Exploration of AI Literacy Cultivation Mechanisms in English Education in the Digital Age

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Abstract: *The digital age sees artificial intelligence reshaping the landscape of English education, and the interaction between learners and intelligent systems imposes new literacy requirements for language competence. This study focuses on the conceptual connotation and cultivation mechanisms of AI literacy in English education. From the perspective of English education, it defines the three-dimensional attributes of AI literacy, namely cognition, language interaction, and critical evaluation, and analyzes the constituent elements such as task decomposition and feedback integration in human-machine collaborative contexts. The study examines the interactive adaptability of AI tools, the dynamic adjustment of learning strategies by algorithmic feedback, and the calibration model of language trust. Based on these investigations, it constructs a progressive framework for human-machine collaboration underpinned by language task chains, proposes a literacy advancement pathway from tool operation to pragmatic reflection, and develops a cognitive transformation model that integrates language acquisition with algorithmic awareness, thereby providing a theoretical analytical framework for the cultivation of AI literacy.*

Keywords: *English Education; AI Literacy; Human-Machine Collaboration; Language Cognition; Cultivation Mechanisms*

Introduction

In the context of the widespread integration of intelligent language models into English learning scenarios, learners no longer interact only with static language materials or human teachers; instead, they frequently encounter algorithmic systems capable of generating, evaluating, and adjusting language output. This transformation demands a restructuring of the traditional English education framework centered on the acquisition of language knowledge. Learners must possess the ability to collaborate with intelligent tools to accomplish language tasks, namely AI literacy. Current research on AI literacy mostly extends from information literacy or digital literacy, yet it lacks a systematic theoretical construction embedded in the specific context of English education. In particular, during the process of human-machine collaborative language learning, the dimensional composition, developmental pathways, and cultivation mechanisms of AI literacy remain unclear. Therefore, it is necessary to define the composite attributes of AI literacy from the disciplinary characteristics of English education, to analyze its interactive logic with language cognition, learning strategies, and trust relationships, and to explore cultivation mechanisms oriented toward the learning process. The significance of this study lies in filling the gap in the theoretical framework of AI literacy in the field of English education, providing a conceptual foundation and a relational map of functions for subsequent instructional design, while also responding to the urgent need for transformation in language learning methods in the digital age.

1. Conceptual Definition and Theoretical Foundation of AI Literacy in English Education in the Digital Age

1.1 Multidimensional Attributes of AI Literacy from the Perspective of English Education

In the field of English education, AI literacy is not a single technical operational ability; instead, it constitutes a composite literacy encompassing three dimensions: cognition, language interaction, and critical evaluation. The cognitive dimension refers to learners' basic understanding of the operational logic of artificial intelligence language models, including natural language processing mechanisms,

corpus training biases, and output probability characteristics. The language interaction dimension focuses on learners' ability to communicate effectively in English with AI systems, involving specific skills such as prompt design, semantic clarification, and feedback recognition. The critical evaluation dimension requires learners to judge the accuracy, appropriateness, and cultural pragmatic aspects of English texts generated by AI, thereby avoiding blind acceptance of algorithmic output[1].

The multidimensional attributes of AI literacy also manifest as contextual sensitivity and dynamic adaptability. Different English learning tasks, such as vocabulary expansion, writing revision, or speaking simulation, demonstrate varying degrees of activation for each dimension of AI literacy. Writing tasks place greater emphasis on critical evaluation, whereas speaking practice prioritizes interactional fluency. Meanwhile, as learners' English proficiency improves, their usage strategies for AI tools also undergo a shift, moving from basic information retrieval to complex pragmatic negotiation. This multidimensional and variable nature requires that the definition of AI literacy in English education be embedded in specific language use scenarios rather than being described as a context-free general technical capability.

1.2 Constituent Elements of AI Literacy in Human-Machine Collaborative Language Learning Contexts

The human-machine collaborative language learning context emphasizes the process in which learners and intelligent systems jointly complete language tasks. Within this context, the constituent elements of AI literacy first manifest as the ability to decompose tasks and structure instructions. Learners need to break down complex English learning objectives, such as writing an argumentative essay or simulating a business conversation, into subtasks that can be delegated to AI systems, and express these subtasks through clear, executable English instructions. This process involves anticipating the functional boundaries and limitations of AI to avoid requests that exceed its processing capacity. At the same time, learners must possess the real-time monitoring capability to identify incoherent, irrelevant, or pragmatically inappropriate English outputs from AI and adjust their subsequent interaction strategies accordingly.

