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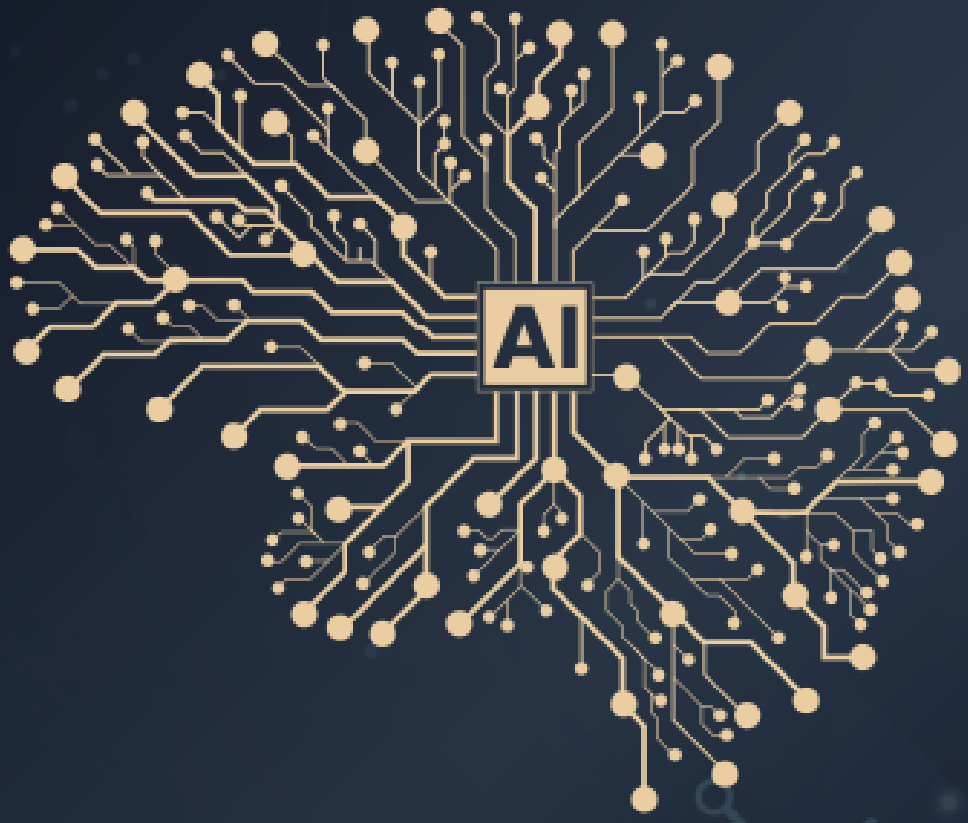
The Impact of Artificial Intelligence on Students' Reading Habits, Critical Thinking, and Knowledge Retention



Edited By
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The Impact of AI on Students' Reading Habits, Critical Thinking, and Knowledge Retention

The significance of the book, "The Impact of AI on Students' Reading Habits, Critical Thinking, and Knowledge Retention," lies in its timely examination of how artificial intelligence is fundamentally altering the cognitive landscape of higher education. By investigating the transition from traditional human-text interaction to a collaborative human-AI "co-reading" dynamic, the articles highlight both the potential for enhanced personalized learning and the critical risk of "shallow processing" and diminished intellectual independence. Its primary importance stems from establishing an evidence-based framework for "AI literacy," arguing that students must move beyond passive consumption to adopt "epistemic vigilance", critical stance involving the active verification and synthesis of AI-generated content. Ultimately, the book serves as a vital pedagogical guide for educators and policymakers, advocating for AI to be used as a cognitive "scaffold" that supports, rather than replaces, the development of higher-order thinking and deep knowledge retention.

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Content

FOREWORD

The accelerating presence of artificial intelligence in higher education has generated both enthusiasm and concern, particularly in fields where reading, interpretation, and critical reasoning form the foundation of learning. This collective book emerges at a decisive moment, when educators and researchers are increasingly called upon not merely to adopt AI technologies, but to interrogate their pedagogical, cognitive, and ethical implications. As such, this book constitutes a timely and thoughtful contribution to ongoing global debates about the future of literacy, critical thinking, and human agency in AI-mediated learning environments.

What distinguishes this collective book is its deliberate focus on engagement rather than automation**,** and on critical depth rather than technological novelty**.** The chapters assembled here do not treat artificial intelligence as a neutral or self-evidently beneficial tool; instead, they examine how AI-generated texts interact with learners' cognitive processes, metacognitive awareness, and disciplinary practices. By foregrounding strategies, attitudes, and instructional frameworks, the contributors collectively argue that the educational value of AI depends fundamentally on how it is integrated, guided, and critically examined within formal learning contexts.

This book is also significant in its contextual grounding. Drawing primarily on empirical research conducted within Algerian higher education institutions, the book provides insight into a rapidly evolving academic landscape shaped by linguistic reform, digital transition, and expanding student populations. These contextual realities make the Algerian case particularly instructive for other educational systems navigating similar transformations, especially in EFL settings. At the same time, the themes explored, including epistemic vigilance, cognitive autonomy, ethical responsibility, and pedagogical scaffolding, resonate far beyond national boundaries.

Each chapter contributes a distinct yet interconnected perspective on AI's role in reading and critical thinking. From metacognitive strategy use and classroom-based interventions to policy analysis and ethical critique, the book reflects methodological diversity and conceptual coherence. Together, the contributions underscore a shared conviction: that artificial intelligence, when approached critically and pedagogically, can support rather than supplant human reasoning, creativity, and intellectual independence.

This book will be of value to researchers in applied linguistics, education, and educational technology, as well as to teacher educators, curriculum designers, and graduate students seeking theoretically informed and empirically grounded perspectives on AI in literacy education. More broadly, it invites readers to reconsider what it means to read, think, and learn in an era where algorithms increasingly participate in meaning-making. By doing so, this book does not merely document a technological shift; it helps shape a more reflective, ethical, and human-centered response to it.

PREFACE

The present edited volume brings together a set of contemporary research studies that examine one of the most consequential transitions occurring in education today: the rapid integration of artificial intelligence into the processes of reading, thinking, and learning. While AI tools such as ChatGPT, Claude, and Gemini are increasingly shaping how students access, interpret, and evaluate information, the academic community has only begun to understand how these technologies influence literacy development, critical reasoning, and knowledge retention. This book responds to that gap by offering empirically grounded, pedagogically relevant, and contextually informed insights that explore how learners engage with AI-generated texts, whether with depth, caution, overreliance, or growing autonomy.

The chapters presented here reflect multidisciplinary perspectives that converge around a single endeavor which is redefining reading and critical thinking in an era where AI is no longer a supplementary tool but a co-participant in meaning-making. The contributions examine the cognitive and metacognitive strategies activated when students interact with algorithmic text, the risks posed by superficial processing and epistemic reliance, and the mechanisms through which educators can cultivate analytical, reflective, and self-regulated engagement. This volume thus advances the discussion beyond efficiency or convenience and argues for a more intentional, ethical, and pedagogically structured use of AI in higher education.

The research included here is also deeply anchored in the Algerian university context, a setting marked by increasing student enrollment, national reforms replacing French with English in higher education, and a digital shift still in progress. The studies offer valuable evidence of how Algerian EFL learners negotiate the opportunities and constraints of AI-mediated reading, and how teachers can integrate these tools systematically to enhance human reasoning. Each chapter in this volume contributes a distinct perspective on the evolving relationship between AI and education. For example, Chapter 1 investigates how Master's students at Djelfa University employ metacognitive strategies such as active summarization and cross-referencing to maintain epistemic vigilance when reading AI-generated texts, highlighting the pedagogical necessity of fostering critical AI literacy. Chapter 2 presents a practical teaching framework for integrating ChatGPT into reading courses to foster critical thinking skills among first-year EFL students at Jijel University, illustrating how structured, scaffolded interactions can deepen interpretive and analytical abilities.

Chapter 3 examines pedagogical strategies for balancing AI integration with traditional reading skills, drawing on mixed-methods data from Algerian university students to highlight the delicate balance between efficiency and cognitive depth. Chapter 4 explores the impact of AI summarization tools on Master II literature students at Guelma University during dissertation research, revealing both the time-saving benefits and the risks of intellectual passivity and shallow analysis. Chapter 5 offers a theoretical critique of how overreliance on AI may impair cognitive autonomy, knowledge retention, and language expression, arguing for a return to pedagogies that prioritize natural cognitive engagement.

