

Human-Machine Collaborative Critical Thinking: An Innovative Pathway for Integrating AIGC into College English Education

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Abstract

Drawing upon human-machine symbiosis theory, constructivist learning theory, and critical discourse analysis, this paper proposes a comprehensive pre-class, in-class and post-class human-machine collaborative critical thinking teaching model for college English reading-writing instruction. The model repositions AI not as a mere productivity tool but as a dialogic thinking partner—a multi-perspective content provider, an adversarial reasoning interlocutor, and a diagnostic logic analyst. The paper analyzes the pedagogical rationale, implementation logic, and practical challenges of this approach, and proposes targeted optimization strategies across four dimensions: teacher AI literacy development, classroom usage guidelines, prompt engineering, and multi-stakeholder evaluation systems. The proposed pathway offers a theoretically grounded and practically actionable framework for fostering critical thinking in college English classrooms through intentional human-AIGC collaboration.

Keywords

Human-machine collaboration; AIGC; college English; reading-writing instruction; critical thinking.

1. Introduction

The digital transformation of higher foreign language education has accelerated dramatically in recent years. AIGC tools have become easily accessible teaching and learning aids for both university teachers and students. While these intelligent tools greatly enrich teaching resources and reduce repetitive language training workloads, they also bring new challenges to the cultivation of students' independent judgment and critical thinking. Against this backdrop, exploring how to reasonably coordinate human teachers, students and AIGC tools to realize complementary advantages has become an urgent research topic in college English teaching reform.

At present, college English reading and writing teaching in China has an obvious contradiction: teaching standards take critical thinking as a key ability to cultivate, but daily classroom teaching still focuses on language accuracy and basic text understanding. Critical thinking has long been recognized as an important goal of university education, especially in the current age of massive information and fast technological updates [1]. In China's foreign language core competency standards, critical thinking, language ability, cross-cultural communication and independent learning are listed as four essential abilities that college English teaching needs to cultivate. However, there is a big gap between teaching goals and actual classroom effects. Traditional college English teaching mostly focuses on basic language knowledge such as words, grammar and literal text comprehension, ignoring the training of advanced thinking ability [2]. This research has both theoretical and practical value for foreign language teaching research. The human-machine symbiosis theory proposed by J.C.R. Licklider in 1960 holds that humans and computers can cooperate efficiently. Humans are responsible for setting goals, making

critical judgments and evaluation, while computers undertake repetitive and data-heavy work. Their joint output can reach the intellectual level that neither side can achieve alone [3].

In theory, this study enriches the research on human-machine cooperative teaching. It constructs a targeted teaching framework that uses AIGC to train critical thinking. The model can adapt to different school environments, with flexible implementation methods. It can adapt to the actual teaching limits of various schools while keeping the core teaching ideas unchanged [4].

2. Conceptual Foundations and Theoretical Framework

2.1. Core Concepts Defined

Artificial Intelligence Generated Content (AIGC). AIGC refers to text, pictures, audio, video and other content generated by AI systems represented by large language models [5]. In teaching, AIGC includes ChatGPT, Wenxin Yiyan, Claude and other generative AI tools, which can generate human-like text according to user's prompts.

Human-Machine Collaborative Critical Thinking Instruction. It refers to a teaching mode where students and AI interact regularly to improve critical thinking [6]. Unlike the teaching mode that only uses AI to get answers or modify grammar, this cooperative mode regards AI as a research partner. It can offer different viewpoints, raise difficult questions and give analytical feedback to push students to reflect and revise their ideas.

College English Reading-Writing Critical Thinking Ability. This ability means students can read English texts with a critical eye and write articles with clear logic, sufficient evidence and diversified viewpoints. Specifically, students need to judge arguments, find hidden assumptions, recognize biased expressions, integrate information from different materials, put forward reasonable opposing views, and adjust their own ideas according to new materials or different opinions [2].

2.2. Theoretical Framework

Human-Machine Symbiosis Theory. Licklider put forward the idea of human-machine symbiosis, which was later applied to education. It believes that human intelligence and machine intelligence can complement each other. This theory denies two extreme views: one is that AI will completely replace teachers, the other is that AI has no teaching value. Instead, it advocates "human-AI cooperative teaching": teachers and AI each play their own advantages in teaching. AI can automatically complete personalized feedback and material sorting, freeing teachers to focus on high-level teaching work such as guiding thinking, emotional communication and value judgment [4]. Such cooperation requires several prerequisites: teachers' AI literacy, independent teaching decision-making, ethical norms and scientific teaching design [5].

