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PERCEIVED IMPACT OF AI-ASSISTED LEARNING ON CRITICAL THINKING: EVIDENCE FROM CHINESE ENGLISH MAJORS

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Abstract:

This study explored how AI-assisted learning influences critical thinking skills (CTSs) among Chinese undergraduate English majors, focusing on analysis, evaluation, inference, and self-regulation from the Paul-Elder framework. Using a mixed-methods approach with 188 survey responses and 10 interviews, a tailored questionnaire measured students perceived CTSs changes. Findings show AI tools are widely used for writing, translation, and idea generation. While perceived analytical gains were modest (M=3.28), scores for evaluation, inference, and self-regulation hovered near neutral. Frequent AI use correlated negatively with self-regulation ($r = -0.20$, $p = 0.007$), suggesting risks of cognitive offloading. Interviews indicated that, despite recognizing AI's limitations, students often relied uncritically on these tools under academic pressure and an efficiency-driven environment. The results highlight a core tension: as efficiency becomes central, independent thinking and metacognition risk being sidelined. Addressing how to shift AI from a cognitive shortcut to a true thinking aid emerges as a key educational challenge.

Keyword:

AI-Assisted Learning, Critical Thinking Skills (CTSS), English Majors, Paul-Elder Framework for Critical Thinking

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Introduction

Generative AI—specifically, large language models (LLMs)—has quickly become part of educational practice, moving from speculation to adoption in practice in curriculum design, teacher materials, formative feedback, and digital assessments (Dickey & Bejarano, 2023; Mittal et al., 2024; Chan & Colloton, 2024). While generative AI tools are being adopted widely, there are many questions still regarding the extent of how these technologies may contribute to learners' cognitive development. Despite using AI for summarization, translation, or idea generation, we are in the beginning stages of research that may clarify the broader implications of students' thinking and engagement with knowledge (Zhai et al., 2024; Gerlich, 2025).

Critical thinking (CT) is defined as the independent analysis, evaluation, and creation of ideas (Paul & Elder, 2006). It is one of the paramount goals of higher education. However, the increasing triggers of using AI tools make us question the ability of students to make decisions and the risk that they engage superficially rather than robustly and provide AI with fewer opportunities for active, deep engagement (Aoun, 2017; Selwyn, 2019; Liu & Sihes, 2025). This is particularly present and important in language education, where reflective reasoning and agency are fundamental to making meaning in communication (Liang & Wu, 2024).

In higher education in China, the introduction of AI into EFL classrooms represents not only advancements in technology but also frictions between established traditions of educational practices and AI's new possibilities (Liu & Wang, 2024; Liang & Wu, 2024). Although cultural reasons might receive a lot of attention, the tradition of exam and memorization-based learning is an even more immediate contribution (Tian & Low, 2011). The habits developed through this tradition are deeply seated; students perceive AI as a useful tool for leading to assignment completion, rather than a useful way to engage. Under these pressures, students may be less willing to engage with AI critically, and may tend toward using it as a shortcut, instead of a way to aid their thinking, ultimately allowing AI to reduce their effort and independent thought (Zhai et al., 2024; Gerlich, 2025). When educational contexts privilege engagement with time, right answers, and efficiency, we would be right to worry that quality, deeper approaches to learning will quietly go away.

Despite a growing body of research on AI in education, little is known about how students themselves perceive these tools, particularly regarding their effect on CTSs development. Most studies focus on technical or institutional aspects, with limited attention to student experience (Luckin et al., 2016). As a result, higher-order cognitive domains such as analysis, inference, and self-regulation are often overlooked (Sumakul et al., 2022; Liu & Sihes, 2025). This gap is especially notable among Chinese English majors, who, while active AI users (Wang & Xue, 2024), have not been studied in depth regarding how they perceive AI's integration into learning. Addressing this, the present study, drawing on Paul and Elder's (2006) framework,

International Journal of Modern Education
IJMOE
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Volume: 8 Issue: 29 (March 2026) PP. 408-429

examines Chinese English majors' perceptions of AI's impact on CTSs, exploring their usage patterns, perceived benefits, and potential limitations.

Literature Review

The Paul-Elder Framework for Critical Thinking

The Paul-Elder framework offers a comprehensive model for cultivating CTSs in education, defining CT as "the art of analyzing and evaluating thinking with a view to improving it" and emphasizing standards like clarity, logic, depth, and fairness (Elder & Paul, 2007). The model centers on three components: elements of thought, intellectual standards, and intellectual traits. Of the eight elements, analysis, evaluation, inference, and self-regulation are most relevant to academic tasks involving AI tools—particularly in reading, writing, and argumentation.

AI-assisted learning environments engage these dimensions in targeted ways. Analysis and evaluation are supported as students use AI to generate ideas, organize arguments, correct grammar, and receive automated feedback (Malik, 2023). Inference is facilitated through outlining, summarizing, and paraphrasing, helping students synthesize information (Ozfidan, 2024). Self-regulation develops through iterative AI use, prompting reflection and revision (Pakdel, 2025).

These four dimensions are thus core cognitive processes most affected by AI-mediated learning. They are central not only in Paul and Elder's taxonomy but also in academic literacy demands. As Table 1 shows, each dimension aligns with distinct implications of AI use, highlighting the dual potential for AI to support or displace critical engagement.