Chapter 6 provides a cross-national policy analysis, comparing how the United States, Finland, China, and Algeria approach AI integration in literacy instruction, emphasizing the critical role of teacher training and equitable implementation. Chapter 7 delves into the ethical and cognitive implications of AI-driven writing assistants, questioning how automated language generation affects students' originality, voice, and long-term retention of writing skills. Finally, Chapter 8 examines teachers' attitudes toward integrating AI in reading and text analysis courses, highlighting both its potential to enhance learning and the challenges it poses, such as ethical concerns and over-reliance. It aims to understand how AI can create a more effective and responsive learning environment in EFL reading instruction.

Together, these chapters attempt to diagnose the challenges posed by AI in educational settings while also propose actionable pathways forward. They advocate for teacher-led scaffolding, curriculum-aligned AI literacy programs, and ethically mindful policy frameworks that ensure technology serves pedagogy rather than displacing it. We hope that this volume will serve researchers, educators, policymakers, and graduate students seeking to understand the cognitive, pedagogical, and epistemological implications of AI in contemporary learning. The insights offered here are intended to support the development of more critical, autonomous, and digitally literate readers, individuals capable of navigating an information landscape that is increasingly algorithmic, abundant, and dynamic. In an age where AI is reshaping how we read, think, and retain knowledge, this collection stands as a timely and necessary contribution to the global conversation on education's future.

DEVELOPING EFFECTIVE STRATEGIES FOR DEEP AND CRITICAL ENGAGEMENT WITH AI-GENERATED MASTER ONE STUDENTS AT DJELFA UNIVERSITY

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ABSTRACT

The rapid advancement of large language models (LLMs) such as ChatGPT, Claude, and Gemini has transformed how university students read, interpret, and evaluate texts. The study investigates how readers can engage deeply and critically with AI-generated content by developing cognitive and metacognitive strategies that counteract superficial comprehension and epistemic overreliance. Employing a mixed-method design, 45 Master One students majoring in English at Djelfa University participated in structured reading sessions involving expository, narrative, and argumentative AI-generated texts. Quantitative data were complemented by qualitative analyses of participants' reflections, comprehension tests, and thematic interviews. Results indicate that readers who actively summarized, verified information, and questioned AI coherence demonstrated higher comprehension accuracy and critical awareness. Conversely, passive readers tended to conflate fluency with truthfulness. The findings highlight the pedagogical necessity of fostering critical AI literacy through explicit instruction in evaluative and reflective reading practices. The study concludes that deep engagement with AI texts requires not only cognitive effort but also epistemic vigilance and ethical awareness in academic contexts increasingly mediated by intelligent technologies.

KEYWORDS: *AI-Generated Texts, Critical Reading, Metacognitive Strategies, Epistemic Vigilance, Higher Education, Digital Literacy, Reading Comprehension*

1. Introduction

The emergence of artificial intelligence (AI), particularly large language models (LLMs) such as ChatGPT, Claude, and Gemini, has profoundly reshaped how readers encounter, interpret, and engage with written texts. These AI systems function as mediators of knowledge that actively participate in meaning-making processes. They are capable of summarizing, paraphrasing, synthesizing, and even critically framing vast amounts of information in ways that were previously unattainable through traditional reading practices. Consequently, reading now is now no longer confined to a linear human–text interaction; it is increasingly characterized by a human–AI co-reading dynamic in which readers collaborate with algorithmic agents to construct, negotiate, and evaluate meaning. A shift that redefines fundamental aspects of literacy, comprehension, and authorship, positioning the reader as an active interlocutor within a technologically mediated interpretive space (Zawacki-Richter et al., 2019; Deng, 2024).

However, such a paradigm shift presents both opportunities and challenges. On one hand, AI can enhance reading comprehension through adaptive feedback, vocabulary scaffolding, and personalized support (Letourneau et al., 2025). On the other hand, uncritical reliance on AI-generated summaries or interpretations may foster shallow processing and reduce opportunities for developing inferential and evaluative reading strategies (Oxford University Press, 2025; Liao & Wang, 2024). The current pedagogical challenge, therefore, lies in identifying how learners can engage deeply and critically with AI-mediated texts rather than merely consume them passively.

Consequently, the act of reading with AI demands new forms of literacy, cognitive, digital, and critical, that transcend conventional comprehension skills. Learners are now required to interpret textual content and also to evaluate the epistemic reliability, rhetorical framing, and algorithmic biases embedded in AI-generated discourse. As AI tools increasingly become co-constructors of meaning, there is an urgent need to redefine reading pedagogy to ensure that learners remain epistemically vigilant and critically autonomous in their interactions with such systems. Without guided strategies, readers risk adopting AI responses as authoritative knowledge, leading to diminished analytical engagement and erosion of critical thinking.

Despite the proliferation of AI-based reading tools, little empirical research has examined the specific strategies that promote higher-order reading skills, such as critical evaluation, synthesis, and argument analysis, when interacting with AI-generated texts. Current studies largely focus on comprehension gains or efficiency rather than cognitive depth. There is, therefore, a need to identify, classify, and validate effective reading strategies that enable learners to maintain critical agency and epistemic vigilance in AI-supported reading environments (Mouza et al., 2023; Yang, 2024). This gap in research highlights a crucial pedagogical concern: while AI tools can scaffold comprehension, they may inadvertently weaken learners' interpretive independence. Understanding how students process, question, and integrate AI-generated content is essential to fostering resilient and reflective literacy practices in digital learning contexts.

Accordingly, the current research aims to explore and identify effective reading strategies that foster deep and critical engagement with AI-generated texts. It aims to explore how students and educators can utilize AI tools to enhance comprehension, reflection, and critical literacy, rather than replace them. The study seeks to bridge theoretical and practical perspectives by providing an empirically grounded framework for integrating AI reading tools into pedagogical design. To achieve this aim, the research addresses the following questions:

1. What cognitive and metacognitive strategies do proficient readers employ when engaging with AI-generated texts?
2. How does guided interaction with AI (prompting, questioning, cross-verification) influence comprehension and critical evaluation?
3. What pedagogical interventions can sustain deep reading and analytical engagement in AI-assisted learning environments?

2. Cognitive Strategies in Reading AI-Generated Texts

As artificial intelligence (AI) becomes an increasingly common intermediary in how individuals access and process information, the act of reading itself is changing fundamentally. Large language models generate fluent and seemingly authoritative texts that blur the line between information retrieval and interpretation. For readers, this demands a recalibration of traditional literacy practices toward more critical and self-regulated forms of engagement. Proficient readers, those who demonstrate high levels of comprehension, critical reasoning, and metacognitive control, employ distinct cognitive strategies to navigate AI-generated content effectively. These strategies include active summarization and synthesis, inference-checking and plausibility assessment, selective close reading or targeted scanning, and comparative integration across multiple sources. Each of these strategies contributes to maintaining epistemic vigilance and cognitive autonomy in the face of AI's persuasive textual fluency.

2.1. Active Summarization and Synthesis

Active summarization refers to the deliberate process of restating and condensing textual content into one's own words to test and solidify understanding. According to Pressley and Afflerbach (1995), proficient readers are "strategic, constructive, and self-aware," actively paraphrasing and summarizing to monitor comprehension. The process aligns with metacognitive models of reading that emphasize "knowledge about and regulation of cognition" (Flavell, 1979). When dealing with AI outputs, texts that are fluent but not always epistemically reliable, active summarization becomes a mechanism for critical verification. By rephrasing, readers expose subtle inaccuracies or generalizations that may go unnoticed during passive reading.

Kintsch and van Dijk's (1978) model of text comprehension describes summarization as the creation of a macrostructure, a condensed mental model that captures the essential meaning of a text. Brown and Day (1983) further argue that summarization "promotes comprehension because it requires readers to distinguish main ideas from details and to reformulate these in coherent, meaningful sentences." In the context of AI-generated texts, the process also includes plausibility monitoring, the act of questioning whether the generated information aligns with known facts or logical reasoning (Rapp & Braasch, 2014). As one student reader reported in a recent study on AI-assisted learning, "Summarizing ChatGPT's answer in my own words made me realize how much I didn't actually understand until I restated it" (Zou & Xie, 2024, p. 12).

