Study on the Cultivation Paths of Critical Thinking Ability in College English under the Artificial Intelligence Environment

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Abstract: *With the accelerated integration of artificial intelligence (AI) technology into the field of education, college English teaching is undergoing a profound transformation from knowledge transmission to competence generation. As a crucial dimension of core English literacy, critical thinking ability demonstrates new construction logic and developmental paths within AI-dominated cognitive environments. This study focuses on the intrinsic mechanisms of cultivating critical thinking ability in college English under the AI environment, systematically analyzing the intelligent evolution of language input patterns, the cognitive transfer characteristics of information-processing paths, and the deep involvement of interaction logic in language comprehension. It elaborates on the structural generation mechanism of critical thinking ability in language embedding, cognitive collaboration, and pragmatic transition. On this basis, the paper further proposes strategies for constructing AI-based intelligent hierarchical teaching structures, personalized cognitive feedback mechanisms, and thinking-oriented task systems, aiming to provide theoretical support and practical references for innovating college English teaching models and systematically cultivating thinking abilities. An analysis of the intelligent paths of language input patterns, information-processing routes, and teaching structures in AI environments shows that AI is not merely a technological tool for language teaching but also an important engine for reshaping cognitive processes and promoting the deep evolution of thinking structures.*

Keywords: *artificial intelligence environment; college English; critical thinking ability; cognitive reconstruction; task system; intelligent feedback*

Introduction

Against the backdrop of accelerating globalization and the integration of intelligent technologies, college English education has gradually shifted from emphasizing language knowledge acquisition to promoting the coordinated development of comprehensive language application skills and higher-order thinking abilities. As a key cognitive ability that enables English learners to filter information, make judgments, and construct logical reasoning in complex contexts, critical thinking ability has become increasingly significant. However, traditional teaching models, characterized by monotonous language input, vague cognitive guidance, and a lack of logically challenging task design, severely restrict the effective stimulation of students' thinking potential. With the deepening application of AI technologies—centered on natural language processing, semantic recognition, and learning analytics—in educational contexts, intelligent systems are reconstructing the mechanisms of language input, processing logic, and feedback approaches.This paper aims to explore the cognitive generation mechanisms and instructional restructuring strategies for cultivating critical thinking ability in college English under AI environments. It analyzes how AI integrates into different stages of language learning to facilitate a profound transition from pragmatic awareness to critical thinking, thereby providing theoretical foundations and operational approaches for systematically updating English teaching paradigms and enhancing students' cognitive structures.

1. The Reconstruction Mechanism of College English Cognitive Structure in the Artificial Intelligence Environment

1.1 The Intelligent Evolution of Language Input Patterns

Artificial intelligence technology has deeply intervened in the field of college English teaching, significantly reshaping learners' language input patterns. In traditional teaching systems, language input mainly relied on linear texts and teacher lectures, with limited input types and constrained contextual construction. In the artificial intelligence environment, however, language input has shifted from static to dynamic and from a single form to multimodal expression, encompassing diverse carriers such as text, speech, images, and videos, thereby enhancing the perceptual accessibility and cognitive richness of the input. AI technologies centered on natural language processing (NLP), speech recognition, and semantic recommendation promote contextual embedding and semantic linkage of language input content, constructing learning contexts with greater authenticity and pragmatic relevance [1].

With the support of intelligent recommendation mechanisms, the selection of input materials has become more personalized and semantically precise, effectively matching learners' knowledge backgrounds and cognitive needs, reducing redundant information interference, and improving the efficiency of cognitive resource allocation. Corpus scheduling systems, based on data modeling and semantic prediction, generate differentiated language materials, making language input more targeted and inspiring, thus providing cognitive scaffolding for the activation and expansion of critical thinking ability. Language input is no longer a unidirectional process of information reception but a dynamically constructed process coupled with semantic processing, stance identification, and viewpoint integration, forming preliminary mechanisms of critical understanding at the input stage.

1.2 Cognitive Transfer Characteristics in Information-Processing Paths

In AI-assisted learning systems, information processing in college English learning exhibits significant cognitive transfer characteristics. The presentation of corpora, semantic feedback mechanisms, and multitasking features in AI environments prompt learners to continuously reorganize and transfer knowledge schemas while understanding, analyzing, and reconstructing language materials, thereby facilitating the transition of thinking patterns from surface-level language memorization to deep logical reasoning. Particularly in intelligent interactive systems, real-time feedback generated through semantic production and contextual computation results in an intertwined structural pattern of non-linear, associative, and reflective information-processing paths.