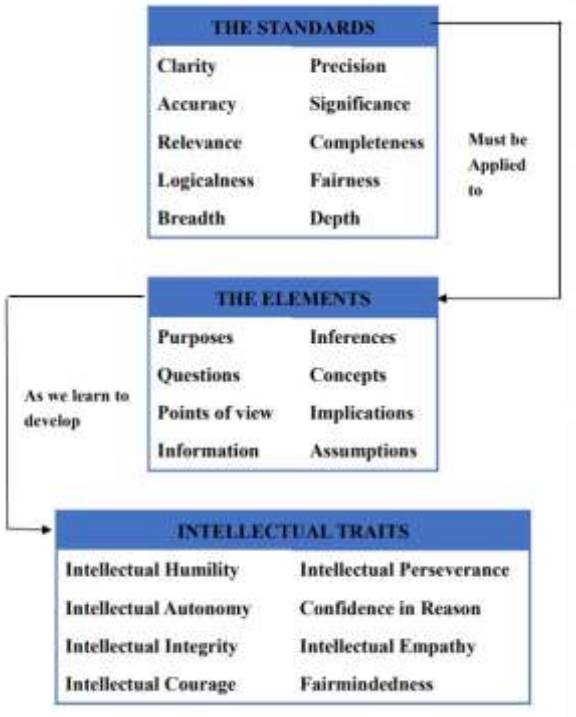

Figure 1: The Paul-Elder Framework for Critical Thinking

International Journal of Modern Education
EISSN: 2637-0905
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Table 1: CT Dimensions and Their Relevance to AI Use

Dimension	Definition	Relevance to AI Use
Analysis	Examining ideas and identifying arguments and evidence.	AI tools assist students in generating ideas, organizing arguments, and refining content. While this can support analytical reasoning, it may also reduce active engagement if overused (Malik, 2023; Sumakul et al., 2022).
Evaluation	Judging the credibility of information or the quality of reasoning.	When students rely on AI outputs without verifying sources or logic, evaluative judgment may weaken. Critical reflection is essential to avoid surface-level acceptance (Selwyn, 2019).
Inference	Drawing logical conclusions based on available information.	AI tools help summarize, paraphrase, and outline texts, which can support inferencing if students actively synthesize content. However, passive use may lead to cognitive bypassing (Ozfidan, 2024; Liu & Sihes, 2025).
Self-regulation	Monitoring one's own cognitive processes, including recognizing biases or gaps.	Iterative use of AI can promote metacognitive awareness when students revise and reflect on their thinking. Still, effective regulation requires balancing human agency with technological input (Pakdel, 2025; Jiang et al., 2024; Aoun, 2017).

A growing body of both empirical and theoretical work has begun to examine the cognitive implications of AI in education. Selwyn (2019), for example, raises concerns that AI-driven learning environments may limit students' chances for deep reflection, potentially narrowing rather than expanding cognitive engagement. In a similar vein, Aoun (2017) calls for a "robot-proof" education—one that prioritizes the development of human judgment, creativity, and adaptability. More recently, Jiang et al. (2024) reported that even when AI use did not lead to measurable improvements in CTSs scores, students nonetheless became more aware of their own cognitive processes. Taken together, these findings highlight the need to explore how students themselves make sense of AI's influence on their academic thinking, particularly from the inside out.

AI in Developing Critical Thinking in Higher Education

A growing body of empirical research shows that AI supports the development of CTSs such as analysis, inference, argumentation, and information integration, particularly in collaborative learning settings (Ruiz-Rojas et al., 2024; Hasan et al., 2025; Çelik et al., 2024; Lawasi et al., 2024). AI's perceived advantages stem from features like personalized feedback, adaptive simulations, and real-time prompts, which can foster student autonomy and reflective awareness (Hasan et al., 2025; Hikmawati & Mohammad, 2025; Cai et al., 2024). However, the realization of these benefits often depends on ideal conditions, such as students' intrinsic motivation, technological proficiency, and strong pedagogical design (Liu & Wang, 2024), yet current research rarely examines these prerequisites systematically.

International Journal of Modern Education
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IJMOE
Volume: 8 Issue: 29 (March 2026) PP. 408-429

In practice, while AI-enhanced learning environments can improve writing fluency and text structuring, their impact on deeper thinking is often overstated. Without adequate teacher guidance, AI tends to reinforce surface-level operational skills rather than analytical thinking or intellectual independence (Pervaiz et al., 2025). Students' ability to benefit critically from AI relies on their capacity to evaluate and reflect on AI-generated outputs (Ruiz-Rojas et al., 2024; Cai et al., 2024).

Increasing attention is being paid to "cognitive offloading," where students shift tasks that require active thinking to AI, especially those lacking self-monitoring abilities (Gerlich, 2025; Essien et al., 2024). Ethical concerns—such as algorithmic bias, factual inaccuracies, and authorship ambiguity—are also becoming more pronounced (Gonsalves, 2024; Rusandi et al., 2023), but discussions often remain theoretical, lacking exploration of their dynamics in classrooms.

Some educators worry that in the absence of critical training, students under academic pressure may uncritically accept AI-generated content, weakening independent thought (Gerlich, 2025; Amirjalil & Nikbakht, 2024; Mehrabi et al., 2019). Thus, the critical promotion of CTSs depends on teachers' guidance—emphasizing quality questioning, in-depth feedback, and fostering classroom values that stimulate thinking (Gonsalves, 2024; Stuchlíková & Weis, 2024). Information literacy, including questioning and verifying AI outputs, must be central in modern education (Walter, 2024; Rusandi et al., 2023).

