New Pathways for Improving College Students' Reading Literacy in the AI Era

Chunhong Lu[1*], Yu Liu[2]

[1]*Dalian University of Engineering, Dalian, 116600, China*
[2]*Dalian Development Zone Vocational Technical School, Daliar 116600, China*
[*]*Corresponding author: luchunhong1979@126.com*

Abstract: *The artificial intelligence technology is closely related to reading activity, the features of intelligent text environment include algorithmic recommendation, dialogue-based generation and multimodal feedback; the structure of college students' reading literacy changes from linear text comprehension to attention resource management, multimodal semantic integration, critical interpretation, meta-reading and semantic verification. Analyzing how recommendation algorithms reshape the reading choice and attention structure, the dual effects of dialogue-based generation for comprehension scaffolds and cognitive offloading, regulating interpretive depth and memory integration by multimodal feedback at three levels including the reconstruction of the competence structure, mechanisms of technological effects and improvement pathways, construct pathways such as dynamic matching between adaptive reading tasks and cognitive load, prompt-driven critical reading and semantic verification training, and human-AI collaborative reading reflection portfolios and value-added literacy assessment to theoretically refer to the conceptual renewal of college students' reading literacy and design support systems in the AI era.*

Keywords: *AI era; college students' reading literacy; cognitive load; multimodal semantic integration; meta-reading; semantic verification*

Introduction

The emergence of artificial intelligence technology in reading changes the environment for reading object, pathway, and meaning construction through intelligent texts. The reading literacy of college student does not only involve text decoding and passage comprehension, it also needs resource allocation of attention, modality-based integrated meanings, verified generated content, and regulation of cognition while working together with humans and machines. There are many discussions about traditional reading literacy and digital reading competence; however, there are still insufficiencies on systematically understanding mechanisms and constructing pathways of AI technology embedded in reading selection, comprehension, interpretation, and evaluation. Our study's significance is expanding the competence structure of reading literacy by integrating cognitive load, multimodal semantic integration, critical interpretation, meta-reading, and semantic verification into an analysis framework. The necessity of this research is that due to the change of algorithmic recommendation and generative content, the entry point of reading, cognitive engagement, and mode of judgment will be changed, without corresponding pathways, readers will be prone to weaken their deep comprehension and autonomous judgment amidst the illusion of fluency and cognitive dependence. We unfold our discussion from reconstructing the competence structure, the mechanism of technological effects, and improvement pathways providing a coherent explanation and pathway response to college students' reading literacy in the AI era.

1. Reconstruction of the Competence Structure of College Students' Reading Literacy in the AI Era

1.1 Reading Cognitive Load and Attention Allocation in Intelligent Text Environments

Hyperlinks, information streams, pop-ups, conversation, and generative completion create a smart text environment with fluid text boundaries. According to cognitive load theory, there are three kinds: intrinsic load, extraneous load, and germane load when reading. Intrinsic load depends on text

complexity and task requirement whereas the latter comes from interface organization and information presentation; Germane load relates to schema construction and deep processing. Intelligent text environment decreases some extraneous loads (summary generation, terminology explanation, semantic retrieval, and structural visualization), however it also increases attentional switching cost due to parallel multi-source information, switching between recommendation streams, and immediate feedback. They have to screen information, meaning connection, and keep goals within their limited working memory capacity[1].

Allocation of attention in intelligent text environment is negotiation between top-down goal orientation and bottom-up stimulus-driven attention: Selective attention suppresses irrelevant recommendations content for reading goals; Sustained attention guarantees cognitive persistence necessary for long-text comprehension; Divided attention temporarily integrates with the text, annotations, search results, and generated answers. Algorithmic recommendation makes attentional trajectory (clicks, dwell time, interaction history) personalize and bifurcate reading paths. Attention dimension in college students' reading literacy extends from mere concentration to attentional resource management capacity such as reading goal setting, distraction inhibition, evaluate cost of task switching, judge boundary of cognitive offloading. Cognitive offloading undermines deep encoding but reduce immediate load—readers need to know if they want to use or keep their internal processing by using external tools.