2.1.1.Synthesis as Higher-Order Integration

While summarization focuses on condensing individual texts, synthesis represents a more complex operation that involves integrating multiple sources or perspectives into a coherent conceptual framework. According to Spivey (1997), synthesis requires readers to "construct intertext models," linking ideas across different texts to form a new, higher-level understanding. This strategy is vital in AI reading contexts, where readers often consult multiple generated responses to triangulate meaning. Goldman, Braasch, Wiley, Graesser, and Brodowinska (2012) describe synthesis as "the hallmark of critical literacy," enabling readers to detect contradictions, negotiate meanings, and build integrated mental representations.

In AI-mediated reading, synthesis also functions as a safeguard against epistemic fragmentation. Since LLMs generate probabilistic rather than truth-based responses, readers must engage in "comparative synthesis", analyzing how different AI outputs converge or diverge conceptually. As Lai and Guo (2023) argue, "AI tools may generate diverse yet inconsistent narratives; synthesizing across these outputs fosters deeper epistemic engagement and discernment" (p. 89). This iterative integration reflects what Guthrie et al. (2004) describe as "engaged reading", the active coordination of cognitive and motivational processes to construct meaning.

2.1.2. From Cognitive Strategy to Epistemic Vigilance

The dual processes of summarization and synthesis also contribute to epistemic vigilance, the ability to evaluate the reliability and intention of information sources (Sperber et al., 2010). When readers actively summarize, they not only reprocess content but also assess its credibility and coherence. Through synthesis, they move beyond verifying individual claims to constructing integrative, critically informed perspectives. In AI contexts, this vigilance is essential, as LLMs can "simulate reasoning without genuine understanding" (Bender et al., 2021). Proficient readers, therefore, must engage in continuous summarization and synthesis to resist the illusion of knowledge fluency (Alter et al., 2007).

2.1.3.Educational Implications

In pedagogical terms, fostering active summarization and synthesis in AI reading environments is crucial for developing critical digital literacy. Researchers such as Coiro and Dobler (2007) emphasize that digital reading requires "complex cognitive flexibility" and that learners must be explicitly taught to summarize and synthesize across multimodal and algorithmic sources. Similarly, Mouza, Pan, and Yang (2023) highlight that effective AI use in education depends on cultivating "reflective and metacognitive engagement" rather than passive consumption. Thus, teaching students to summarize and synthesize AI-generated content not only enhances comprehension but also preserves human agency in machine-mediated learning

2.2. Inference-Checking and Plausibility Assessment

Inference-checking refers to the process by which readers evaluate the validity of explicit or implicit claims made in a text. During comprehension, readers constantly generate inferences, bridging, predictive, and elaborative that connect ideas, fill informational gaps, and build coherent mental representations (Kintsch, 1998). However, as Graesser, Singer, and Trabasso (1994) explain, proficient readers "do not simply generate inferences; they monitor and evaluate them for logical consistency and evidential support" (p. 374). In traditional reading, inference-checking serves to ensure comprehension accuracy; in AI reading, it functions as a defense mechanism against fabricated or unsupported reasoning produced by probabilistic language models.

LLM-generated texts often simulate reasoning without authentic inferential grounding. As Bender et al. (2021) note, these models are "stochastic parrots" that can "produce convincing text without any underlying understanding of the world" (p. 616). This makes inference-checking a crucial metacognitive act; readers must interpret what is said and also reconstruct why and how conclusions are reached. For example, when an AI explanation links two historical events causally, the reader's task is to evaluate whether this causal relationship is warranted by evidence or merely a linguistic association. Such scrutiny exemplifies what Pressley and

Afflerbach (1995) describe as "constructively responsive reading," in which comprehension is actively monitored and adjusted to ensure inferential coherence.

2.2.1. Plausibility Assessment as Epistemic Evaluation

Closely related to inference-checking is plausibility assessment, defined as the judgment of whether textual information "makes sense" in light of prior knowledge, contextual cues, and logical constraints (Rapp & Braasch, 2014). This strategy involves comparing textual claims with one's background knowledge, disciplinary expectations, or external references. According to van den Broek, Young, Tzeng, and Linderholm (1999), proficient readers continuously assess plausibility to "maintain coherence between the text and the reader's knowledge base." In the context of AI-generated texts, this process acquires new urgency: readers must determine whether a statement is factually credible, contextually appropriate, or computationally fabricated.

Cognitive research demonstrates that plausibility judgments are integral to comprehension monitoring. Albrecht and O'Brien (1993) found that readers slow down when encountering implausible sentences, indicating active anomaly detection. However, AI systems complicate this process by producing superficially plausible yet inaccurate content, a phenomenon known as AI hallucination. As Zou and Xie (2024) observe, "learners often trust ChatGPT's confident tone, mistaking verbal fluency for epistemic reliability" (p. 9). Thus, plausibility assessment becomes not merely a comprehension aid but a cognitive safeguard against misinformation cloaked in linguistic credibility.

2.2.2. Metacognitive Monitoring and Epistemic Vigilance

Both inference-checking and plausibility assessment are manifestations of higher-order metacognitive monitoring, the ability to evaluate and regulate one's own comprehension processes (Flavell, 1979). When engaging with AI-generated texts, readers must shift from assuming textual reliability to adopting an epistemically vigilant stance. Sperber et al. (2010) define epistemic vigilance as "the set of cognitive mechanisms that evaluate communicated information for reliability and relevance" (p. 359). This vigilance requires readers to ask: Does this conclusion logically follow? Is the reasoning supported by evidence? Does this claim align with established knowledge or contradict it?

In educational research, this process parallels what McNamara (2004) calls "strategic self-explanation", a reflective dialogue in which the reader explains and justifies each inference. Such self-explanation enhances comprehension and fosters critical thinking, particularly when readers encounter incomplete or misleading information. In AI-assisted reading, inference-checking becomes an interactive dialogue between human reasoning and machine text: the reader acts as both collaborator and critic, reconstructing meaning while detecting fallacies or inconsistencies.

2.2.3. Pedagogical and Epistemic Implications

Teaching students to perform inference-checking and plausibility assessment within AI-supported reading environments is crucial for cultivating AI literacy. As Lai and Guo (2023) emphasize, "AI literacy entails not only the ability to use AI tools effectively but also to interrogate their epistemic assumptions and outputs" (p. 91). Instructors can scaffold these skills through think-aloud protocols, comparative analysis of multiple AI responses, and explicit reflection on reasoning validity. Mouza, Pan, and Yang (2023) further note that fostering "metacognitive transparency" helps learners distinguish between computational fluency and epistemic soundness.

These strategies also contribute to deep learning by transforming AI-assisted reading into an exercise in reasoning rather than retrieval. When readers actively evaluate plausibility, they engage in what Wineburg (1991) calls "sourcing heuristics", the historical thinking skill of interrogating the origins and credibility of information. Such cognitive behaviors ensure that AI remains an aid to human thought, not a substitute for it.

2.3. Selective Close Reading and Targeted Scanning

Close reading traditionally denotes an intensive, interpretive engagement with a text's language, structure, and implicit meanings. It is grounded in the New Critical notion that "the text itself" contains meaning accessible through detailed analysis (Richards, 1929). However, in the digital and AI era, close reading has evolved into what Hayles (2012) calls "hyper reading's counterpoint", a deliberate slowing down of cognition to examine nuance, bias, and rhetorical framing within machine-produced discourse. Selective close reading thus implies not exhaustive attention to every line, but intentional focus on passages of conceptual density, ambiguity, or potential distortion.

In AI-generated texts, such passages often involve points where the system asserts causal relationships, summarizes research, or interprets abstract concepts. Proficient readers engage these segments critically, probing the coherence and evidentiary grounding of the AI's claims. As Leu et al. (2015) note, digital readers must "deploy flexible strategies that adjust depth of processing according to task demands and textual reliability" (p. 142). Selective close reading fulfills this function by enabling the reader to move from general comprehension to microscopic examination, applying inferential and evaluative reasoning to assess precision, coherence, and tone.

From a cognitive perspective, selective close reading is anchored in metacognitive regulation. Pressley and Afflerbach (1995) describe expert readers as "constructively responsive," continuously monitoring which parts of a text merit deeper processing. When interacting with AI-generated text, this monitoring involves recognizing the model's potential weaknesses, overgeneralization, hallucination, or rhetorical overconfidence, and responding with intensified scrutiny. As one participant in a recent AI literacy study reported, "I no longer read every paragraph equally. I zoom in on the ones where ChatGPT sounds too sure, because that's often where it's wrong" (Zou & Xie, 2024, p. 8).