At the institutional level, traditional academic integrity principles are inadequate for the challenges posed by AI. Universities need clearer guidelines, error-identification tools, and to actively foster students' AI literacy and critical awareness (Shafei & Mahmood, 2025; Gerlich, 2025). In summary, while AI excels at handling academic tasks, its ability to promote deep learning remains debated, with dependency and ethical risks rising if not critically integrated into pedagogy.

AI-Supported Learning in EFL Contexts

In the past few years, there have been initiatives to integrate AI technologies into the EFL classes focusing on automated assessment (Jiang, 2022), translation (Jiang, 2022; Alharbi, 2023), conversational AI (Wang et al., 2024), virtual simulations (Jiang, 2022), and affective computing technologies (Yuan & Liu, 2024). Alshumaimeri and Alshememry (2024) and Yeh (2024) also added that AI has been transforming the relationships that both instructors and learners have with teaching materials. For the development of speaking (Song & Song, 2023), writing (Wang et al., 2024), and vocabulary skills (Hsiao & Chang, 2023), LLMs (Large Language Models) have been proven to be effective as they are capable of giving level-adjusted feedback (Liu et al., 2024; Guo et al., 2024).

Studies show AI improves students' language proficiency and cognitive and emotional engagement. Increased utilization of AI platforms improves students' writing fluency (Yang et al., 2025), oral communication (Yeh, 2024), and vocabulary (Yuan & Liu, 2024). These improvements come from adaptive feedback, writing scaffolds, and input with various modalities which also help relieve task anxiety and bolster confidence (Wu et al., 2025; Liu et al., 2021). AI's instantaneous personalization and feedback can also positively affect engagement and motivation for participation (Dai & Liu, 2024).

International Journal of Modern Education
IJMOE
EISSN: 2637-0905
Volume: 8 Issue: 29 (March 2026) PP. 408-429

Moreover, AI is perceived as a means of fostering creativity and self-directed learning, by assisting students with idea generation, providing writing feedback, and helping with interactive tasks (Alzubi et al., 2025; Wu et al., 2025). This promotes experimentation as well as collaboration. Still, in the absence of well-planned teaching strategies, students may become chronically dependent on AI, which could diminish creativity and the building of CTSs. AI's impact on learning outcomes is contingent upon the means of its integration into the lessons. Both students and teachers' attitudes (Liu et al., 2024) along with teachers' digital competencies (Yeh, 2024; An et al., 2022) are of great importance. Students who actively engage in prompt optimization and rewriting AI-generated texts achieve greater learning than those who are passive and accept suggestions (Wang et al., 2023).

Even with the abundant possibilities offered by AI, there still remains gaps in its working application, including the lack of professional development, disputes with applied ethics, and prejudice in tool design (Jiang, 2022; Dai & Liu, 2024; Alzubi et al, 2025). AI technologies in education, and also more broadly, in learning technologies, hinges on the foresight shaping within the learning design framework, which is proactive, dynamic, and conscientious.

In conclusion, AI is increasingly becoming an integral part of EFL instruction, supporting language development while stimulating student engagement and creativity. However, its success hinges on its deliberate and thoughtful integration into daily teaching practices. Only when both teachers and students possess digital literacy, ethical sensitivity, and critical awareness (Wu et al., 2025; Liu et al., 2024; Song & Song, 2023) can AI truly facilitate deep learning, rather than foster superficial dependency.

EFL Learners' Perceptions of AI Tools in Developing CTSs

EFL students' perceptions of AI's role in fostering CTSs are complex and sometimes ambivalent. While many recognize benefits—such as improved text analysis and strengthened reasoning—concerns persist about overreliance on AI-generated content (Çela et al., 2024) and a tendency toward surface-level engagement with learning materials (Lijie et al., 2024). Another concern is AI's limited capacity for personalized feedback, which is crucial for deeper cognitive development (Rusdin et al., 2023).

A growing number of EFL learners acknowledge the value of AI tools—including ChatGPT (Liu & Wang, 2024), automated feedback systems (Wu et al., 2025), and AI-supported debate platforms (Xu & Jumaat, 2025; Shen & Teng, 2024)—for enhancing CTSs. Students often report clearer analytical reasoning, more structured arguments, and better integration of information from multiple sources. Multimodal resources and writing scaffolds are seen as helpful for organizing ideas, clarifying logic, and promoting independent work (Wu et al., 2025). Students also note that exposure to diverse perspectives through AI broadens their reasoning strategies and encourages them to approach problems from various angles (Darwin et al., 2023; Hading et al., 2024; Lawasi et al., 2024). Some highlight psychological benefits, such as reduced anxiety in writing's initial stages, fostering persistence and willingness to take intellectual risks (Rizkiani et al., 2025; Lawasi et al., 2024).

Despite these advantages, several student concerns warrant attention from educators. Overreliance on AI feedback may impair independent thinking, particularly among students with low confidence in their judgment or limited metacognitive strategies (Rizkiani et al., 2025; Hading et al., 2024; Zakaria et al., 2025). Students note that while AI offers generally helpful

International Journal of Modern Education
EISSN: 2637-0905
IJMOE
Volume: 8 Issue: 29 (March 2026) PP. 408-429

suggestions, it often lacks detail and specificity related to individual learning goals. Compared with teacher feedback, AI may overlook important contextual factors or implicit instructions (Darwin et al., 2023; Setiawan & Alkhowarizmi, 2025).

