# StructureMe: Reconstructing Text Structure to Support Deeper Learning in the Age of AI Summarization

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**Abstract:** With the rapid development of large language models (LLMs), AI generated article summaries have become increasingly common in academic reading. Although these tools significantly improve the efficiency in acquiring new information, they also simplify the reasoning process of the whole article, causing learners to only focus on the part of "what" rather than "why", and preventing the formation of deeper understandings. This is an urgent problem, especially to novice readers who lack solid reading habits and struggle to recognize the key structure of academic texts. Regarding this issue, this paper proposes a new technological design to support learners to actively identify and internalize the article structure while reading under the guidance of AI tools. This paper argues that compared to AI-generated article summaries, the proposed design is more likely to foster meaningful understandings and promote development of structured knowledge.

## Introduction

With the rapid development of large language models (LLMs), AI tools have been widely utilized in all kinds of learning and professional contexts. Among these applications, AI-generated article summaries have become increasingly common in academic reading. By simply uploading a 20-page research paper to an AI tool, users can receive a concise, paragraph-length summary within seconds, allowing them to grasp the general idea instantly. Although these tools significantly improve the efficiency in acquiring new information, they also subtly reshape the way people learn and process academic texts. By simplifying the reasoning process of the whole article, learners focus more on "what is presented" rather than "why/how it is constructed". However, this structural understanding is precisely what underpins deep learning and meaningful knowledge transfer.

This issue is especially urgent to novice readers. Unlike experts, who can quickly and intuitively recognize the underlying structure of academic texts, novices often lack the sensitivity and experience needed to identify hierarchical relationships among different article sections. As a result, overly rely on AI-generated summaries may lead them to jump over the important process of constructing structural understandings through sustained reading practices. This can result in fragmented and superficial comprehension, which not only hinders the development of academic reading skills, but may also negatively impact their long-term learning outcomes.

In response to these concerns, this paper reconsiders the role of AI in serious academic reading, and proposes a new technological design grounded in learning science theories. Rather than aiming to replace reading, this design supports learners to actively identify and internalize the article structure while engaging with the original content under the guidance of AI tools. Accordingly, the research question being discussed in this paper is: Does actively visualizing the structure of a text contribute more to improving learners' comprehension compared to AI-generated summaries?

## Theoretical Framework

### I. Cognitive Load Theory & Novice vs. Expert Reading

One key challenge for novice readers is that their working memory has limited capacity. Cognitive Load Theory, introduced by Sweller (1988), explains that when learning materials are too complex, they can easily exceed the capacity and make comprehension difficult. Scholarly articles present a particularly high intrinsic cognitive load for novice readers. They not only need to understand new concepts and unfamiliar terms but also figure out how different parts of the article connect, such as the research question, theoretical background, methods, findings, and broader implications. Trying to do all these at once places a heavy cognitive load on the reader.

CLT also points out that prior knowledge matters. Readers with more background knowledge can process the same text more easily, because they already have mental frameworks to organize the information (Sweller, 1988). This helps explain the gap between how experts and novices read. Studies show that expert readers do not simply read from beginning to end. They read strategically, looking for the article's purpose, argument, methods, and contribution. By contrast, novice readers tend to focus on basic details and often miss the deeper logic of the text (Nelms & Segura-Totten, 2019; Tavalsky, 2017). Nelms and Segura-Totten (2019) found that faculty experts and student novices have different reading goals, prior knowledge, and reading strategies. Experts often use constructive strategies such as note-taking and connecting evidence to claims. Novices may use reading strategies as well, but their strategies are more likely to remain basic level, such as highlighting unfamiliar terms or copying important-looking sentences without reconstructing how the article's ideas relate to each other (Nelms & Segura-Totten, 2019). Novice readers need learning tools to support them to reduce extraneous cognitive load and help them pay attention to how articles are organized.