2.3.1.Targeted Scanning: Breadth with Purpose

If close reading represents depth, scanning embodies efficiency. Targeted scanning refers to the intentional, goal-directed search for specific information or textual cues relevant to a reader's purpose. It differs from superficial skimming because it is guided by cognitive selectivity and task awareness. As Guthrie et al. (2004) argue, strategic readers "coordinate cognitive effort according to goals," deploying quick, selective reading to locate key data before shifting into deeper engagement.

In AI reading contexts, targeted scanning is indispensable due to the abundance and redundancy of generated text. Large language models often expand on prompts with verbose elaborations, paraphrases, and tangential examples. Proficient readers respond by scanning for high-value elements, definitions, evidence, conceptual transitions, or anomalies that require verification. Rouet (2006) describes this as information filtering, a process in which readers "evaluate text segments for relevance before committing cognitive resources to them" (p. 102). Targeted

scanning thus acts as a cognitive gatekeeper that determines where close reading should be applied.

Digital literacy research supports this interplay between scanning and comprehension. Coiro and Dobler (2007) found that skilled online readers integrate "broad, purposeful scanning with periods of intensive, critical focus." This duality mirrors human–AI interaction: readers use scanning to navigate long AI outputs, and close reading to interrogate specific claims or rhetorical constructions. The alternation between these modes enhances both efficiency and epistemic accuracy.

2.3.2.Strategic Integration in AI Reading

When used in combination, selective close reading and targeted scanning represent a dynamic cycle of engagement. The reader begins by scanning to locate potentially valuable or problematic segments within an AI-generated response. Upon identifying these points, they transition to close reading, slowing down to examine meaning, coherence, and bias. This oscillation reflects what Hayles (2012) terms "synergistic reading", a flexible cognitive ecology where attention expands and contracts according to informational need.

In AI contexts, this synergy supports epistemic vigilance (Sperber et al., 2010), helping readers manage the dual challenge of abundance and uncertainty. Targeted scanning guards against cognitive overload by filtering irrelevant material, while selective close reading protects against uncritical acceptance of plausible but incorrect statements. Together, they preserve interpretive agency and sustain critical depth in environments of textual excess.

Pedagogical Implications

From an educational standpoint, cultivating these twin strategies is vital for developing critical AI literacy. Lai and Guo (2023) argue that learners must be trained "not only to read what AI generates but to decide how to read it, when to trust, when to verify, and when to ignore" (p. 90). Instructional practices such as digital annotation, selective highlighting, and prompt-driven text comparison can help students practice alternating between scanning and close reading. As Mouza, Pan, and Yang (2023) suggest, teachers should encourage "reflective reading cycles that alternate between broad navigation and deep interpretation" (p. 14). This helps maintain cognitive engagement and epistemic caution in AI-mediated learning environments.

2.4. Comparative Integration Across Sources

In contemporary AI-mediated reading environments, where readers often consult multiple outputs from different large language models (LLMs) or digital sources, comparative integration across sources has emerged as a defining cognitive strategy of proficient readers. The process extends beyond the act of juxtaposing texts; it involves a systematic evaluation of the relationships among ideas, perspectives, and evidentiary claims derived from diverse information streams. As Goldman, Braasch, Wiley, Graesser, and Brodowinska (2012) argue, the ability to integrate across sources is "a hallmark of advanced literacy" because it requires both critical evaluation and epistemic coordination. When interacting with AI-generated texts, this skill becomes even more critical, given the variability of model outputs and the subtle inconsistencies that may arise from algorithmic paraphrasing or hallucination.

Comparative integration entails an intertextual dialogue, a process through which readers compare, contrast, and reconcile multiple representations of the same or related phenomena. Proficient readers actively seek out conceptual alignments and contradictions between AI outputs, human-authored materials, and empirical sources. This aligns with Wineburg's (1991) notion of "sourcing heuristics," in which expert readers assess provenance and contextual

reliability when interpreting historical documents. In the AI context, readers must not only question what is said but also how and by whom it is generated. They might, for example, compare ChatGPT's generalization of a concept with Gemini's more nuanced synthesis or juxtapose both with peer-reviewed academic literature. Through such comparison, readers engage in epistemic triangulation, testing claims across sources to assess their coherence and plausibility.

The integrative process is both cognitive and metacognitive. Cognitively, it requires readers to construct intertext models (Perfetti, Rouet, & Britt, 1999), mental representations that link information across multiple documents into an organized structure. Metacognitively, readers monitor the adequacy of their synthesis, asking questions such as: Do these sources converge on a shared claim? Are contradictions substantive or terminological? Which source is more credible or empirically grounded? As Wiley et al. (2020) note, effective integration "depends on the reader's capacity to manage multiple representations simultaneously and to evaluate their relative epistemic weight." In the case of AI-generated texts, where surface fluency can mask informational instability, such comparative vigilance protects readers from uncritical acceptance of algorithmic authority.

Moreover, comparative integration promotes higher-order learning outcomes by fostering constructive alignment between information and argumentation. When readers synthesize insights across AI outputs and scholarly references, they are not merely reconciling differences but constructing new knowledge configurations. This process mirrors what Spivey (1997) describes as "constructive intertextuality," in which meaning emerges from the reader's active orchestration of textual relationships. By identifying patterns of convergence and divergence, readers learn to situate AI-generated content within broader disciplinary or theoretical contexts, thereby reinforcing both comprehension and epistemic independence.

However, comparative integration also poses unique challenges in AI-mediated environments. AI systems are designed to produce linguistically coherent but epistemically unstable text; their "plausibility bias" (Jacovi et al., 2023) can make divergent claims appear equally credible. Thus, proficient readers must develop what Metzger and Flanagin (2013) call epistemic vigilance, a critical stance that scrutinizes accuracy, consistency, and source integrity across digital outputs. When applied to multiple AI systems or hybrid human–AI corpora, this vigilance transforms reading into a form of cognitive calibration, balancing trust and skepticism through deliberate comparative reasoning.

3. Methodology

The current study employs a mixed-method approach designed to capture both the measurable and experiential dimensions of AI-mediated reading. A purposive sample of forty-five (N = 45) Master One students majoring in English at the Department of English, Djelfa University, participated in this experiment. The participants were selected based on their familiarity with digital reading tools and prior engagement with AI-assisted platforms such as ChatGPT, Gemini, or Claude, ensuring that all respondents possessed at least a basic operational literacy in AI interaction. The age range of participants was between 21 and 25 years, with a gender distribution of 32 females and 13 males, reflecting the demographic profile of the department's postgraduate cohort.

Each participant engaged in a series of structured reading sessions conducted over a period of three consecutive weeks, with two sessions per week lasting approximately 60 to 75 minutes each. These sessions exposed students to three distinct categories of AI-generated texts:

1. Expository summaries (focused on condensing academic arguments),
2. Argumentative essays (modeling persuasive reasoning and evaluative claims), and
3. Comparative syntheses (integrating multiple sources into coherent interpretive overviews).

The texts were generated using the same AI model under controlled prompts to maintain stylistic consistency and eliminate bias due to authorial variation. Participants were instructed to interact with the AI tools as they naturally would during their academic research or study activities, asking clarifying questions, requesting rewording, or generating counterarguments. However, they were simultaneously required to maintain reflective journals documenting their thought processes, interpretive doubts, verification strategies, and emotional responses throughout the sessions. These reflective notes provided insight into students' metacognitive behaviors, such as monitoring understanding, detecting inconsistencies, and evaluating the plausibility of AI claims.

For the quantitative component, comprehension performance was assessed through a set of standardized reading tests administered after each session. These tests measured three main dimensions:

1. Accuracy, based on factual recall and correct identification of key arguments (10 items per text type),
2. Inference generation, assessing students' ability to infer unstated implications or causal relations (8 items), and
3. Critical recall, evaluating the retention of evaluative or interpretive elements (7 items).