Ethical considerations further complicate classroom AI integration. Students express concerns about bias, information reliability, and issues of authorship and accountability (Darwin et al., 2023; Zakaria et al., 2025; Khan et al., 2024; Eliott, 2024). Many students advocate a careful, reflective approach: using AI as a supportive tool, questioning its outputs, and cultivating their own critical thinking rather than simply accepting AI suggestions (Darwin et al., 2023; Rizkiani et al., 2025). They also stress the need for better training on when and how to use AI responsibly developing skills in content selection, contextual understanding, and ethical reasoning (Zakaria et al., 2025; Khan et al., 2024).

In sum, EFL students generally appreciate AI's potential for supporting CTSs, yet remain wary of possible drawbacks. Successful integration requires educators to provide thoughtful guidance and for students to engage critically and responsibly with AI in their learning.

Research Gap

Despite growing interest in educational technologies, most existing research has focused on STEM fields or general academic settings, with limited attention to language learning, particularly in EFL contexts, where CTSs also involve linguistic and cultural sensitivity (Nguyen, 2022). While the potential of AI to support higher-order thinking is widely acknowledged, few studies have examined how learners themselves perceive these effects, especially through established frameworks such as Paul and Elder's (2006) model. Moreover, key cognitive dimensions—such as inference, evaluation, and self-monitoring—remain underexplored, particularly in Chinese EFL environments shaped by local pedagogical norms and cultural expectations. To address these gaps, this study adopts a theoretically grounded and context-sensitive approach to investigate Chinese English majors' perceptions of AI's role in the development of CTSs.

Research Questions

This study aims to explore Chinese English majors' perceptions of the use of AI tools in relation to their CTSs. The following research questions guide the investigation:
RQ1. How frequently do Chinese English majors use AI tools in their academic learning, and for what specific purposes?
RQ2. What are Chinese English majors' perceptions of the impact of AI tools on their development of CTSs (analysis, evaluation, inference and self-regulation)?
RQ3. Is there a relationship between the frequency of AI tool usage and students perceived changes in their CTSs?

Research Method

Participants

The participants in this study were 202 undergraduate students majoring in English at a comprehensive university in Sichuan Province, China. The sample included students from all four academic years: Year 1 (n = 47), Year 2 (n = 49), Year 3 (n = 47), and Year 4 (n = 59).

International Journal of Modern Education
EISSN: 2637-0905
IJMOE
Volume: 8 Issue: 29 (March 2026) PP. 408-429

Among the participants, 73 were male (36.1%) and 129 were female (63.9%), reflecting the typical gender imbalance observed in English language programs in Chinese higher education. In addition to the questionnaire, follow-up semi-structured interviews were conducted with 10 students selected via purposive sampling from the survey respondents, based on variation in year level and AI usage frequency. The interviewees included 7 females and 3 males, representing different academic years and diverse perspectives on AI-assisted learning.

Participation was voluntary, and informed consent was obtained digitally prior to survey completion. To protect privacy, no personally identifying information was collected, and all data were stored and analyzed confidentially.

Instruments

Questionnaire

The primary instrument for quantitative data collection was a self-designed questionnaire explicitly grounded in Paul and Elder's (2006) critical thinking framework. The 26-item questionnaire comprised three sections: (1) demographic information (gender, year, English proficiency); (2) AI tool usage (types, frequency, purposes); and (3) students' perceptions of AI's impact on CTSs.

A preliminary needs analysis, involving informal interviews and classroom observations, revealed that Chinese English majors primarily used domestic LLMs—DeepSeek, Kimi, Doubao, and Wenxin Yiyan—for academic support. Legal restrictions limited access to platforms like ChatGPT and Gemini, so the questionnaire focused on tools widely available in China. Here, "AI tools" mainly refers to LLM-powered applications, but DeepL, a neural machine translation tool, was also included due to its frequent academic use. For inclusiveness, the term "AI tools" was broadly defined.

The perception section featured 19 Likert-scale items (1 = Strongly Disagree to 5 = Strongly Agree) categorized into four adapted Paul and Elder (2006) dimensions: Analysis (items 1–5: identifying main ideas, assumptions, and logical connections using AI), Evaluation (6–10: judging the accuracy and reliability of AI outputs), Inference (11–15: drawing conclusions, synthesizing information, and generating ideas), and Self-regulation (16–19: monitoring thought processes, recognizing biases, and regulating AI reliance).

Each item operationalized Paul and Elder's definitions, contextualized for AI-assisted language learning (see Table 1). To ensure content validity, two applied linguistics experts reviewed all items, and a pilot with 10 English majors led to minor revisions. Cronbach's alpha ranged from 0.79 to 0.85, demonstrating strong internal consistency.

The questionnaire was administered online via Wenjuanxing, a widely used Chinese platform. Participation was voluntary, anonymous, and informed consent was obtained digitally before completion.

Semi-structured Interviews

To complement the quantitative data and gain deeper insights into students' experiences with AI tools, semi-structured interviews were conducted with 10 participants selected from the

International Journal of Modern Education
EISSN: 2637-0905
IJMOE
Volume: 8 Issue: 29 (March 2026) PP. 408-429

survey respondents. The interviewees were purposively sampled to ensure variation in year of study, gender, and AI usage frequency.