This research expands the human-machine symbiosis theory, clarifying how AI acts as a thinking partner in critical reading and writing. Instead of simply letting teachers use AI tools, this framework regards human-AI interaction as a joint thinking process where humans and AI share thinking tasks and jointly form logical viewpoints [7].

Constructivist Learning Theory. Vygotsky's social constructivism theory provides the second theoretical basis [7]. The core view of constructivist teaching is that students take the initiative to build knowledge through communication with the outside world, rather than passively receiving information. The Zone of Proximal Development (ZPD) — the gap between students' independent ability and the ability they can reach with guidance — is very important for this research. In this model, AIGC acts as a scaffolding within the ZPD. It provides support so that students can complete reading and writing tasks that they cannot finish alone. This kind of

auxiliary support is temporary; when students master critical thinking skills, they will no longer rely on AI [7].

Constructivism also points out that learning works best in real tasks and cooperative communication. Therefore, this model combines AIGC with practical reading and writing tasks. Students need to judge arguments, put forward their own opinions and revise content according to feedback, instead of doing isolated language exercises.

Critical Discourse Analysis Theory. Fairclough, van Dijk and other scholars put forward critical discourse analysis (CDA) [8]. It is used to study how language reflects power relations, values and social phenomena. In teaching, CDA can help analyze how texts set readers' positions, how arguments highlight certain viewpoints, and how language shapes people's inherent thinking modes [7].

This theory supports the model in two ways. First, critical reading, the core link of teaching, is exactly the text analysis advocated by CDA: questioning hidden assumptions, distinguishing different standpoints, judging writing skills, and finding the omitted information in texts. Second, AIGC-generated content is not completely neutral. It is limited by training data and design values. Students need to judge AI output with the same critical standard as human-written articles, and find its defects, biases and artificial traces [8].

3. Current State and Challenges of AIGC-Integrated Critical Thinking Instruction

After many rounds of curriculum reform, college English reading and writing teaching still has obvious defects in cultivating critical thinking [2].

Teacher Neglect of Critical Thinking Pedagogy. Faced with exam pressure and heavy teaching tasks, many teachers pay more attention to language accuracy and text explanation, ignoring critical thinking training. Most teachers regard critical thinking as a side effect of language learning, thinking students can gain it naturally after contacting enough reading materials. They do not treat it as a skill that needs targeted teaching, repeated practice and targeted feedback [1]. Thus, classroom activities mostly focus on information retrieval, word and grammar exercises, with little training on analyzing arguments, evaluating viewpoints or writing counterarguments [2].

Student Weaknesses in Critical Thinking. Affected by the above teaching mode, most college English students lack mature critical thinking skills. Relevant studies show that English learners have difficulty analyzing reading materials objectively, drawing reasonable conclusions and writing logical arguments [2]. Their compositions often use fixed templates and conventional views without real independent thinking. This is not because students lack intelligence, but because they rarely get the chance to practice critical thinking behaviors: questioning assumptions, thinking about different possibilities, judging evidence and adjusting their own opinions.

Homogenization of Student Thinking. The most prominent problem caused by insufficient critical thinking training is that students' ideas become identical. Without being guided to form and defend their own standpoints, students tend to write safe and common answers to meet scoring standards, without independent thinking [2]. This unified thinking goes against the original intention of higher education, which should cultivate students' independent thinking, diversified perspectives and creative ability [9].

Many teachers have tried to use AIGC to assist reading and writing tasks in daily teaching, yet most applications stay at shallow auxiliary levels such as word translation, sentence polishing and material summarization. Few teachers guide students to carry out multi-angle debate and logical scrutiny with AI, which makes it impossible to reverse the long-standing lack of critical

thinking training. Even if students use AI to finish reading reports or argumentative essays, they seldom question the rationality, bias and information authenticity of AI-generated content, leading to deeper cognitive laziness over time.

4. A Human-Machine Collaborative Pathway for AIGC-Integrated Critical Thinking Instruction

4.1. Role Positioning of AIGC in the Classroom

To apply AIGC to teaching reasonably, we need to clarify its functions in class. Combined with human-machine symbiosis theory and critical thinking research, this paper defines three core roles of AIGC in college English reading and writing teaching.