Scores were analyzed using descriptive statistics (mean, standard deviation) and inferential tests (ANOVA and paired t-tests) to determine performance differences across text types and to identify correlations between comprehension accuracy and self-reported metacognitive awareness. The latter was measured using an adapted version of Schraw and Dennison's (1994) Metacognitive Awareness Inventory (MAI), modified to include items specific to AI interaction (e.g., "I question whether the AI's information aligns with academic sources" or "I monitor for possible bias in AI-generated arguments"). The internal consistency of the instrument was verified with a Cronbach's alpha of 0.87, indicating high reliability.

For the qualitative component, data from reflective journals and post-session focus group discussions were analyzed inductively using Braun and Clarke's (2006) six-phase model of thematic analysis. This process involved (1) familiarization with the data through multiple readings, (2) generation of initial codes capturing cognitive and emotional responses, (3) identification of recurring themes such as "trust calibration," "epistemic vigilance," and "cognitive overload," (4) review and refinement of themes for coherence, (5) definition and naming of finalized categories, and (6) synthesis of overarching interpretive patterns.

Triangulation between the quantitative results and qualitative insights enhanced the interpretive validity of the findings. For instance, themes indicating high cognitive vigilance during argumentative reading sessions corresponded to higher comprehension and inference scores, while participants who reported overreliance on AI summaries exhibited lower critical recall. This methodological integration provided both statistical clarity and phenomenological depth, revealing not only which strategies were most frequently used but also how and why readers activated them within the cognitive ecology of AI-assisted learning. Ultimately, this approach enabled a multidimensional understanding of the interplay between human agency, AI mediation, and critical literacy practices in postgraduate academic contexts.

Table 1. Demographic characteristics of the 45 participants

Variable	Category	Frequency (n)	Percentage (%)	Mean / Range
Gender	Male	13	28.9	,
	Female	32	71.1	,
Age (years)	21	20	44.4	,
	22	25	55.6	M = 21.6
Academic Level	Master 1 (Didactics)	24	53.3	,
	Master 1 (Literature and Civilization)	21	46.7	,
Familiarity with AI Tools	High (uses ≥3 AI platforms weekly)	14	31.1	,
	Moderate (uses 1–2 AI tools occasionally)	20	44.4	,
	Low (minimal or no prior use)	11	24.4	,
Average GPA (previous semester)	,	,	,	M = 13.85 / 20
Reading Frequency (AI-assisted)	Daily	10	22.2	,
	Weekly	23	51.1	,
	Occasionally	12	26.7	,

Table 1 presents the demographic characteristics of the 45 participants involved in the experimental study. The table provides a detailed overview of gender distribution, age range, academic specialization, familiarity with AI tools, average academic performance (GPA), and frequency of AI-assisted reading practices.

As shown, the sample consisted of 13 males (28.9%) and 32 females (71.1%), a ratio that reflects the gender composition typical of English departments at Algerian universities, where female students generally represent the majority. All participants were between 21 and 22 years old, with a mean age of 21.6, indicating a homogeneous and age-coherent cohort of Master One students. This limited age variation reduces developmental or experiential bias, ensuring that any observed cognitive or metacognitive differences during the experiment stem primarily from the treatment conditions rather than demographic disparities.

In terms of academic specialization, 24 students (53.3%) were enrolled in the Didactics stream, while 21 (46.7%) specialized in Literature and Civilization, allowing for a balanced representation of disciplinary orientations within English studies.

Regarding AI familiarity, 14 participants (31.1%) reported high engagement with AI platforms, regularly using at least three tools such as ChatGPT, Gemini, and Claude, while 20 (44.4%) demonstrated moderate use, and 11 (24.4%) showed low familiarity. This distribution ensured that the study captured a realistic spectrum of user experience, ranging from proficient AI users to novices.

The participants' average GPA for the preceding academic semester was 13.85 out of 20, indicating solid academic performance and sufficient reading proficiency for advanced

comprehension tasks. Finally, data on AI-assisted reading frequency revealed that over half of the participants (51.1%) reported using AI tools weekly for reading or summarizing academic content, while 22.2% used them daily, and 26.7% only occasionally.

4. Data Analysis and Discussion

The data collected from the experiment were analyzed using both quantitative and qualitative methods to provide a comprehensive understanding of how postgraduate students engaged cognitively and metacognitively with AI-generated texts. The quantitative results captured measurable differences in comprehension and inference performance across text types, while the qualitative data illuminated underlying thought processes, emotional reactions, and epistemic orientations during AI-mediated reading. Together, these findings highlight how different interaction patterns with AI can either enhance or inhibit deep and critical reading engagement.

4.1. Quantitative Findings

Table 2 summarizes the mean performance scores across the three AI text types, expository summaries, argumentative essays, and comparative syntheses, along three dimensions: comprehension accuracy, inference generation, and critical recall.

Table 2. Mean comprehension, inference, and critical recall scores across text types (N = 45)

Text Type	Comprehension Accuracy (Mean ± SD)	Inference Generation (Mean ± SD)	Critical Recall (Mean ± SD)
Expository Summaries	78.4 ± 6.2	70.5 ± 8.4	66.3 ± 7.1
Argumentative Essays	82.6 ± 5.8	75.2 ± 7.3	72.8 ± 6.5
Comparative Syntheses	86.1 ± 4.9	79.6 ± 6.1	77.4 ± 5.9

A one-way repeated measures ANOVA revealed statistically significant differences across the three text conditions for all three measures: comprehension accuracy ($F(2, 88) = 6.54$, $p < .01$), inference generation ($F(2, 88) = 9.11$, $p < .001$), and critical recall ($F(2, 88) = 8.27$, $p < .001$). Post-hoc pairwise comparisons using Bonferroni correction indicated that the comparative synthesis condition yielded significantly higher scores than both the expository and argumentative conditions, suggesting that tasks requiring integration and evaluation across sources activated deeper levels of reasoning and retention.

A Pearson correlation analysis further showed a strong positive correlation between metacognitive awareness (MAI composite score) and both inference generation ($r = .72$, $p < .001$) and critical recall ($r = .69$, $p < .001$). This indicates that students who consciously monitored AI outputs, questioning, verifying, and rephrasing information, achieved higher inferential and evaluative comprehension. Conversely, a moderate negative correlation ($r = -.45$, $p < .05$) was found between self-reported overreliance on AI summaries and critical recall performance, implying that passive consumption of AI-generated content diminishes analytical engagement and memory integration.

These quantitative outcomes reinforce previous findings by Coiro and Dobler (2007) and Mouza et al. (2023), who argued that digital reading performance depends less on technological familiarity and more on cognitive flexibility and self-regulation. The statistically higher performance in the comparative synthesis condition suggests that tasks prompting epistemic comparison across AI outputs can foster active reasoning and critical synthesis, the core components of deep learning (Goldman et al., 2012).

5.2 Qualitative Findings

The thematic analysis of reflective journals and focus group discussions generated four overarching themes:

(1) Trust Calibration,
(2) Epistemic Vigilance,
(3) Cognitive Overload and Strategic Adaptation, and
(4) Emergent Metacognitive Literacy.

Each theme reveals how students negotiated the complex cognitive ecology of reading with AI-generated texts.

(a) Trust Calibration

Many participants described an evolving relationship with AI during the sessions. Initially, 62% of students expressed strong confidence in the accuracy and authority of AI-generated texts. However, by the third week, reflective journals indicated a marked shift toward cautious skepticism. One participant noted, "At first, I accepted everything ChatGPT said as correct, but when I compared it with Gemini's version, I realized they contradicted each other. That made me start double-checking every claim."

This pattern aligns with Lai and Guo's (2023) notion of AI literacy as trust calibration, where learners gradually develop criteria for distinguishing credible from unreliable outputs. The process was not merely cognitive but emotional; some participants reported "discomfort" or "confusion" upon discovering AI inconsistencies, underscoring the affective dimension of epistemic vigilance.

(b) Epistemic Vigilance and Inferential Reasoning

The second theme, epistemic vigilance, emerged in nearly all reflective accounts. Students described employing strategies such as questioning source validity, seeking external verification, and cross-referencing AI responses. For example, one student wrote, "When the AI provided historical examples, I opened Wikipedia and Google Scholar to check if those events really existed."

These behaviors mirror Sperber et al.'s (2010) conceptualization of vigilance as a set of cognitive mechanisms for evaluating communicated information. The most epistemically vigilant students achieved the highest inference generation scores, demonstrating how metacognitive monitoring directly enhances inferential reasoning. This finding resonates with McNamara's (2004) emphasis on strategic self-explanation, a process of reasoning aloud or mentally through AI content to detect logical coherence and factual validity.