Language processing supported by artificial intelligence extends beyond mere semantic recognition, further stimulating learners to employ higher-order thinking strategies such as analogy, abstraction, and induction across different contexts, thus achieving horizontal transfer and vertical deepening of cognitive dimensions. The processing of language information gradually shifts from a grammatical paradigm to a semantic reasoning paradigm, promoting the internalization of logical structures and the upgrading of cognitive models. During information reorganization, learners need to continuously integrate prior experiences with new input, completing contextual transformation, stance evaluation, and conceptual transfer, thereby fostering the organic development of critical thinking ability [2].

1.3 The Intervening Role of Dynamic Reconstruction of Interaction Logic in Language Comprehension

In the artificial intelligence environment, interaction in college English learning has shifted from one-way communicative transmission to a dynamic, collaborative, and multidimensional mechanism of information flow. Intelligent learning platforms, utilizing deep learning algorithms and semantic recognition technologies, enable high-frequency human-computer interaction and instant feedback, transforming language comprehension from the traditional closed model into a semantic construction process characterized by multi-point triggering and continuous evolution. In this process, language comprehension is no longer an isolated perception-decoding procedure but a compound cognitive activity built upon logical judgment, contextual recognition, and pragmatic intention analysis.

The AI-driven interaction model reinforces contextual construction and viewpoint differentiation in language comprehension. When engaging in multi-turn dialogues, instant Q&A sessions, or receiving feedback from automated evaluation systems, learners are required to continuously revise cognitive hypotheses, reconstruct semantic frameworks, and identify logical contradictions as well as filter key

information within alternating contexts, thereby activating critical analytical mechanisms underlying language comprehension. Interaction itself becomes a cognitive triggering device, establishing a dynamic connection between language processing and the generation of critical thinking. Within this logical reconstruction, language comprehension is concerned not only with semantic clarity but also with the rationality of judgment and the coherence of reasoning, providing structural support for the advanced cultivation of critical thinking ability in college English.

2. The Structural Composition and Generation Mechanism of Critical Thinking Ability in English

2.1 Construction of the Language-Embedded Model for Critical Thinking Ability

Critical thinking ability in English is not an independently generated cognitive module separated from the language itself but a dynamically constructed structure embedded within processes of language comprehension and expression. Specifically, the composition of critical thinking ability should be regarded as the outcome of meaning construction achieved by language users through semantic recognition, logical reasoning, and stance expression during cognitive operations. This ability is reflected not only in semantic choices and syntactic organization but, more profoundly, in argument structures, elaboration of viewpoints, and discourse-level construction. Therefore, constructing a language–thinking integrated embedded model helps reveal the cognitive representations and reasoning mechanisms of critical thinking ability from the perspective of language forms.

In the artificial intelligence environment, the processes of language input and output are no longer isolated textual encoding or lexical accumulation but cognitive evolution processes achieved through semantic analysis, logical association, and feedback mechanisms. The embedded model needs to be built on natural language processing and deep semantic learning frameworks to identify the depth of thinking, reasoning structures, and stability of stances reflected in students' discourse construction. For example, by modeling the linguistic features of argumentative writing—such as viewpoint elaboration, causal connections, and refutation structures—it is possible to structurally locate and stage-assess students' critical thinking levels. Language is not merely a vehicle of thought but an explicit manifestation of its organizational patterns, evolutionary paths, and levels of complexity.

It is worth noting that the language-embedded model emphasizes not only the correspondence between language and thinking but also their dynamic association during development. As the complexity of learners' language input increases and the difficulty of output tasks rises, their performance in conceptual construction, semantic organization, and logical integration will demonstrate progressive cognitive characteristics. The construction of the embedded model should fully leverage the advantages of artificial intelligence in corpus analysis, pattern recognition, and feedback optimization, achieving accurate mapping from surface linguistic features to hierarchical thinking structures, thereby providing theoretical support and methodological assurance for the systematic cultivation of critical thinking ability in English [3].

2.2 The Cognitive Synergy Mechanism in the Generation of Critical Thinking Ability

The formation of critical thinking ability is not a linear activation process of a single cognitive module but the result of synergistic operations among multiple cognitive subsystems, including attentional resource allocation, semantic comprehension, contextual judgment, and logical expression. Particularly when processing language input involving multiple stances, ambiguous semantics, or logical conflicts, learners are required to complete high-frequency information transformation and cognitive transfer within an extremely short time. Artificial intelligence platforms, through multidimensional perception and dynamic processing of learners' behavioral data, can construct visualized models of semantic cognitive chains and thinking-jump pathways, thereby revealing the internal synergy mechanism of their cognitive systems. System-level cognitive synergy not only optimizes the efficiency of thinking resource allocation but also enhances the density of information processing and the precision of reasoning during the completion of language tasks.