The interview protocol consisted of six open-ended questions designed to explore students' perceptions of AI's influence on their CTSs. Questions focused on specific use cases of AI tools, perceived benefits and drawbacks, and reflections on how these tools affected their ability to analyze, evaluate, inference, and regulate their thinking.

Each interview lasted approximately 20 to 30 minutes and was conducted in Mandarin Chinese to ensure clarity and comfort. All interviews were audio-recorded with consent, transcribed verbatim, and translated into English for coding and analysis. Thematic coding followed an inductive approach, with emerging categories aligned to the four dimensions of the critical thinking framework.

Data Analysis

The quantitative data collected from the questionnaire was analyzed using SPSS 26.0. Descriptive statistics—including frequencies, percentages, means, and standard deviations—were calculated to summarize participant demographics, patterns of AI tool usage, and students' perceptions of AI's impact on CTSs. The internal consistency of the CTSs perception scale was assessed using Cronbach's alpha coefficients for each dimension (analysis, evaluation, inference, and self-regulation), with values above 0.70 considered acceptable. To address the research questions, inferential statistical analyses were also conducted. Specifically, Pearson correlation analysis was used to examine the relationship between the frequency of AI tool usage and students perceived CTSs.

As for qualitative data analysis, it was conducted using thematic analysis, which is a widely recognized method for identifying, analyzing, and reporting patterns (themes) within qualitative data (Braun & Clarke, 2006). Semi-structured interviews with 10 purposively selected students from different academic years and AI usage backgrounds were transcribed verbatim and analyzed using MAXQDA 2022 software. The thematic analysis involved coding the transcripts to identify recurring themes related to students' experiences, challenges, and perceptions regarding the use of AI tools in their academic English learning.

Results

AI Tool Usage Patterns

After excluding 14 non-users, analysis focused on 188 English majors with AI tool experience (see Table 2). These students showed a strong preference for domestic platforms, especially DeepSeek, Kimi, DeepL, Doubao, and Wenxin Yiyan. Over 60% used AI several times per week, and about one third did so daily. Writing revision and translation were the most frequent applications, followed by idea generation and information searching, while grammar and vocabulary enhancement were less common. Overall, AI tools are now integral to English majors' academic routines, meeting diverse language learning needs and reflecting high engagement with local AI technology.

International Journal of Modern Education
EISSN: 2637-0905
IJMOE
Volume: 8 Issue: 29 (March 2026) PP. 408-429

Table 2: AI Tool Usage Patterns (N = 188)

Variable	Category	Frequency	Percentage (%)
Most Used AI Tool	DeepSeek	129	68.6
	Kimi	128	68.1
	DeepL	120	63.8
	Doubao	119	63.3
	Wenxin Yiyan	102	54.3
	Others	11	5.9
Usage Frequency	Daily	63	33.5
	Several times/week	55	29.3
	Occasionally/month	48	25.5
	Rarely	22	11.7
Purpose	Writing revision	59	31.4
	Translation	45	23.9
	Outline/ideas	44	23.4
	Materials search	21	11.2
	Grammar/vocabulary	19	10.1
	Others	10	5.3

Perceived Impact of AI on CTSs

Table 3 shows that students perceived the greatest AI-related benefit in basic analytical skills, particularly in identifying main ideas (M = 3.28), suggesting AI's value for surface-level comprehension. However, perceived improvements in higher-order CTSs—evaluation, inference, and self-regulation—were limited, with mean scores at or below neutrality. Notably, AI was seen as least effective for stimulating associative or innovative thinking (M = 2.49). High standard deviations across items indicate significant variability in student perceptions, likely due to differing usage patterns and familiarity with AI tools.

Table 3: Perceived Impact of AI on CTSs (N = 188)

Dimension	Sample Item (Abbreviated)	Mean (M)	SD
Analysis	Identify main ideas/supporting details	3.28	1.35
	Analyze structure and logic	2.72	1.42
	Clarify writing relationships/structure	2.88	1.35
	Identify flaws/unclear points	2.87	1.27
	Decompose complex language tasks	2.81	1.34
Evaluation	Question AI conclusions	2.98	1.36
	Distinguish strengths/weaknesses	2.94	1.35
	Consider reasonableness of suggestions	2.79	1.36
	Compare multiple viewpoints	2.91	1.37
	Multiple perspectives	2.69	1.43
Inference	Draw conclusions	2.99	1.34

International Journal of Modern Education
EISSN: 2637-0905
IJMOE
Volume: 8 Issue: 29 (March 2026) PP. 408-429

	Stimulate association	2.49	1.33
	Clarify causality/logic	2.74	1.32
	New explanations/hypotheses	2.64	1.32
Self-regulation	Review thinking after AI use	2.87	1.36
	Awareness of cognitive blind spots	2.80	1.34
	Revise strategies during AI use	2.85	1.34
	Adjust based on AI feedback	2.93	1.35
	Know when to rely on AI or self	2.88	1.34

Correlation Analysis between AI Usage Frequency and Perceived CTSs

To address RQ3, Pearson correlation analyses were conducted to examine the relationship between the frequency of AI tool usage and students perceived changes in their CTSs across four dimensions: analysis, evaluation, inference, and self-regulation (N = 188).

