, reinforcing the connection between cognitive and emotional learning.
2) Our findings provided educators with concrete strategies, such as multimodal learning, VR simulations, and creative reimagining, to enhance literature instruction.
3) Through this study, we highlighted the need for curriculum and assessment reforms that account for not only cognitive development but also emotional and creative dimensions of learning.

In conclusion, we underscored the transformative potential of deep learning strategies in Chinese language education. By fostering learning environments that integrate cognitive engagement and emotional immersion, students experience literature as more than an academic subject—it became a lived and meaningful journey. As one student aptly put it, "Deep learning activities have made me see literature not just as something to study, but as something to experience and live". This shifted from passive learning to active engagement represents a profound reimagining of the role of literature in education, one that has the potential to shape the future of Chinese language teaching and learning.

In the future, we will explore the application of deep learning strategies beyond classical Chinese texts, extending to other literary genres, languages, and educational contexts. Additionally, longitudinal studies could examine the long-term retention and transferability of skills developed through these approaches, ensuring their sustained impact on students' intellectual and creative growth.

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