More importantly, the cognitive synergy mechanism exhibits stronger controllability and real-time adaptability under AI assistance. AI systems can analyze potential cognitive discontinuities in learners' cognitive systems based on their semantic judgment speed, depth of viewpoint organization, and quality of logical connections in specific tasks, and then guide them to perform cognitive compensation and structural optimization through contextual reconstruction, corpus recommendation, or structural

prompts. When learners gradually achieve cognitive integration from viewpoint recognition to stance construction through multi-turn interactions, the system provides intelligent feedback to generate positive reinforcement, strengthening their cognitive ability in logical structure construction and reflective expression. This synergy-based cognitive activation model enables critical thinking ability to develop not merely through experiential accumulation and intuitive response but through systematic processing and dynamic feedback, resulting in a more stable developmental path.

2.3 The Transition Path from Pragmatic Awareness to Critical Thinking

Pragmatic awareness, as a context-sensitive mechanism in language communication, constitutes an essential prerequisite structure in the generation of critical thinking ability. In authentic language use, pragmatic awareness manifests as learners' ability to rapidly capture and judge the speaker's intentions, implied meanings, communicative rules, and cultural contexts, which directly influences the accurate interpretation of language meanings and the identification of stances. In the artificial intelligence environment, learning platforms simulate multi-context inputs and multi-role dialogic interactions, enabling learners to train their contextual adjustment and semantic inference abilities within constantly changing communicative situations. Such highly variable contextual input drives learners to extend their focus from the language content itself to a deeper understanding of language-use strategies and communicative purposes, thereby constructing a more comprehensive pragmatic cognitive network [4].

The generation of critical thinking is a logical extension based on pragmatic awareness. After mastering communicative intentions and language strategies, learners need to further evaluate, question, and reconstruct language information to develop stable logical judgment and critical abilities. In the AI environment, systems can introduce cognitive conflicts by providing heterogeneous corpus comparisons, presenting opposing viewpoints, and incorporating controversial topics, prompting learners to reorganize viewpoints and engage in value-based reasoning, while machine-generated feedback stimulates reflective processing mechanisms. Through this transition path from pragmatic awareness to critical thinking, language learning moves beyond the input–comprehension stage to a deeper cognitive level involving stance construction, logical argumentation, and value judgment, thereby achieving a synergistic enhancement of both language proficiency and thinking quality.

3. Reconstruction of Teaching Paths for Critical Thinking Ability Based on the Artificial Intelligence Environment

3.1 Intelligent Hierarchical Structuring and Path Optimization of Teaching

In an AI-empowered teaching environment, cultivating critical thinking ability in college English needs to transcend the limitations of the traditional "knowledge–skills" linear transmission model and reconstruct an intelligent hierarchical path centered on progressive cognitive levels and the stepwise activation of thinking ability. Based on Bloom's taxonomy of educational objectives and the constructivist learning model, a three-tiered progressive teaching structure for critical thinking ability can be constructed: the basic level emphasizes information acquisition and semantic comprehension; the intermediate level focuses on logical induction and relational analysis; the advanced level is dedicated to viewpoint generation and value judgment. AI platforms, through learning trajectory tracking, semantic tag recognition, and cognitive complexity modeling, conduct real-time analysis of students' language cognition states and levels of thinking engagement, providing data support for the hierarchical division of teaching tasks.

At the level of teaching path optimization, AI systems can dynamically regulate task difficulty, cognitive load, and language complexity, facilitating the transition from knowledge recognition to the generation of deeper critical thinking. Multimodal corpus input, multi-turn dialogue generation, and personalized semantic intervention mechanisms shift the teaching process away from static and fixed structures toward an adaptive evolutionary mechanism centered on learners' cognitive development. The organization of teaching activities no longer relies on uniform teaching progress but is instead reconstructed differentially based on individual cognitive pathways, thereby enhancing the precision, openness, and systematic nature of teaching. AI-based structural task chains not only accurately locate cognitive obstacles but also dynamically match comprehensible input, activating learners' higher-order cognitive systems and effectively supporting the progressive generation and stable construction of critical thinking ability [5].