Table 4. Correlation between AI Usage Frequency and CT Dimensions (N = 188)

Dimension	Pearson's r	p-value	Interpretation
Analysis	0.08	0.28	No significant correlation
Evaluation	0.03	0.69	No significant correlation
Inference	0.10	0.18	No significant correlation
Self-regulation	-0.20	0.007*	Significant negative correlation

*p < .01

The results indicate that there were no significant correlations between AI usage frequency and students' perceived abilities in analysis, evaluation, or inference ($p > .05$). However, a significant negative correlation was observed for self-regulation ($r = -0.20$, $p = 0.007$), suggesting that students who used AI tools more frequently tended to report lower self-regulation in their learning and CT processes. This finding is consistent with the concept of cognitive offloading, where excessive reliance on AI diminishes metacognitive regulation (Gerlich, 2025).

Qualitative Results: Interview Findings

Semi-structured interviews with ten undergraduate English majors, purposively selected to ensure diversity in academic year and frequency of AI use, provided in-depth insights into students' experiences with AI-assisted learning and the perceived development of CTSs. Guided by Paul and Elder's framework, thematic analysis identified four recurring themes—analysis, evaluation, inference, and self-regulation—each revealing both enabling and constraining roles of AI tools in students' thinking processes.

(1) Analysis
Most participants reported that AI tools such as Kimi and DeepSeek were helpful for organizing ideas, outlining essays, and simplifying complex texts. This perception is consistent

International Journal of Modern Education
EISSN: 2637-0905
IJMOE
Volume: 8 Issue: 29 (March 2026) PP. 408-429

with the quantitative finding that analytical support received the highest mean score (M = 3.28). One participant explained:

"When I feel lost at the beginning of an essay, AI helps me quickly see the structure and main points. It makes the task feel more manageable." (Interviewee 2, Year 2)

However, several students emphasized that this support was largely limited to surface-level understanding rather than deeper textual analysis. As one senior student noted:

"AI helps me understand faster, but it doesn't really push me to analyze the text deeply. I often just accept its summary instead of thinking through the details myself." (Interviewee 8, Year 4)

These accounts suggest that while AI facilitates basic analytical organization, its contribution to independent, in-depth analysis remains limited.

(2) Evaluation

In line with the quantitative results showing neutral perceptions of evaluative improvement (M = 2.98), many participants described a tendency to accept AI-generated outputs with minimal critical scrutiny. Several students reported judging AI responses primarily by fluency or coherence rather than accuracy or credibility. One participant remarked:

"If the answer sounds professional and fluent, I usually assume it's correct. I don't always check whether the information is reliable." (Interviewee 5, Year 3)

At the same time, a smaller group of students demonstrated growing awareness of AI's limitations and reported engaging in more critical evaluation. For example, one participant stated:

"Sometimes AI gives confident answers that are actually wrong. After noticing this a few times, I started comparing its responses with other sources." (Interviewee 1, Year 1)

These contrasting views reflect varied levels of evaluative engagement among students when interacting with AI tools.

(3) Inference

Participants generally perceived AI as moderately helpful for drawing conclusions and completing assignments but reported limited influence on creative or original thinking. This perception corresponds with the lowest mean score in the inference dimension (M = 2.49). One interviewee commented:

"AI helps me finish tasks faster, but the ideas it gives are very common. It doesn't really inspire new or creative thinking." (Interviewee 6, Year 3)

Some students also expressed concern that reliance on AI-generated ideas could constrain divergent thinking:

"If I follow AI too much, my writing becomes similar to everyone else's. It feels safe, but not creative." (Interviewee 9, Year 4)

These responses suggest that while AI may assist inferential efficiency, it may also limit originality and exploratory reasoning.

International Journal of Modern Education
EISSN: 2637-0905
IJMOE
Volume: 8 Issue: 29 (March 2026) PP. 408-429

(4) Self-Regulation

A prominent theme across interviews was cognitive offloading, with many students reporting habitual reliance on AI for correction, revision, and decision-making. This pattern aligns with the significant negative correlation between AI usage frequency and self-regulation observed in the quantitative analysis ($r = -0.20$, $p = 0.007$). One participant reflected:

"When I use AI too often, I stop checking my own work carefully. I just trust that AI has fixed the problems." (Interviewee 4, Year 2)

In contrast, students who reported lower-frequency AI use tended to describe more deliberate self-monitoring and reflective engagement. As one participant explained:

"I try to use AI only as a reference. I still revise my work myself because I'm worried about becoming too dependent." (Interviewee 10, Year 1)

These findings indicate differing self-regulatory strategies among students, with heavier AI use often associated with reduced metacognitive oversight.

Overall, the qualitative findings reveal the complex and sometimes contradictory role of AI-assisted learning in the development of CTSs. While AI tools support efficiency and organizational aspects of learning, students' accounts highlight persistent limitations in fostering evaluative judgment, creative inference, and self-regulated thinking. These interview-based insights complement and deepen the quantitative results, providing a clearer empirical foundation for the discussion of pedagogical implications in the following section.