Multi-Perspective Content Provider. AIGC can generate articles, viewpoints and examples from multiple standpoints on one topic. Students cannot accept these contents blindly; they need to compare, judge and integrate different viewpoints. This role gives full play to AIGC's advantage of quickly generating diverse materials, and lets students act as critical judges rather than passive receivers [10].

Adversarial Thinking Partner. AIGC acts like a Socratic dialogue partner: it puts forward difficult questions, provides opposite viewpoints, and pushes students to explain, improve or change their standpoints. Dialectical communication can exercise critical thinking: different views help students clarify hidden assumptions and form more rigorous logic. Unlike human partners, AI can keep putting forward opposing views without fatigue, switch multiple standpoints continuously, and respond in real time to maintain the depth of discussion [10].

Diagnostic Writing Logic Analyst. AIGC can give formative feedback on students' compositions. It not only finds grammar mistakes, but also analyzes logical structure, argument rationality and evidence adequacy [8]. With this feedback, students can revise articles repeatedly and learn to evaluate their own writing. However, teachers need to guide students to use AI feedback correctly: distinguish important logical problems from minor language errors, and absorb suggestions without losing their own writing characteristics [4].

The three roles of AIGC are not isolated in actual teaching, but interpenetrate and cooperate with each other throughout reading and writing activities. In one complete learning task, AIGC can first provide diversified materials as a multi-perspective content provider, then put forward opposite arguments as an adversarial thinking partner, and finally sort out logical flaws in students' output as a diagnostic logic analyst. Such coordinated role switching can form a closed-loop training chain for critical thinking, avoiding the single and rigid use of AI tools in traditional classrooms.

4.2. Pedagogical Design Principles

Four core principles guide all teaching design links of this model [4][5].

Student-Centeredness. All activities take students as the main body of learning. AIGC is only a learning resource used by students actively, not a substitute for their independent thinking. Students are responsible for putting forward questions, judging AI content, drawing conclusions and forming their own arguments.

Thinking Priority. The core teaching goal is to cultivate critical thinking; language improvement is secondary. All classroom activities focus on analysis, judgment, integration and reflection, rather than simple mechanical language training [6].

Human-Machine Collaboration. AIGC cannot be used alone. It needs to cooperate with teachers and classmates. Different subjects (humans and AI) have their own strengths, and the best learning effect comes from their coordinated cooperation [6].

Pedagogical Controllability. Teachers hold the final control over teaching design, activity arrangement and evaluation standards. AIGC works within the scope set by teachers. Teachers can limit AI output, guide students' interaction with AI, and intervene at any time to ensure teaching goals are achieved [4].

4.3. Full-Process Implementation Pathway

The proposed model organizes AIGC integration across the full instructional sequence: pre-class preparation, in-class engagement, and post-class consolidation [4].

Pre-Class: AIGC-Facilitated Preparatory Critical Reading. Before class, students engage with AIGC-generated preparatory materials designed to activate prior knowledge and surface multiple perspectives on the upcoming topic [8]. The instructor provides a guiding prompt that asks AIGC to generate: (1) a summary of key debates or issues; (2) arguments representing different positions; and (3) questions for further inquiry. Students are tasked with reading these materials critically, identifying assumptions, evaluating arguments, and formulating their own initial positions. This preparatory work ensures that students enter the classroom having already engaged with the intellectual content and having articulated preliminary thoughts—conditions that enable more productive in-class dialogue [7].

In-Class: Human-AIGC Dialogic Critical Inquiry. The classroom session is organized around sustained dialogue among students, instructor, and AIGC [10]. The sequence typically follows this structure: (1) students share and compare their pre-class responses, surfacing divergent interpretations and positions; (2) the instructor introduces a challenging question or problem that requires deeper analysis; (3) students engage in structured dialogue with AIGC—posing questions, requesting counterarguments, testing claims, and evaluating AI-generated responses; (4) small groups synthesize their findings and prepare to present positions to the class; and (5) the whole class engages in discussion that integrates insights from human and AI sources [8]. Throughout, the instructor's role is to facilitate, probe, and ensure that cognitive engagement remains substantive.

Post-Class: AI-Powered Formative Feedback and Revision. After class, students complete writing assignments that require them to synthesize their learning and articulate their own positions [4]. AIGC provides formative feedback on drafts, focusing on both surface-level issues and higher-order concerns such as argument structure, logical consistency, and evidentiary support. Students revise their work in response to feedback, then submit final versions for instructor evaluation. This iterative feedback-revision cycle is central to the development of both writing proficiency and critical thinking.