1.2 Multimodal Semantic Integration and Critical Interpretation Competence

Multimodal texts include written text together with images, audio, video, dynamic charts, and interactive interface: it forms an intricate semiotic system in which meanings are dispersed via referential, temporal, causal, and affective relations between different modalities. The cognitive theory of multimedia learning emphasizes dual channel processing and cognitive load coordination; the social semiotics perspective focuses on modality selection, salience, and combination that guide meaning construction. College students must engage in cross-modal mapping when they read multimodally, find correspondences, complementarities, conflicts between verbal propositions and visual representations, assess the conflict between emotional tone in audio and textual stance, follow chains of argumentation in hypertext links. Semantic integration competence appears as constantly assessing consistency, redundancy, and complementarity among modalities.

The ability to critically interpret competes with fluent, polysemous, and ambiguous sources of generated content within intelligent text environments. Fluently written text may conceal bad evidence, logical jumps, or implicit premises. Visual synthesis and audio generation produce perceptual realism. Readers need to analyze argument structures, evidence types, causation inference, and framing, distinguish between descriptive and normative statements, selectivity and context omission. Narrowing information and semantic echo by algorithmic recommendation and generative models requires cross-source comparison, stance identification, and counterexample search for readers. Multimodal semantic integration and critical interpretation is a deep dimension of reading literacy in the AI era indicating maintaining comprehension validity and judgment autonomy against increasing symbol density and modality complexity[2].

1.3 Meta-Reading and Semantic Verification Awareness in Generative Content

Generative content uses a predicting probability and it has surface coherence; concealed sources; fluid facts; context transfer. Meta-reading is regulating your goal, choice of strategies, state of comprehension, emotional response while you read. Metacognitive knowledge (awareness of text type, task requirement, condition for using strategy), metacognitive experience (a feeling of comprehending fluently or confusingly) - metacognitive regulation (planning, monitoring, correcting). Generative content easily creates an illusion of fluency that links linguistic fluency with semantic truth. The meta-reading ability needs constant calibration of understanding as you're reading, distinguishing what you know vs. don't know, detecting uncertain expressions, vague reference, incomplete argument in generated texts.

Semantic verification awareness verifies truth (propositional); source reliability; valid inferences. Objects are facts, data citation, time, causality, values. Cross-source comparison, trace back to original sources; check evidence level; test logical consistency; use counterfactual reasoning. Use generative models as a tool of reading assistance to explain, summarize, answer questions, writing continuations: when readers fully transfer their cognitive authority to the model, there will be automation bias and

cognitive dependence. Meta-reading and semantic verification awareness make readers consider generated content as semantic hypotheses that need verification instead of definite knowledge. From receptive understanding to negotiated understanding and verificatory understanding, keep goal dominance, evidence sensitivity, openness to revision during human-machine interactions[3].

2. Mechanisms Through Which AI Technology Is Embedded in College Students' Reading Literacy

2.1 Recommendation Algorithms' Reshaping of Reading Choices and Attentional Structure

Recommendation algorithms use techniques such as collaborative filtering, content feature matching, sequence modeling or reinforcement learning when it comes to candidate generation, ranking and presentation of reading content. From an active retrieval process to algorithm based choice among a set of candidates with interface elements (information feed, recommendation bar, related reading, autoplay) as default reading path. Algorithms collect interest representation through behavior signals such as clicks, dwell time, completion, favorites and interaction frequency form personalized ranking and content push. The algorithmization of reading entry points makes topic distribution, source structure and text types subject to ranking logic: higher chance of exposure to homogeneous content, change opportunity for cross-domain exposure. Expand choices from guided by one intention to be influenced by intentions, algorithmic representations and interface cues together.

Short cycle feedback and multitasking switching of attention structure takes place under the conditions of a recommendation environment – immediate rewards cause frequent interaction; headlines, covers, summaries, popularity indicators are attention capture points; the visibility of in-depth argumentation depends on its entry into algorithmic candidates and ranking position. Attention switch costs increase, the cognitive dwell time required for comprehending long texts is compressed, the requirements for coordinating selectivity, sustainedness, divided attention rise. In absence of goal monitoring, the trajectory of reader's reading corresponds to the rhythm of recommendations; but when metacognitive regulation is applied, treating the result of recommendations not as commands, but as cues, they reconstruct their attentional order by actively retrieving, subscribing across sources, creating topic lists or making reading plans. Recommendation algorithms serve as mediating mechanism between reading choices and attentional structure that regulate the condition for maintaining goals, manage attention, regulate information diversity in reading literacy.