3.2 Data-Driven Personalized Cognitive Feedback Mechanism

The generation of critical thinking ability is essentially a dynamically evolving cognitive regulation process rather than a static outcome of language output. In the artificial intelligence environment, teaching systems continuously collect and analyze learning behavior data, language production corpora, and interaction feedback records to construct learners' cognitive profiles across different contexts. These cognitive profiles include not only language proficiency and expressive ability but also higher-order thinking dimensions such as logical organization patterns, argumentative strategy preferences, and viewpoint generation pathways. Through multi-source data fusion modeling, the system can identify issues such as logical discontinuities, one-sided viewpoints, and semantic ambiguity in the process of critical thinking, providing targeted feedback to achieve dynamic adjustment of cognitive structures and the gradual development of reflective capacity.

The core advantages of the personalized cognitive feedback mechanism lie in its precision, immediacy, and adaptability. Unlike traditional single-point test-based evaluations, AI platforms, through process-oriented semantic tracking and interactive behavior analysis, can deliver real-time, staged, and multidimensional dynamic feedback. For example, in group discussions or writing training tasks, the system can instantly identify the number of logical connectors used, the strength of argumentative support, and the coherence of viewpoints, providing interpretable suggestions and optimization pathways through natural language generation technology. Feedback functions not only at the level of language expression but also penetrates into cognitive processing and thought organization, prompting students to engage in deep reflection after each task and enhancing their self-regulation and metacognitive abilities. This mechanism achieves a paradigm shift from "assessment-oriented feedback" to "cognitive-construction-oriented feedback," providing systematic support for the personalized development of critical thinking ability in college English.

3.3 Construction Logic of a Thinking-Oriented Task System

The formation of critical thinking ability depends on learners' cognitive engagement and logical reasoning in authentic contexts; therefore, the design of a task system must be based on the dual logic of thinking-driven and semantic generation. In the artificial intelligence environment, supported by core technologies such as natural language processing, semantic understanding, and contextual simulation, teaching tasks are no longer static knowledge drills but cognitive construction processes guided by complex problem-solving. A thinking-oriented task system should focus on presenting problem scenarios characterized by multiple stance tensions, value conflicts, and logical challenges. Through structural problem chains, students are guided to elaborate viewpoints, integrate evidence, and verify logic, thereby gradually fostering critical thinking in pragmatic practice [6].

This type of task system emphasizes openness, progressiveness, and adversariality. Task design should reflect a cognitive progression from factual judgment to value stance and from information filtering to logical reasoning, while also allowing students to express diverse viewpoints and engage in linguistic negotiation during problem-solving. Within the task system, AI platforms serve dual roles as "dynamic schedulers" and "cognitive navigators," capable of adjusting problem focus and interaction forms in real time based on students' language output, thereby promoting continuous optimization of logical structures and language strategies during interactions. Additionally, by employing dialogue-tree generation technology to simulate complex contexts and design multi-turn dialogue paths, the system enables students to develop reflective abilities and deepen argumentative reasoning amidst semantic uncertainties and stance conflicts.

Thinking-oriented tasks are not merely external manifestations of teaching content but internal triggering mechanisms for the generation of thinking ability. Supported by artificial intelligence systems, task design, generation, and feedback can achieve process closure and structural coupling, making the task system an effective connecting device between language input, cognitive processing, and language output. This system construction model, with cognitive logic at its core and task chains as its carrier, provides transferable, traceable, and assessable operational pathways for cultivating critical thinking ability in college English, significantly enhancing the linkage between teaching effectiveness and cognitive depth [7].

Conclusion

The artificial intelligence environment injects new cognitive momentum and systemic potential into

college English teaching, fundamentally reshaping language input structures, processing pathways, and interaction patterns, while providing technical support and a logical framework for the systematic development of critical thinking ability. This study, starting from the multimodal evolution of language input, cognitive transfer in information processing, and dynamic reconstruction of interaction logic, analyzes the cognitive restructuring mechanism of critical thinking ability in college English under AI intervention and clarifies its internal structures within the language-embedded model, cognitive synergy mechanism, and pragmatic–critical transition path. Furthermore, the paper proposes a teaching reconstruction scheme adapted to the AI environment, emphasizing a multi-dimensional linkage model that optimizes teaching logic through intelligent hierarchical structuring, deepens cognitive feedback through data-driven approaches, and guides thinking construction through task systems, thereby exploring precise adaptation mechanisms between instructional design and thinking generation. Future research may further expand the integration potential of AI systems in semantic generation, learning path prediction, and multimodal interaction, delving deeper into the synergistic patterns between language cognition and technological intervention, thus promoting the cultivation model of critical thinking ability toward higher levels of personalization, dynamism, and systematization.

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