4.4. Subject-Specific Implementation Strategies

The above general process can be adjusted according to the different characteristics of reading and writing teaching [10].

Critical Reading with Human-AIGC Collaboration. In reading class, the model trains critical reading ability through structured interaction with AIGC. Common activities include: (1) Comparative reading, compare human-written texts and AI-generated articles on the same topic, analyze their arguments, assumptions and writing skills; (2) Opposite reading, let AIGC put forward counterarguments against the text, then judge whether these counterarguments are reasonable; (3) Context supplement reading, ask AIGC to provide historical, cultural or theoretical background to help understand the text; (4) Inquiry reading, raise questions about the text, use AIGC to find possible answers, then judge the reliability of these answers [10]. The core goal is not to replace traditional intensive reading with AI, but to enrich students' text analysis through AI-assisted research [7].

Critical Writing with Human-AIGC Collaboration. In writing class, AIGC participates in every stage of writing [8]. Before drafting, students use AIGC to brainstorm ideas, try different article

structures and collect diversified viewpoints. During drafting, students finish writing independently first, then let AIGC give feedback on argument clarity, logical coherence and evidence support. In the revision stage, students communicate with AIGC repeatedly, ask it to question their viewpoints, suggest expression methods and find logical loopholes. Finally, peer review and teacher evaluation ensure human judgment occupies the core position of scoring [4]. Relevant research proves that under complete teaching design, AI-assisted process genre teaching can greatly improve college students' argumentative writing ability [10][6].

5. Conclusion and Future Directions

This paper puts forward a human-machine cooperative critical thinking teaching scheme that integrates AIGC into college English reading and writing teaching. Based on human-machine symbiosis theory, constructivist learning theory and critical discourse analysis, this model defines AIGC as a dialogue thinking partner rather than a simple efficiency tool. It can provide multi-angle materials, carry out opposing reasoning discussions and analyze writing logic for improvement suggestions. The pre-class-in-class-after-class full-process implementation scheme provides a complete, theory-based operation guide for teachers who want to use AIGC while avoiding its risks.

The core value of this research lies in redefining the relationship between AIGC and education. Many people think AI will hinder critical thinking and let students avoid independent thinking. But this model regards AI as a tool to develop critical thinking. With scientific teaching design and targeted guidance, human-AIGC cooperation can let students contact diversified viewpoints, find their own logical loopholes, and continuously polish their thinking and writing ability.

However, this research still has some limitations and unresolved problems. First, the model has not passed practical experimental verification; follow-up research needs to adopt quasi-experimental or design research to test its actual effect on students' critical thinking. Second, the adaptability of this model in different school environments needs further research, including differences in equipment conditions, class scale and students' English level. Third, the ethical problems of human-AIGC cooperation need long-term attention, such as algorithm bias, data privacy, and whether AI will solidify existing unequal value views.

Future research and practice can develop in four directions. Empirically, long-term tracking research is needed to observe the long-term changes of students' critical thinking under AIGC-assisted teaching. In teaching practice, more detailed teaching materials need to be developed, including activity plans, prompt templates and scoring standards for teachers to use. Technologically, education-specific AIGC tools should be developed, with functions such as Socratic questioning, perspective conversion and metacognitive guidance. Theoretically, researchers need to continuously optimize the human-machine symbiosis framework according to experimental data and updated AI technology.

In short, applying AIGC to college English reading and writing teaching is both a challenge and an opportunity for cultivating critical thinking. The challenge is to design teaching activities that make use of AI's advantages without reducing students' independent thinking. The opportunity is to build a learning environment where students can access diverse viewpoints, get timely targeted feedback, and form stable critical thinking habits for study and work. The human-machine cooperative scheme proposed in this paper provides a feasible starting point to realize this goal.

As digital educational technology continues to iterate and update, the human-machine collaborative teaching mode proposed in this paper will also keep evolving along with AIGC functions. Educators should maintain an open and rational attitude toward intelligent teaching tools, constantly adjust teaching strategies according to real classroom feedback, and always

take the long-term cultivation of students' critical thinking as the core teaching goal. Only in this way can AIGC truly serve the high-quality development of college English education rather than become a barrier to students' intellectual growth.

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