2.2 The Dual Impact of Dialogic Generation on Comprehension Scaffolding and Cognitive Offloading

Natural language interaction is the interface between the dialogic generator and features of explanation, summarization, paraphrasing, exemplification, question answering and continuation writing. Comprehension scaffolding: Generative models provide immediate paraphrase, background knowledge, structure, analogical mapping based on readers' questions which reduces working memory load in advancing understanding from current level to potential level; Interactive follow-up questioning gradually adjusts granularity of explanations from concept definition to argument reconstruction; Generated content serves as an advance organizer setting up text schema or a reflective mirror revealing comprehension deviation. The effectiveness of comprehension scaffolding depends upon matching question quality, follow-up strategies to task goals[4].

Cognitive offloading: Offload memory, reasoning, integration, and verification from readers to the model; use external cognitive resources instead of internal processing. Cognitive offloading frees up cognitive resources for higher order judgment when task complexity is high, but it decreases deep encoding and generative processing when task complexity is low. Fluently generated answers will lead to an automation trust which leads readers to skip evidence checking and logical reasoning. Mechanism of dialogic generation has a dual nature – provides comprehension support changing the structure of cognitive investment. Readers need to treat model's output as a revisable semantic hypothesis with engaging cognition through counterexample questioning, source questioning, multi-model comparison, and self-explanation. Scaffolding comprehension and cognitive offloading are two sides of the same mechanism regulating the balance between depth of understanding and cognitive autonomy in reading literacy.

2.3 The Regulation of Multimodal Feedback on Depth of Interpretation and Memory Integration

Multimodal feedback displays reading states and textual relations in form of visual highlighting, dynamic charts, semantic networks, audio cues, interactive annotations or generative visualization. Multimodal feedback shows text structure, conceptual associations, argument chains, comprehension progress, attention distribution. Structured feedback interprets linear text as a network that makes implicit premises, causal chains, contrastive frameworks visible – helping to go from literal understanding towards relational understanding and critical analysis. Interactive feedback allows switching perspectives seeing different conceptual levels and argument paths promoting building up multiple representations. External representations aid interpretation; readers may repeat calibration between the text, the feedback and their understanding[5].

For memory integration: Semantic congruity texts and images improve encoding and retrieval; Dynamic feedback reveal causal process by time sequence, Spatial feedback reveal conceptual structure by position relationship. If multimodal feedback match reading goal and have moderate load, Promote schema construction and transfer (if the information is redundant or there exists modality conflict), Increase extraneous load, Divert attention and interfere with integration. Timing, Granularity, Modality Matching of feedback influence memory consolidation; Immediate feedback help correct errors, Delayed feedback allow for summative reflection. Readers need to interpret and filter feedback transform external representation into internal knowledge structure. Multimodal feedback regulate depth of interpretation Memory integration constitute the feedback mechanism embedding AI technology in reading literacy.

3. Construction of Pathways for Improving College Students' Reading Literacy in the AI Era

3.1 Dynamic Matching Between Adaptive Reading Tasks and Cognitive Load

Adaptive reading tasks according to cognitive load theory include three types: intrinsic load (complexity of text, density of concepts, argument hierarchy); extraneous load (organization of interface, way of presenting information, interaction modes) and germane load (construction of schema, integration of reasoning, deep encoding). Adaptive systems detect readers' cognitive states and comprehension process through such signals as: prior knowledge level, reading speed, rereading frequency, dwell time, interaction paths, immediate question-answering performance, semantic annotation behavior etc.. The difficulty of a task, text modality, density of auxiliary information, strength of generative scaffolding, timing of feedback are adjustable parameters; it tries to find an adaptive range between underload and cognitive overload in order to use our working memory resources more for meaning construction and critical processing[6].

At the heart of dynamic matching are the gradual changes in scaffolding and cognitive autonomy – explanatory, prompting and self-monitoring scaffolding gradually transition as per task progress from receiving generated explanations toward their own hypothesis proposals, organization of evidence, and revision of understanding; modality adaptation according to text features and task goals (abstract concepts rely on structured visual representations, complex arguments rely on relational graphs, temporal processes rely on dynamic feedback), coordinating feedback channels for semantic consistency and load coordination without conflicting visual, textual, and audio information increasing extraneous load; adaptive mechanism places reading tasks in a edge-of-competence range promoting development of attention management, depth of understanding, and transfer ability via difficulty adjustment, gradual scaffolding withdrawal, and feedback matching.