Discussion

AI Tool Usage Patterns among Chinese English Majors

The data from the survey revealed that Chinese English majors exhibit frequent and purposeful use of AI tools in academic contexts. Among the AI tools mentioned in the questionnaire, DeepSeek (68.6%), Kimi (68.1%), and Doubao (63.3%) emerged as the most widely used, with nearly one-third of students reporting daily usage. Students most commonly relied on these platforms for tasks such as text rewriting (31.4%) and translating academic materials (23.9%), both of which align closely with the demands of English-major coursework. However, these usage patterns were not entirely driven by personal preference. Many students noted that teacher recommendations and institutional endorsement of specific platforms also played a role. Within the highly structured and performance-oriented environment of Chinese universities, such tools are often viewed as practical solutions for managing urgent or assessment-intensive academic tasks. These findings are consistent with recent studies conducted in comparable English as a Foreign Language (EFL) context (Liu & Wang, 2024; Wu et al., 2025; Song & Song, 2023).

Perceived Benefits of AI in Developing CTSs

The findings suggest that, although students tended to use AI tools pragmatically and did not consistently reflect on their cognitive impact, AI nevertheless played a supportive role in facilitating basic analytical engagement. The highest-rated item—identifying main ideas and outlining details ($M = 3.28$)—indicates that AI tools were primarily perceived as aids for foundational comprehension and structural organization rather than for higher-order reasoning.

International Journal of Modern Education
EISSN: 2637-0905
IJMOE
Volume: 8 Issue: 29 (March 2026) PP. 408-429

From a critical thinking perspective, this pattern implies that AI functions most effectively at the entry level of analytical processing, where tasks involve clarification, organization, and initial interpretation.

This form of support appears particularly relevant in high-pressure academic contexts, where efficiency and task completion are prioritized. By reducing the cognitive burden associated with idea generation and linguistic formulation, AI tools may lower entry barriers to engagement and help students sustain attention during demanding assignments. In this sense, AI operates less as a driver of advanced critical thinking and more as a cognitive scaffold that stabilizes early-stage analytical activity. Such a role aligns with previous research characterizing AI as a form of low-risk academic support that enhances task manageability without necessarily deepening reasoning processes (Çelik et al., 2024).

Importantly, the perceived benefits identified in this study resonate with prior findings that AI-assisted tools are particularly effective in supporting foundational language development and academic task performance (Hsiao & Chang, 2023; Wang et al., 2024; Yuan & Liu, 2024). Rather than directly cultivating higher-order CTSs, AI appears to create favorable conditions for engagement by alleviating anxiety, reducing initial cognitive overload, and providing continuous, non-evaluative assistance. These functions may explain why students value AI as a reliable academic aid, even when its contribution to deeper analytical, evaluative, or inferential thinking remains limited.

Cognitive Risks and Contradictions in Students' AI Use

The findings point to a persistent tension between students' awareness of the potential cognitive risks of AI use and their actual engagement practices. While students generally recognized the importance of maintaining critical thinking autonomy, their reported behaviors suggest that efficiency frequently takes precedence over depth of processing. This discrepancy reflects a form of pragmatic rationality, whereby AI is employed as a time-saving resource under academic pressure rather than as a tool for reflective inquiry. Quantitative results reinforce this interpretation. Lower mean scores on items associated with higher-order thinking—such as analyzing logical structure (M = 2.72) and identifying flaws in reasoning (M = 2.87)—indicate that students' interactions with AI are less conducive to complex analytical engagement. Taken together, these patterns suggest a broader inclination toward cognitive efficiency, where the imperative to meet deadlines and manage workload overrides sustained critical deliberation (Gerlich, 2025; Zhai et al., 2024). From a cognitive perspective, reliance on AI in this manner may be understood as a form of cognitive shortcutting: a strategy that reduces immediate cognitive load but risks weakening deeper reasoning processes over time. This contradiction is particularly evident in the domain of evaluative thinking. Although survey responses suggested a neutral self-assessment of evaluative capacity, qualitative findings indicate limited engagement in verifying, challenging, or revising AI-generated content. Instead, judgments of reliability often appear to be based on surface indicators such as linguistic fluency or professional tone. Such reliance on superficial cues points to vulnerabilities in metacognitive self-regulation, where learners overestimate their critical vigilance while under-engaging in monitoring and control processes (Shen & Teng, 2024).

These patterns raise important concerns about the long-term implications of AI-supported learning for independent critical evaluation. When AI tools are routinely used as default cognitive substitutes—particularly in high-pressure contexts—they may inadvertently

diminish learners' willingness to interrogate arguments, assess evidence, and tolerate epistemic uncertainty. This risk has been widely noted in recent scholarship, which cautions that uncritical reliance on generative AI can erode deep intellectual engagement and reflective judgment (Giannakos et al., 2024; Shoufan, 2023; Gonsalves, 2024; Shafei & Mahmood, 2025). Within this study, the observed contradictions underscore the need to conceptualize AI not merely as a productivity aid, but as a cognitive influence that reshapes how learners allocate attention, effort, and responsibility in thinking-intensive tasks.

Usage–Perception Link: Correlation and Interpretations

Statistical results also highlight the complicated—and sometimes troubling—relationship between AI use and students' CTSs. There was a modest but meaningful negative correlation between how frequently students used AI and their scores on self-regulation ($r = –0.20$, $p = 0.007$). This suggests that students who used AI tools more frequently may have been less likely or less able to monitor and control their thinking effectively. Interviews echoed this finding: students who heavily depended on AI often realized only later, upon reflection, that their ability to engage critically had declined after prolonged AI usage. Such evidence supports broader worries that AI use could unintentionally reduce cognitive effort, limiting opportunities for students to develop essential metacognitive abilities (Wu et al., 2025; Liu et al., 2021).