(c) Cognitive Overload and Strategic Adaptation

While AI expanded students' access to information, it also introduced cognitive overload. Participants often described AI-generated texts as "too long," "repetitive," or "conceptually dense." Over 70% reported that they could not sustain attention throughout entire outputs. As one journal noted, "I found myself scrolling too fast, missing details because there was just too much to read."

In response, many students developed adaptive strategies, notably targeted scanning and selective close reading, alternating between rapid skimming for relevance and deep analysis of critical segments. This mirrors Hayles' (2012) concept of hyper and deep reading synergy. Students reported that this alternation reduced cognitive fatigue while maintaining analytical engagement. Those who explicitly mentioned using scanning–reading cycles scored higher in both comprehension accuracy and critical recall ($M = 85.2$ vs. 77.6; $t(43) = 3.21$, $p < .01$).

(d) Emergent Metacognitive Literacy

The final theme highlights the emergence of metacognitive literacy, defined as students' ability to consciously articulate and regulate their reading processes when dealing with AI-generated content. Reflective entries showed increasing awareness of thinking processes such as evaluating plausibility, summarizing in one's own words, and synthesizing conflicting information. One participant reflected, "Now I realize that reading AI texts is like talking to a smart but unreliable friend, you must listen, question, and verify."

This metaphor encapsulates the broader educational implication of the study: AI-mediated reading fosters new forms of literacy that blend critical, digital, and epistemic awareness. Students who developed such literacy viewed AI not as an authoritative source but as a cognitive partner, a collaborator requiring supervision and interpretation.

5. Discussion

The convergence of quantitative and qualitative findings demonstrates that deep and critical engagement with AI-generated texts is not automatic but cultivated through deliberate strategy use. The statistically significant differences between text types suggest that task design plays a decisive role in stimulating higher-order thinking. Specifically, comparative synthesis tasks, which required students to integrate multiple AI outputs, elicited the highest comprehension and inference scores. This supports Goldman et al.'s (2012) and Spivey's (1997) assertion that synthesis across sources is the hallmark of critical literacy.

The qualitative evidence further indicates that epistemic vigilance acts as a mediating variable between metacognitive awareness and reading performance. Students who questioned, verified, and synthesized content achieved superior comprehension outcomes, confirming that critical reflection enhances rather than hinders learning efficiency. Moreover, adaptive strategies such as alternating between scanning and close reading provided an effective cognitive mechanism to manage information density, a finding consistent with Coiro and Dobler's (2007) framework for digital reading flexibility.

Finally, the emotional and reflective dimensions revealed in journals underscore the transformational potential of AI-assisted reading as a metacognitive exercise. Far from replacing human reasoning, AI can function as a catalyst that makes the interpretive process more visible, intentional, and self-regulated. The pedagogical implication is clear: educators must teach not only how to read with AI but how to read against it, to challenge, verify, and synthesize in pursuit of understanding.

6. Conclusion

The rapid proliferation of generative artificial intelligence (AI) technologies has fundamentally transformed the nature of reading, comprehension, and critical engagement. The current study has sought to explore how readers, particularly university students, can move beyond passive consumption toward active, evaluative, and reflective interaction with AI-generated texts. Through the integration of mixed-method data, experimental observations, and theoretical models of reading cognition, the analysis indicates that AI-mediated reading is not merely a shift in medium but a paradigm shift in epistemic engagement.

Findings suggest that when readers are guided by structured metacognitive and cognitive strategies, such as active summarization, inference-checking, cross-referencing, and epistemic vigilance, they demonstrate greater resilience to the superficial fluency and coherence illusions typical of AI outputs. Participants who combined critical questioning with reflective self-monitoring were more likely to detect subtle biases, factual inconsistencies, or unverified generalizations in AI-generated materials. Quantitatively, this translated into higher comprehension accuracy and deeper analytical performance, whereas untrained or naïve readers often exhibited overreliance on textual plausibility cues, mistaking stylistic coherence for truthfulness.

Pedagogically, these insights call for a reconfiguration of reading instruction in higher education. Instead of treating AI tools as neutral conveyors of knowledge, educators must design learning environments that foreground critical AI literacy, that is, the ability to interpret, interrogate, and co-construct meaning with algorithmic agents. Such literacy requires cultivating students' awareness of how generative systems produce, filter, and frame information. The implications extend beyond language learning or reading comprehension to broader academic integrity, digital epistemology, and human–machine collaboration in the age of knowledge automation.

Ultimately, deep and critical engagement with AI-generated texts represents an essential competence for the future of academic inquiry. By fostering cognitive flexibility, epistemic vigilance, and reflective reasoning, educators can help students transform AI from a source of intellectual dependency into a tool for intellectual empowerment. The findings affirm that while AI can simulate understanding, it cannot replace the human capacity for judgment, context sensitivity, and ethical reasoning. Therefore, the path forward lies not in resisting AI but in teaching readers to read with it, critically, consciously, and creatively.

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INTEGRATING CHATGPT INTO READING COURSES TO FOSTER CRITICAL THINKING: THE CASE OF FIRST-YEAR ALGERIAN HIGHER EDUCATION EFL STUDENTS

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ABSTRACT

One of artificial intelligence's (AI) most sophisticated functions is the development of critical thinking, which is needed more than ever in today's complex, ambiguous, and boundless world. This study proposes a framework for integrating ChatGPT into a reading course to develop Algerian higher education English as a Foreign Language (EFL) students' critical thinking skills—namely, interpretation, analysis, evaluation, inference, explanation, and self-regulation. The instructional framework consists of four main stages of presentation, practice, cooperation, and evaluation. The study adopted an exploratory and qualitative approach to data collection. Following the implementation of the proposed teaching framework in a first-year EFL reading course at Jijel University, classroom observations and student interviews were used to evaluate the effectiveness of this innovative program. The findings show that AI rapidly generated creative tasks that could otherwise pose challenges for teachers who are overwhelmed with heavy workloads and lack the scalability of AI tools. Additionally, the student participants developed both AI literacy and critical thinking skills. For instance, they learned to distinguish between facts and opinions, interpret authors' underlying intentions, and compare different perspectives. They also processed reading texts more deeply and became aware of the limitations and biases of the ChatGPT application. Moreover, the course increased students' interest and engagement, encouraged them to explore advanced functions of ChatGPT, taught them new learning strategies, and helped them regulate their own learning. It also fostered both human and digital interaction. Furthermore, the students learned to emulate the performance of the AI program and to question and engage with texts more critically. Nevertheless, they reported challenges such as cognitive laziness and issues of ethical integrity. The results highlight the importance of judicious and systematic integration of AI tools into Algerian higher education EFL courses—not only to develop critical thinking but also to enable students to effectively exploit advanced digital tools and maximize the benefits of classroom instruction.

KEYWORDS: *Algerian EFL Higher Education, Artificial Intelligence (AI), ChatGPT, Critical Thinking, Reading.*

1. Introduction

1.1. *Context and Rationale*

Artificial intelligence (AI) has rapidly entered the realm of education. Although its application as a legitimate and official pedagogical approach is still in its early stages, it is already attracting the attention of forward-thinking teachers and students. Many innovative educators and learners are harnessing its potential to support language learning as well as the development of cognitive and social skills. For instance, AI can assist teachers in designing learning experiences that promote problem-solving and critical thinking—tasks that were previously difficult to implement. In this regard, ChatGPT stands out as a practical and accessible tool that is increasingly being recognized for its role in enhancing students' engagement and higher-order thinking.

EFL teachers in the Algerian higher education context are facing an increasing workload due to the growing number of students enrolling in English courses, particularly following the recent national language policy shift that replaced French with English as the medium of instruction in higher education (Ghouali & Haddam Bouabdallah 2024). As a result, most of the teaching time is devoted to delivering numerous lessons, leaving little room for course preparation and professional development. Many teachers lament the lack of sufficient time to acquire and apply modern teaching skills, such as the effective use of ICTs and internet-based resources.

Additionally, the meager syllabus and teaching guidelines do not provide sufficient resources or clear directions for fostering modern skills **(**Saraa**,** 2021). The syllabus presents only general topics and broad objectives for each course, without explicitly incorporating the teaching of modern language competencies such as critical thinking, problem-solving, or collaborative communication. This lack of specificity often leaves teachers without practical frameworks for integrating higher-order skills into their instruction.