Another core constituent element is the ability to integrate feedback and reallocate cognitive resources. In human-machine collaborative contexts, AI systems provide immediate linguistic form feedback, such as grammatical error corrections, vocabulary substitution suggestions, or sentence restructuring options. Learners need to distinguish which feedback can be directly adopted and which should be filtered or modified based on their own language development stage. Meanwhile, AI undertakes part of the lower-order cognitive load, such as spell-checking or basic grammatical judgment, thereby enabling learners to focus their attention on higher-order language processing, including discourse structure, rhetorical effects, and cross-cultural pragmatic appropriateness. This reconfiguration of cognitive resources constitutes a key mechanism of AI literacy in English education.

1.3 The Expansion Logic of Language Cognitive Competence with the Intervention of Intelligent Technology

Intelligent technology, through algorithm-driven language models, alters the cognitive pathways through which English learners process input and output information. Traditional language cognition relies on a linear processing model, moving from word recognition to syntactic analysis and then to semantic integration. However, after AI intervention, learners can obtain nonlinear, multi-source feedback by means of instant queries, auto-completion, or parallel corpus comparisons, thereby accelerating the process of forming and validating semantic hypotheses. This expansion logic manifests as an improvement in cognitive flexibility: learners no longer adhere rigidly to a single language rule but can, with the help of multiple expression variants provided by AI, quickly compare and select appropriate linguistic forms[2].

Furthermore, intelligent technology expands the depth and breadth of language cognition. At the depth level, AI can present implicit language knowledge such as the statistical probability distribution of lexical collocations and the frequency of syntactic structures across different registers, thereby enabling learners to go beyond explicit rules and access the probabilistic characteristics of language use. At the breadth level, learners can use machine translation and cross-linguistic alignment functions to quickly compare differences between their native language and the target language, thereby developing metalinguistic awareness. This expansion does not passively replace cognitive processes; instead, it requires learners to actively regulate the pace of interaction with AI systems, forming a cyclical

cognitive mechanism of “expansion, monitoring, and integration,” thus reconstructing the developmental pathway of language competence in English education in the digital age.

2. Interactive Adaptability of AI Tools in the Process of Language Input and Output in English Education

2.1 Interactive Adaptability of AI Tools in Language Input and Output

During the language input process, AI tools significantly influence the difficulty control and content presentation of the English materials that learners encounter. Adaptability manifests in two aspects. The first aspect is the comprehensibility adjustment of input materials: intelligent systems can dynamically filter or generate English texts at an appropriate difficulty level based on learners' current vocabulary size and syntactic proficiency, thereby avoiding cognitive load imbalance caused by input that is either too difficult or too easy. The second aspect is the adaptability of input modality diversity: AI can provide multiple modality combinations, including audio, text, images, and even interactive dialogues, to accommodate different learning styles and task requirements. This adaptability requires learners to possess the ability to identify and actively adjust AI input parameters; that is, they should be able to select appropriate difficulty levels, speech rates, and content topics according to their own language development status, thus constructing a personalized input environment.

During the output process, the interactive adaptability of AI tools primarily manifests in the real-time processing of learners' language production and the selection of feedback formats. When learners generate English sentences or paragraphs, AI can provide multiple types of feedback, including direct correction, metalinguistic explanation, or reformulation suggestions. Different feedback types have varying effects on language internalization, and learners need to judge which form of feedback is more aligned with their current learning goals. For example, in speaking practice that prioritizes fluency, immediate interruptive correction may disrupt communicative coherence, whereas delayed summary feedback proves more appropriate. Furthermore, AI tools can recognize learners' output intentions, such as requests, statements, or questions, and adjust their response strategies accordingly, thus forming a two-way adaptive closed loop of language interaction. The establishment of this adaptive mechanism depends on learners' continuous observation of AI response patterns and their strategic utilization of those patterns.

2.2 Dynamic Regulation Mechanism of Algorithmic Feedback on English Learning Strategies

Algorithmic feedback, as the evaluative information provided by AI systems to learners at the levels of linguistic form and content, exerts a continuous regulatory effect on the evolution of English learning strategies. This regulatory mechanism manifests as a phenomenon of strategy transfer, in which learners actively adjust their own learning strategies based on the type and frequency of feedback. When algorithmic feedback frequently points out grammatical errors, learners may shift from a meaning-oriented strategy to a form-monitoring strategy, thereby increasing their attentional allocation to syntactic structures. Conversely, if the feedback focuses on semantic coherence or pragmatic appropriateness, learners will strengthen their discourse organization strategies and contextual judgment abilities. This dynamic regulation is not linear accumulation but exhibits stage-specific characteristics, as learners repeatedly weigh the reliability of algorithmic feedback against the adaptability of their own strategies across different learning cycles[3].