**II. The ICAP Framework**

The ICAP Framework describes four modes of how learners engage with learning materials: Passive, Active, Constructive, and Interactive (Chi and Wylie, 2014). The framework proposes that as engagement deepens learning outcomes improve (Chi and Wylie, 2014). Passive engagement involves receiving information without producing any output, such as reading a summary. Active engagement involves some interaction with the material or asking questions. Constructive engagement needs learners to generate something new such as explaining an idea in their own words (Chi and Wylie, 2014). Thus, passively reading an AI-produced summary is not enough. However, if learners read the article themselves and try to identify the research question, locate the key argument, and connect the findings to a larger conversation, they do constructively engage in learning. We want to design a reading analysis tool that prompts learners to rebuild the article's structure when they are reading and ask them to actively interact with AI to ask reading related questions.

**III. Structural Learning Theory & Text Structure Instruction**

Structural Learning Theory argues that learning is about building organized knowledge and understanding how ideas connect and relate to each other (Scandura, 2001). Kintsch and van Dijk (1978) also proposed that truly understanding a text required readers to build a global picture of what the text is about, not just follow it sentence by sentence. This global understanding, macrostructure, comes from connecting basic details into coherent meaning. If novice readers only read a summary, they might skip this process entirely.

Bogaerds-Hazenberg et al. (2021) found that instruction in text structure significantly improved reading comprehension in upper elementary grades. García et al. (2023) also showed that paying attention to how a text is organized leads to deeper processing. Tools like concept mapping and highlights can support students' stronger understanding and externalizing their thinking (Díaz & Garmendia, 2025).

**IV. AI Support**

AI tools are changing how students engage with academic reading and comprehension. These tools can be helpful: they can quickly turn a long and dense article into a short summary, which may lower the barrier for novice readers. However, researchers have raised concerns about what happens when students use AI summaries as a replacement for reading. When students skip the original text and rely only on the summary, they miss out on the thinking process that leads to deep understanding, such as following an argument, noticing how evidence is used, and understanding the structure of the work (Huang et al., 2023; Heldreth et al., 2026). This does not mean AI should be removed from academic reading. Rather, it suggests that how AI is used matters. Instead of producing a final summary for students to read passively, AI can be used to guide and prompt students as they work through an article themselves. The tool should be designed to lower unnecessary cognitive load, encourage constructive engagement, and help novice readers build a clear understanding of how scholarly articles are organized and argued.

## Design Functions

According to the support of the above learning theories, the article proposes a new learning tool called StructureMe. This design no longer substitutes learners' reading process, but tries to leverage AI to help learners construct the article structure, making the argumentative relationship and reading logic behind more clear and so promote deeper comprehension. Specifically, instead of generating summary text, StructureMe uses AI to identify content with different functions within the article and then overlays highlights onto the original text using different colors: for example, the topic sentence of each paragraph is all highlighted in yellow; evidence, examples, and content of reasoning used to support arguments are marked in blue; experimental setups and research findings are highlighted in green; and words indicating transitions, enumerations, or conclusions—such as "however," "first," "therefore," and etc.—are highlighted in red. In this way, learners can intuitively see the organizational logic of the text while reading, making it easier to understand and remember.

In addition, since learners often hold different objectives when reading an academic article—some focus more on a specific theoretical framework mentioned in the text, while others wish to analyze and reference the experimental design methods—this tool allows learners to briefly input their reading objectives after uploading an academic article. The AI system then provides two switchable annotation modes (tabs). The first tab is always a general structural annotation mode, which color-codes different functional components of the text based on general principles of academic reading. For example, topic sentences, arguments, evidence, inferential relationships, and key discourse markers are systematically highlighted, helping learners understand the article's basic organizational structure and argumentative logic. The second is a goal-oriented annotation mode, which highlights specific text elements based on the learning objectives the user sets before reading. For example, when a user selects "understand the theoretical framework," the system will highlight and emphasize the key concepts, definitions, and their relationships; whereas when a user focuses on "experimental methods," it will prioritize highlighting information such as research design, variable settings, and procedural steps. Learners can freely switch between the two modes to meet different levels of reading needs.