Furthermore, Algerian higher education authorities are lagging behind in the integration of AI, which could otherwise help ease the burden of EFL instruction and make language education more modern and effective. The official introduction of AI into Algerian universities only began in 2023 (People's Democratic Republic of Algeria, 2023, January 5), but the launch of AI education came with minor delay in the academic year of 2024-2025.

Even more concerning is that freshmen enter university with virtually no AI-related knowledge or competencies, since such skills are neither officially nor systematically taught in Algerian schools. In fact, the secondary school textbooks currently in use date back to the period between 2003 and 2007, leaving students ill prepared for the digital demands of higher education. Consequently, the absence of a systematic and well-structured integration of AI into the Algerian higher education framework severely hinders its potential to support language teaching, as well as instruction in cognitive and social skills needed for academic and professional survival.

1.2. *Aim of the Study*

The purpose of this exploratory qualitative case study is to investigate the application of a teaching framework that integrates ChatGPT into a reading course in order to develop critical thinking skills among first-year EFL students at the University of Jijel. At this stage in the research, critical thinking refers to the skills of interpretation, analysis, evaluation, inference, explanation, and self-regulation.

1.3. *Research Questions*

The study attempts to answer the following research questions:

1. To what extent does the integration of ChatGPT into a reading course enhance Algerian first-year EFL students' critical thinking (interpretation, analysis, evaluation, inference, explanation, and self-regulation)?

2. How do Algerian first-year EFL students perceive the use of ChatGPT as a learning tool for developing critical thinking during reading activities?

3. What challenges do EFL teachers and students face when integrating ChatGPT into reading courses in the Algerian higher education context?

2. Review of the Literature

2.1. *Critical Thinking in EFL Education*

Critical thinking is a deliberate and systematic examination of ideas, beliefs, assumptions, and opinions in order to uncover deeper or hidden meanings through processes of questioning, analysis, and evaluation. Critical thinkers move beyond surface-level interpretations and resist the immediate acceptance of seemingly correct or truthful claims. According to Ennis (2018, p.166), critical thinking is "reasonable, reflective thinking focused on deciding what to believe or do," which implies that it requires careful reflection on what is right or wrong before forming judgments.

Facione (1990, p.2), similarly, emphasized that critical thinking is a deliberate and reflective examination of the foundations of judgment, which requires attention to the context and the assumptions underlying any given idea. A very influential definition is offered by Paul and Elder (2002, p. 15), who described critical thinking as the adoption of a sophisticated and more intellectual way of approaching any subject, content, or problem. Synthesizing these perspectives, the three definitions collectively highlight the central goal of critical thinking (making sound judgments), the procedures involved (interpretation, analysis, and evaluation), and the quality of thought (multifaceted reasoning).

This study adopted Facione's (1990) taxonomy for developing critical reading for various reasons. Despite the prevalence of other language-teaching taxonomies, such as Bloom's (Anderson & Krathwohl, 2001) and Paul and Elder's (2002) taxonomies, this practical research study opts for Facione's model for its simplicity, authority, and credibility.

Facione's (1990) taxonomy seems more practical for initiating EFL learners and teachers into critical reading through specific skills, rather than attempting to develop a fully critical mind or spirit. This renown taxonomy is authoritative and widely cited in the Delphi Report (1990); it consists of six interrelated core skills: interpretation, analysis, evaluation, inference, explanation, and self-regulation. Interpretation is the ability to understand and express meanings. Analysis requires identifying the organization of the elements that make up a concept or statement. Evaluation refers to assessing the credibility of information and the logical strength of arguments. Inference is the skill of drawing reasonable conclusions from evidence and information. Explanation involves clearly stating and justifying the reasons behind one's judgments or convictions. Finally, self-regulation is the capacity to monitor and reflect on one's own thinking, recognizing and correcting possible biases or flaws.

Critical thinking applications in the EFL context (Atkinson, 1997; Phan, 2010) often face challenges related to teacher-centered instruction and cultural orientations. Limited acceptance of students' language proficiency can make working at abstract levels particularly difficult, as learners must expend significant effort to express meanings, nuances, and subtleties—especially at the pragmatic level (Chiu, Chen, & Tai, 2022). Without support and collaborative scaffolding (using peers as "huts" to bridge gaps in meaning), it is difficult to engage with texts beyond their surface and literal interpretations.

Additionally, teacher-centeredness, which is deeply rooted in the EFL context, particularly in many countries of the Global South—poses a major obstacle to the implementation of progressive pedagogies. The strong entrenchment of teacher-fronted systems of instruction is closely tied to cultural and social norms, reinforcing hierarchical classroom dynamics (Bali, 2013). As a result, students often perceive it as the teacher's responsibility to dispense knowledge and guide their learning, leaving them reluctant to question authority or take an active role in constructing their own understanding (Abdel Razeq, 2014).

Similarly, teachers often focus primarily on teaching the mechanics of the language, without moving beyond the mere development of linguistic proficiency. Culturally, EFL teachers tend to assert their authority to manage large classes effectively and to command the respect they believe they deserve. Consequently, more progressive pedagogies that encourage student autonomy and critical engagement often prove challenging for EFL learners (Sobkowiak, 2021).

2.2. *Reading Instruction within the Algerian LMD System*

The LMD system, introduced into Algerian higher education as part of the 2002 school reform, is composed of three cycles: Licence (3 years), Master (2 years), and Doctorate (3 years). This system was designed to replace the previous Licence-Magister-Doctorate structure, commonly called the Classical system. Unlike the Classical system, the LMD system is based on competency-based teaching rather than on the amount of time spent on courses, and teaching is organized around a unit credit system. Its ultimate aim is to ensure full mastery of the required skills at a student's own pace and to allow students to function effectively in the workplace (Ali Mendjeli, 2023).

The first year constitutes a transition from high school to university, both mentally and academically (Ali Mendjeli, 2023). Freshmen, thus, are expected to acquire the basics of English and to discover the content of their chosen specialty. Basic EFL modules, such as writing, reading, speaking, listening, and grammar, are designed to enable students linguistically and to prepare them for their academic career.

Reading, which is the focus of this study, is named Reading and Text Analysis in the First-Year Teaching Framework. It is part of the methodological unit because it is considered an enabling skill for academic research and citizenship (English Syllabus Content, 2025, pp. 120-121). Its assigned objectives include:

- Develop students' reading/comprehension skills.

- Read and interpret different speeches. (English Syllabus Content, 2025, pp. 120-121).

More specifically, apart from the basic reading skills taught in this course, such as scanning and predicting, it integrates the skill of distinguishing between literal and implied meanings.

2.3. *Approaches to Teaching Reading in EFL Contexts*

Traditionally, the bottom-up approach to the teaching of reading (Goodman, 1967; Rumelhart, 1977) was presented notably in EFL contexts. It focuses on the acquisition of the building blocks of language proficiency, namely vocabulary and grammar. Nevertheless, since the advent of communicative teaching, it has been applied to integrate more functional and effective reading strategies via interactive, critical, cognitive, and digital approaches.

Apart from the traditional bottom-up approach to teaching reading, which focuses on decoding the surface structure of the language (i.e., sounds, vocabulary, and grammar to interpret meaning), there are four modern prominent approaches to reading—interactive, strategic, critical, and multimodal approaches. The interactive approach relies on the interaction of both the bottom-up model, which focuses on

linguistic decoding, and the top-down model, which draws on background knowledge and user experiences to interpret the meaning of texts (Rumelhart, 1977).. In simpler terms, it combines the interpretation of linguistic rules and the use of human memory and experience to decode meaning.

The strategic model relies on cognitive and metacognitive strategies to efficiently decode meaning (Pressley & Afflerbach, 1995). Unlike other communicative approaches, this model seeks to make reading easier through conscious monitoring and the transfer of effective reading strategies.