Furthermore, the presentation format and timing of algorithmic feedback exert an influence on the stability of learning strategies. Delayed feedback tends to promote the development of learners' autonomous error-detection abilities, enabling them to establish internal monitoring mechanisms during the production process; whereas immediate feedback is more suitable for the acquisition of automatic linguistic forms, such as the accurate use of fixed collocations and high-frequency sentence patterns. The degree of certainty in algorithmic feedback also participates in regulating the selection of learning strategies: highly deterministic corrective feedback can prompt learners to adopt mechanical memorization and repeated practice strategies, whereas feedback with probabilistic annotations, such as “the acceptability of this expression in this context is 72%,” guides learners toward comparative analysis and contextual judgment strategies. Through continuous interaction with algorithmic feedback, learners gradually develop a metacognitive regulatory system that enables them to dynamically switch learning strategies according to the characteristics of the feedback.

2.3 The Calibration Model of Language Trust Between Learners and Intelligent Systems

The language trust relationship between learners and intelligent systems is neither static nor unidirectional; instead, it constitutes a dynamic model that undergoes continuous calibration during the interactive process. Trust calibration refers to the process in which learners dynamically adjust the extent of their reliance on AI for completing language tasks based on their evaluation of the accuracy, consistency, and interpretability of AI outputs. In the initial stage, learners may exhibit either excessive trust or insufficient trust due to a lack of understanding of algorithmic mechanisms. As the frequency of interaction increases, learners gradually establish context-sensitive thresholds of trust by comparing AI outputs with authoritative corpora or teacher feedback. For example, when consulting lexical collocations, learners may grant AI a relatively high degree of trust; however, when generating tasks involving cultural metaphors or humorous expressions, they will activate a more stringent review mechanism.

Another important dimension of the language trust calibration model is the identification of AI error types and the corresponding response strategies. AI systems may produce different types of output deviations during English interactions, such as semantic biases, stylistic inappropriateness, or factual errors. Learners need to develop the ability to differentiate based on error types: for random errors, they can adopt local correction strategies; for systematic biases, such as repeated misuse of specific sentence patterns, they need to adjust their overall interaction strategies or switch to other tools. Meanwhile, trust calibration also involves an affective dimension: learners must avoid completely rejecting the language capability of AI due to occasional errors, and they must also guard against automatic blind obedience resulting from multiple correct outputs. This calibration process prompts learners to establish a balance between language trust and critical scrutiny, thereby forming a flexible cooperative model and optimizing the functional positioning of AI literacy in English learning[4].

3. Construction of Cultivation Mechanisms for AI Literacy Oriented Toward the English Learning Process

3.1 A Progressive Framework for Human-Machine Collaboration Based on Language Task Chains

A language task chain decomposes English learning activities into a series of subtasks with internal logical connections, forming a progressive sequence from lower-order to higher-order tasks. Within this framework, human-machine collaboration follows the principle of inverse matching between task complexity and the depth of AI involvement. For simple language tasks, such as word lookup or sentence pattern recognition, AI assumes the primary execution function, and learners only need to initiate the task and receive the output. As task complexity increases, such as paragraph writing or argumentation, the role of AI gradually shifts to that of an auxiliary collaborator, and learners need to take the lead in task planning, intermediate result evaluation, and final output integration. This progressive shift in collaboration mode requires learners to actively adjust their interaction strategies at different task nodes, thereby avoiding the weakening of language processing depth caused by excessive AI intervention.

The connection points of the task chain provide a structured space for regulating human-machine collaboration. After the completion of each subtask, learners need to evaluate the linguistic quality and information completeness of the intermediate products provided by AI, and then decide whether to proceed to the next step or revert to the previous task for revision. This evaluation process involves not only the understanding of AI output content but also the reconfirmation of learners' own language needs. For example, when completing a task chain for English abstract writing, learners sequentially perform subtasks such as topic extraction, key sentence generation, logical connection, and sentence polishing, with AI providing corresponding support at each stage. At the task nodes, learners need to judge whether the draft abstract generated by AI accurately reflects the main idea of the original text; if deviations exist, they need to re-adjust the prompt words or make manual modifications. This progressive collaboration framework allows AI literacy to be repeatedly practiced and naturally internalized during the execution of language tasks[5].

3.2 The Hierarchical Transition Path of AI Literacy from Tool Operation to Pragmatic Reflection

The development of AI literacy in the English learning process presents a characteristic of hierarchical transition. Its starting point is the ability at the tool operation level, which means that

learners can activate AI systems, input instructions, obtain outputs, and complete basic language tasks. This level primarily manifests as familiarity with the AI interface and basic functions, as well as the ability to recognize common output formats. However, remaining only at the tool operation level fails to fully realize the potential value of AI in language learning; learners need to transition to the strategic use level, which is demonstrated by the ability to select appropriate AI functional modules according to different English learning goals, such as invoking synonym replacement tools for writing tasks and choosing dialogue simulation modes for speaking practice. The key to this transition lies in learners beginning to establish a mapping relationship between tasks and tools.