3.2 Prompt-Driven Critical Reading and Semantic Verification Training

Metacognitive tools: Prompting externalizes questioning, follow-up questions, doubt, verification in reading to a visible and controllable thought chain; concept clarification, evidence sources, hypothesis identification, reasoning chains, counterexample searching, stance comparison, uncertainty annotation drive prompt-driven training. The generative model's output are treated as semantic hypotheses requiring verification rather than final knowledge. Readers require the model to provide source cues, argument structures, alternative explanation, evidence level, and counterexample materials via prompting for cross-source comparison between text, model output, and external sources. Semantic verification identifies factual statements, data citations, temporal information, causal claims, value judgments (verifying logical consistency, sufficiency of evidence, validity of reasoning).

From structured prompts to autonomous prompting: readers build up their habits of verification and critical sensitivity through repeated questioning. Multi-model comparisons, original source tracing, manual retrieval, and self-explanations are all ways of semantic verification; vague references, incomplete arguments, and fluency illusion in generated content become apparent after follow-up questioning. Critical reading identifies not only fallacies but also reconstructs arguments, evaluates evidence, negotiates meanings. Cognitive authorities between them and generative models are redistributed while they keep goal setting, evidence selection, and final judgment. Prompt sequences become a reflective cognitive trajectory when semantic verification awareness is strengthened via continuous follow-up questioning and cross-source comparison.

3.3 Human-Machine Collaborative Reading Reflection Portfolios and Value-Added Literacy Assessment

Reading reflection portfolio: reading goals, Source texts, prompts sequence, output generation, verification processes, revision traces, Reflective logs, Multimodal interactions. Model's clustering, visualization, summarization and feedback suggestion for process data embodies human-machine collaboration – readers interpret meaning, calibrate goal, adjust strategy. Portfolio is a carrier of formative assessment promotes self-regulated learning and metacognitive monitoring. Value-added literacy assessment measures individual long-term changes on aspects like attention management, multimodal semantic integration, critical interpretation, meta-reading and semantic verification without replacing process judgment with one result. Value-added assessment estimates the direction of change in cognitive strategies and depth of understanding from task sequences, process indicators, reflective texts and pre-and post-performance.

Rereading strategies, source verification frequency, prompt quality, modality switching, and argument reconstruction constitute a variable cognitive behavior. The transparency and interpretability of human-machine collaboration in assessment is required without any algorithmic labels solidify readers' development possibilities; Assessment results will feed back to task adaptation and prompt training—task difficulty, strategy training, and literacy assessment dynamically evolve. Readers adapt themselves to an intelligent text environment step by step, verify their generated content, and regulate the human-machine division of labor—the way to improve reading literacy has acquired its own internal mechanism for continuous operations.

Conclusion

Put college students' reading literacy in the AI era into intelligent text environment, proposing its competency structure (attention management, multimodal semantic integration, critical interpretation, meta-reading and semantic verification); recommending algorithms, dialogic generation and multimodal feedback intervene on the reading process by reshaping choices, scaffolding and offloading and feedback regulation; Improvement pathway is a dynamic cycle via adaptive task matching, prompt-driven semantic verification training, human-machine collaborative reflection portfolios and value-added literacy assessment. Longitudinal follow-up on cross-modal semantic integration and meta-reading can be done in future research, refining the relationship between gradually withdrawing scaffolding and cognitive autonomy in adaptive tasks, exploring the effect of prompt training for transfer of critical reading strategies, improving the interpretability of reflection portfolios and value-added assessment, constantly coordinating the cognitive authority distribution, technological transparency and readers' judgment autonomy in human-machine collaboration should also be paid attention to. Expand to an interactive framework of technological evolution and cognitive development: Investigating the impact of leaps in the capability of generative models on reading task design, semantic verification standards and assessment indicators; Testing the robustness of the pathway across scenarios and over time; Constructing an interpretable, adjustable, and negotiable human-machine collaborative reading ecosystem, while paying attention to maintaining the autonomy of readers regarding goal setting, evidence selection and meaning construction.

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