After learners enter their objective and StructureMe analyzes the uploaded article, learners would be directed to a split-screen interface, where on the left is the original text with overlayed highlights, and on the right is a conversation window for real-time interaction with the AI. This design not only meets learners' need to read the full original text but also provides support for immediate questions and feedback, allowing them to resolve questions dynamically during the reading process without having to leave the current context. Additionally, this design supports learners in actively annotating and taking notes during the reading process. Users can add text boxes to the blank margins of the article to record their personal understanding, questions, or reflections, just like what they normally do when reading articles on paper. This feature enhances learner engagement and also provides a foundation for subsequent review and knowledge integration. Overall, by combining the "visual structure," "personalized reading support," and an "interactive reading environment," this design offers learners, especially novices, a clearer, more targeted academic reading experience without replacing the reading process itself. With the assistance of this reading aid, learners can master academic reading methods more quickly and systematically, gradually developing the habit of structured comprehension.

## Design Implications

The design of StructureMe addresses the proposed research question from various dimensions. First, from the perspective of structure-based learning, this design makes the implicit article structure explicit by highlighting arguments, evidence, inferential relationships, and functional connecting vocabularies. This process significantly reduces the cognitive load on learners when identifying the organizational logic of a text, allowing them to focus more on understanding the relationships between pieces of information rather than merely skimming the surface. In contrast, while AI summarization improves the efficiency of information acquisition to some extent, it often weakens the presentation of structural information, making it difficult to support learners in building systematic knowledge representations.

Second, from the aspect of the differences between novices and experts, this design provides novices with a scaffold that approximates the reading style of experts. Collins and Ferguson (1993) point out that the key to learning lies not only in mastering content knowledge but also in mastering the "epistemic forms" used to understand the world. Putting new and complex information in these structures helps learners organize and comprehend them, and hierarchical structure is one of the common epistemic forms. Experts are able to analyze text efficiently and precisely because they are skilled at using these tools to identify the key structures of a text and, based on this, filter and integrate information. By using color coding and structural cues, this tool makes these expert strategies explicit, allowing novices to gradually internalize this reading approach through repeated use, thereby facilitating a transition from dependency of the tool to independent reading proficiency.

In addition, the introduction of the "goal-oriented annotation model" further enhances learners' initiative and sense of purpose. By clarifying their reading goals before start, learners can approach the text with a clearer cognitive framework, which aligns with the concepts of "goal-directed learning" in learning science. The system dynamically adjusts the presentation of information based on different goals, helping to reduce distractions from irrelevant information and improve the focus and efficiency of reading.

To evaluate the expected benefits stated above, the article suggests an experiment design, where StructureMe can be used as a treatment condition in a comparative study against AI-generated summaries. The study would recruit thirty first-year undergraduate students aged 18–20, who have limited experience reading academic research articles. Participants would be randomly divided into two groups: one group reads using AI summaries, and the other engages with the original text supported by StructureMe's structural visualization. The study is expected to sustain two weeks and participants will be assigned more than 10 articles to read. Their comprehension would be assessed through both pre- and post-tests. The pre-test would establish participants' baseline ability to understand academic texts, including their capacity to identify key arguments and relationships within a passage. Following the reading task, the post-test would measure changes in comprehension through tasks such as identifying argument structures, explaining reasoning processes, and transferring knowledge to new contexts. If StructureMe effectively supports learners in recognizing and utilizing text structures, we would expect participants in this condition to demonstrate greater improvement from pre- to post-test, including stronger structural understanding, more coherent explanations, and deeper knowledge transfer. In this way, the design not only supports learning but also functions as a tool for testing key learning science theories, including structure-based learning and epistemic forms.

Overall, this design not only differs functionally from AI summarization tools but is also more likely to promote deep understanding through its learning mechanisms, thereby providing a robust design response to the research question.

## Conclusions

We have to admit that the technology of AI has rapidly entered educational contexts, often prioritizing efficiency and outcomes over the development of learners' deeper and long-term competencies. This paper reimagines the role of AI in academic reading by shifting the focus from replacing the cognitive processes to actively supporting them, bringing learners back into the reading process itself. Through the design of StructureMe, AI becomes a tool that helps learners engage with the structure and logic of texts, fostering more meaningful and transferable understanding rather than surface-level comprehension.

This study also acknowledges its limitations. The effectiveness of the proposed design still requires further empirical validation, and future research should explore how different types of texts may require differentiated annotation strategies. Overall, this work seeks to balance efficiency with depth, offering a new perspective on how AI can be designed to support the development of academic literacy rather than simply accelerating access to information.

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