The higher-level transition points to the level of pragmatic reflection, where learners go beyond the surface-level reception of AI output content and instead focus on contextual appropriateness, implied meanings, and cultural conventions in language use. At this level, learners not only judge whether the English expressions generated by AI are correct, but also examine their appropriateness in specific communicative situations and identify possible pragmatic biases or cultural stereotypes in algorithmic outputs. For example, when AI suggests a formal expression for an informal setting, learners can adjust it based on their contextual knowledge. This transition depends on learners comparing and integrating the linguistic forms provided by AI with their own pragmatic knowledge system, thereby forming a reflective language awareness. The hierarchical transition of literacy does not occur automatically; instead, it requires learners to continuously accumulate comparative experiences through repeated language interactions and actively engage in cognitive abstraction and generalization[6].

3.3 The Cognitive Transformation Model Integrating Language Acquisition and Algorithmic Awareness

The integration of language acquisition and algorithmic awareness constitutes an advanced cognitive form of AI literacy in English learning, the core of which lies in learners' synergistic integration of the internalization process of foreign language rules with their understanding of algorithmic operating logic. This transformation model contains two cognitive channels. The first channel processes linguistic form and meaning: learners acquire comprehensible input through AI interaction, generate comprehensible output, and modify their interlanguage system within the feedback loop. The second channel processes algorithmic behavior patterns: learners identify the response tendencies of AI, the distribution characteristics of its errors, and the sources of output uncertainty. The two channels are not parallel and independent; instead, they intersect and influence each other at interaction points. When learners realize that AI frequently makes errors in a certain syntactic structure, they allocate greater attention to that structure, thereby strengthening their autonomous monitoring of language rules.

The operation of this cognitive transformation model depends on an integration mechanism at the metacognitive level. Learners need to possess a dual monitoring capability: on the one hand, they monitor whether their own language production conforms to target language norms; on the other hand, they monitor the reliability of AI output and the discrepancies between that output and their own language judgments. When discrepancies arise, learners initiate a cognitive coordination process, reassessing whether to adjust their language hypotheses or to modify their trust in AI output. As interaction experience accumulates, learners gradually form a joint representation, meaning that their mastery of a particular language item simultaneously includes an expectation of how that item is typically processed in the AI system. This integrated state enables learners to maintain a high degree of language autonomy when detached from the AI environment, while also allowing them to efficiently utilize algorithmic assistance when connected to the AI environment, thus forming a cross-contextually stable language cognitive competence. This transformation model provides an actionable cognitive development pathway for the cultivation of AI literacy in English education in the digital age.

Conclusion

This study, from the disciplinary standpoint of English education, systematically defines the multidimensional attributes of AI literacy and its constituent elements in human-machine collaborative contexts, reveals the expansion logic of intelligent technology for language cognitive competence, and clarifies the interactive adaptability of AI tools in the process of language input and output, the dynamic regulation mechanism of algorithmic feedback on learning strategies, and the calibration model of language trust between learners and intelligent systems. On this basis, this study constructs a progressive framework for human-machine collaboration based on language task chains, proposes a

hierarchical transition path for AI literacy from tool operation to pragmatic reflection, and develops a cognitive transformation model that integrates language acquisition with algorithmic awareness. The above theoretical framework provides a systematic cognitive basis and operational pathways for the cultivation of AI literacy in English education in the digital age. Future research can further explore the differential characteristics of AI literacy development trajectories among learners with different English proficiency levels, as well as the dynamic distribution of the weights of literacy dimensions across various language tasks. In addition, more detailed empirical investigations are needed to examine the long-term effects of output deviations of intelligent systems on language trust calibration and the moderating effects of changes in algorithmic transparency on the hierarchical transition of literacy.

References

[1] Zhang, Jing, and Zhu Zhouxian. "Application of Digital Media in College English Education: A Case Study of S University." Journal of Hubei Adult Education Institute, vol. 32, no. 01, 2026, pp. 53-59.
[2] Li, Jun. "Autonomous Learning and Technology Integration in English Education in the Digital Age." Overseas English, no. 24, 2025, pp. 144-146.
[3] Cui, Yan, Ji Liya, and Chen Xiaopeng. "Application and Innovation of Digital Human Technology in College English Education." Digital Technology and Application, vol. 43, no. 09, 2025, pp. 4-6.
[4] Liu, Jing. "Technological Dependence and Humanistic Care: The Balancing Approach of English Education in the AI Era." Campus English, no. 20, 2025, pp. 51-53.
[5] Pan, Ying. "A Study on the Opportunities and Risks of AI Chatbots Empowering English Education in Higher Vocational Colleges." English Teachers, vol. 24, no. 23, 2024, pp. 99-101.
[6] Qiu, Xiuwen. "Data Intelligence Empowering AI-Assisted Learning: A Practical Research on Basic English Education and Teaching Based on the Concept of Curriculum Education." Campus English, no. 43, 2024, pp. 9-11.