Students candidly acknowledged certain limitations of AI, including its tendency to constrain originality of thought, yet many still reported relying on it to generate ideas. This points to a mismatch between students' expectations and the actual capabilities of these tools, suggesting a possible threshold where cognitive dependence begins to outweigh strategic benefits. Without explicit guidance on how to engage with AI critically and reflectively (Walter, 2024), there is a risk that students may develop a passive learning style—one that could potentially undermine the cognitive skills that higher education seeks to cultivate (Aoun, 2017; Selwyn, 2019).

These findings underscore the urgent need for educators to deliberately and explicitly integrate AI literacy and CTSs into their teaching practices, to ensure that the benefits of educational AI do not come at the expense of deeper intellectual development (Yusuf et al., 2024).

Implications and Limitations

This research offers key insights into supporting CTSs in EFL teaching and curriculum design. While AI tools are widely used by students, their motivations are primarily practical and shaped by external factors such as instructor or institutional requirements, rather than self-driven cognitive engagement. Learners largely recognize the advantages of AI for basic comprehension or structural support, but do not perceive deeper cognitive gains. Critically, the study found that higher-order cognitive skills—especially self-regulation—are insufficiently supported by current AI practices. As AI becomes more prevalent in academic settings, EFL educators must consider not only how students use these technologies but also what thinking habits they encourage or inhibit.

Building on prior work (Darwin et al., 2023; Obaje, 2025; Gerlich, 2025), this study provides additional evidence of concerns about cognitive offloading—the tendency to favor ease and fluency over independent analysis. Beyond previous findings, this research highlights students' limited awareness of AI's inherent constraints and the lack of structured approaches for critically evaluating AI output. Some students accept machine-generated responses uncritically,

without considering issues such as bias or the validity of conclusions. These findings underscore the urgent need for explicit AI literacy instruction that not only covers technical use but also fosters critical analysis and moral agency. Recommended strategies include comparative analyses of AI and human texts, reflective journals on AI experiences, and debates that challenge students to interrogate AI-generated claims. Such assignments shift learning away from passive acceptance toward active, purposeful engagement. Teacher training should focus on helping students transform AI from a passive tool to an interactive learning partner. The integration of localized AI tools that provide meaningful pedagogical feedback can further support CTSs instruction in EFL contexts. Structured interventions—such as peer review of AI and human writing, reflective journals evaluating AI use, and "AI awareness checkpoints" for credibility and logic assessment—can bridge the gap between AI use and critical thinking development. These approaches not only embed CTSs training into regular instruction but also strengthen students' metacognitive skills and ethical reflection.

This research has several limitations. Firstly, the sample was exclusively drawn from English majors at a single university in Southwest China, which may limit the generalizability of the findings. Secondly, the data primarily relied on student self-reports, which are susceptible to social desirability bias, and thus may not accurately reflect their metacognitive levels, especially under academic pressure. Thirdly, the interview sample size was relatively small and predominantly consisted of high-frequency AI users, potentially failing to comprehensively cover diverse usage patterns and learning experiences. Furthermore, the study treated AI tools as a single entity without differentiating between specific types, such as large language models and grammar checkers. Consequently, it is difficult to determine the precise impact of different tools on various dimensions of CTSs (e.g., evaluation, inference). This aggregated treatment might mask pedagogically significant differences. The study also lacked a longitudinal perspective, leaving it unclear whether long-term AI use deepens cognitive engagement or conversely exacerbates dependency. Future research should expand sample diversity and combine self-reports with behavioral observations or performance-based assessments to obtain a more comprehensive judgment of cognitive effects.

A key challenge is identifying the tipping point at which students shift from strategically using AI to passively depending on it—thereby weakening their capacity for independent thought. This transition often occurs subtly in routines that emphasize speed over reflection, especially when students lack AI literacy or critical awareness. Effective pedagogy should treat AI not as a cognitive substitute but as a scaffold that supports deeper engagement. Instruction must avoid reducing learning to tasks easily handled by AI and instead promote reflection, reasoning, and sustained cognitive effort. Only through intentional integration into reflective teaching can AI's educational potential be fully realized.

Conclusion

Grounded in the Paul-Elder framework, this mixed-methods study explored Chinese English majors' views on AI tools for developing CTSs. Students widely used domestic tools such as DeepSeek, Kimi, and Doubao for translation, revision, and idea generation, showing modest gains in analytical skills. However, improvements in evaluation, inference, and self-regulation were limited. A significant negative correlation between AI use frequency and self-regulation ($r = –0.20$, $p < .01$) suggests greater reliance on AI may hinder independent critical thinking.

International Journal of Modern Education
EISSN: 2637-0905
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Volume: 8 Issue: 29 (March 2026) PP. 408-429

By centering Chinese EFL students' perspectives, this study reveals that while AI enhances efficiency, it can foster dependency and weaken metacognition. Educators should encourage reflective practices—such as comparing AI and human writing, maintaining reflective journals, and designing prompts for critical AI use—and integrate AI literacy, including ethics and contextual awareness, into curricula.

Future research should investigate other disciplines and contexts, using longitudinal and behavioral methods to examine how different AI tools affect cognition. Distinguishing "strategic use" from "passive dependency" is essential to ensure AI supports, rather than undermines, cognitive development.

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International Journal of Modern Education
EISSN: 2637-0905
IJMOE
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