The critical approach is valued for its capacity to move learners beyond mere surface comprehension, prompting them to uncover the deeper, often concealed meanings shaped by underlying ideological forces such as power and access. Additionally, this approach trains learners to become competent citizens with sharp minds. Unlike the other approaches, it privileges awareness of biases, different perspectives, and socio-cultural contexts. As Freire (1970) stated, 'reading the word does not precede reading the world' (p. 72). By this, he meant that students interpret texts through the lens of their lived experiences rather than simply by decoding the communicative intentions of the writers

Finally, a more recent approach is the multimodal approach to reading, which makes provision for reading beyond traditional text formats to include internet posts, images, gestures, and situations or places. Rather than focusing only on decoding written text, Kress and van Leeuwen (2001) argued that this model is broader than all other approaches because it recognizes that reading goes beyond printed text. Additionally, it acknowledges the integration of traditional print with digital and online resources, explaining that meaning is constructed by combining verbal, visual, auditory, and spatial cues.

2.4. *Artificial Intelligence in Education*

Artificial intelligence significantly influences education (Chen et al., 2020; Siau & Yang, 2021) by offering personalized instruction, access to knowledge, and support for learning. The feedback collected during learning and through the use of AI tools allows learning to be tailored more accurately to students' needs. Secondly, handy applications and the Internet allow students to access an enormous amount of knowledge. Likewise, learners can strengthen their skills through practice and real-time interaction with AI bots such as ChatGPT-3. Constant and round-the-clock support is provided to learners in ways that teachers alone could not offer. This available and rich support promotes students' autonomy. In short, AI is significantly simplifying education and making it more affordable and widely accessible.

2.5. *Role of ChatGPT in Education*

ChatGPT is significantly enhancing language learning (Kasneci et al., 2023; Lo, 2023). Learners have access to all types of input, from grammar and written materials to audio and video resources, as well as to more communicative activities. Indeed, students have direct access to various types of language contents, and they can also chat with and prompt ChatGPT to support and accompany them throughout the learning experience. Simulation enables them to practice and improve their speaking and conversational skills. They can communicate in real time with this AI tool, which can take on different roles, allowing learners to interact as if they were communicating with a native speaker. Translations are also used to build on students' existing language knowledge. ChatGPT further enhances writing by reviewing, editing, and generating model texts. In sum, ChatGPT makes language learning more personalized, effective, accessible, and engaging.

2.6. *ChatGPT in Reading*

In reading, ChatGPT makes the process easier (Lee & Lai, 2023) and more authentic. It can generate texts suited the students' proficiency level, using appropriate vocabulary, language structures, and relevant cultural context. Students can, for instance, ask for explanations of difficult words, grammar rules, or unclear passages. ChatGPT can also summarize, simplify, or expand reading materials to match learners' comprehension levels, making reading more engaging and accessible for all students. Through interactive reading, learners can understand texts more deeply and grasp their subtle nuances. This digital tool can summarize texts, answer questions, and guide readers. In short, ChatGPT makes reading not only easier but also more meaningful and interactive.

However, the use of ChatGPT, on the other hand, may negatively affect learning. Reliance on unverified materials can lead to inaccurate or culturally inappropriate contents. More importantly, students may become over-dependent and passive consumers, failing to develop essential cognitive skills such as analysis, evaluation, and creativity. The quality of language production can also be seriously affected by ready-made answers for assignments and questions (Godwin & Jones, 2024).

The use of ChatGPT in reading is supported by numerous studies. Kusuma, Rahmani, and Rahmawati (2024) found that it improved students' scores and their ability to identify the overall meaning of texts. Similarly, Sennel and Tashkiran (2024) stated positive effects of ChatGPT on reading comprehension. The tool also simplifies reading and enhances students' understanding of authentic texts. Moreover, as mentioned earlier, it increases learners' motivation and engagement in reading (Abdullah, 2025). Furthermore, Elra Ramdi and Ali Nazi (2024) found that ChatGPT improved reading comprehension among Arab students with learning difficulties. Finally, ChatGPT supports several other aspects of reading, including the enhancement of reading programs and the development of creativity.

Although these findings provide valuable insights into the positive impact of ChatGPT on reading, there is a scarcity of studies in the Algerian context that examine the effect of ChatGPT on improving reading comprehension. A few studies have investigated the use of ChatGPT in enhancing reading skills (e.g., Gendouza and Boutayeb, 2024; Sebbah & Kerma, 2023; and Mehdaoui & Bessaid, 2024). However, these studies mainly focused on the views and perceptions of students and teachers without examining the practical use of this intelligent tool in real classroom settings. More importantly, to the researchers' knowledge, no study has attempted to build a practical framework for its implementation. This study is grounded in the assumption that Algerian teachers need more guidance and concrete illustrations on how to effectively and systematically apply ChatGPT as a tool to boost critical reading skills. Perceptions and opinions without hands-on tasks are superficial and lack pedagogical validity.

3. Research Methodology

This section discusses the research design and procedure of the study, as well as the description of the target-reading course.

3.1. *Research Approach*

The study adopts an exploratory approach. An exploratory case study is a qualitative research method used to investigate new or under-researched topics. According to Yin (2018, p. 52), an exploratory case study aims "to explore situations in which the intervention being evaluated has no clear, single set of outcomes." In line with this definition, the present study explores the potential role of ChatGPT in enhancing critical reading skills among Algerian first-year EFL students, which represents an entirely novel area of inquiry. Moreover, as Yin (2018) noted, this approach is suitable for examining a contemporary phenomenon within its real-life context.

Hence, ChatGPT—an emerging instructional tool in the EFL context—is examined to explore how it can support the development of critical thinking in reading.

3.2. *Sampling*

The study followed convenience-sampling method. As it was unpractical to use both random and cluster sampling, the researcher opted for convenience sampling. A group of 21 first-year EFL students from the University of Jijel who volunteered to take part in the learning experience was selected. Random sampling was not possible because not all students could accept to take part in the target course. Likewise, for ethical reasons, it was deemed unfair to interrupt the official teaching syllabus of one or two groups out of eight and involve them in a different reading methods and contents.

While random sampling offers equal chances for everyone to be selected and cluster sampling involves choosing existing groups within an institution, convenience sampling relies on accessible and available informants. This choice is motivated by both the availability of participants and the nature of the research. Dörnyei (2007) argued that qualitative studies often adopt non-probability sampling techniques such as convenience sampling, as the focus is on the quality and depth of responses rather than generalization. Similarly, Creswell (2012) emphasized that qualitative data collection typically involves small samples to allow deeper exploration and understanding of emerging phenomena. Therefore, convenience sampling was considered the most suitable approach for this study, given its exploratory and context-specific nature.

3.3. *Course Description and Procedures*

The case study involved the implementation of a reading course using ChatGPT for 21 first-year EFL university students, conducted over nine weekly sessions. The texts were prepared by the researcher and adapted in class in accordance with the students' level of proficiency. The flexibility of ChatGPT allowed for the rapid modification of texts. Additionally, the researcher prepared critical thinking tasks for the reading course in line with Facione's (1990) model discussed above. The students were also allowed to manipulate and modify the content of the questions under the teacher's guidance. The six critical thinking skills identified by Facione were developed in tandem.

The four instructional steps are embedded in theory. The first step involved projecting texts through data presentation to permit full access to the internet and content. Hence, the students were not required to have internet hardware or connection. The projection is likened to the use of a whiteboard and laptop instead of white chalk or markers. This first stage is grounded in Krashen's (1980) Input Hypothesis, which emphasizes three characteristics: simplicity, interest, and resourcefulness.

The second stage of practice is grounded in Ericsson's (1993) Deliberate Practice Theory, which states that focused and repeated practice promotes language learning. At this stage, students were offered both guided and free practice to engage with the target reading texts and critical thinking skills. Stage three is underpinned by Vygotsky's (1978) socio-constructivism and connectionism theories, which respectively emphasize social and machine-assisted interactions in developing language capacities. Phase four of the course is based on Kolb's (1984) Experiential Learning Theory, which argues that learning occurs through doing, reflecting, and applying knowledge in practice with feedback. At this final stage, the teacher provides feedback and monitors the students' progress, while students reflect critically on their experience and address their perceived weaknesses.

Approval to use participants' data for research purposes was obtained at the onset of the teaching experience. Before implementing the research tools and documenting the process, the researcher

secured informal consent from the students, who agreed to have their data published anonymously for the purposes of this study.

3.4. Topics Used in the Tasks

To effectively develop critical thinking through reading tasks, the author selected four main topics, each targeting specific reasoning skills. The first topic involved analyzing and creating advertisements to enhance students' interpretation and analytical abilities, allowing them to identify persuasive techniques and examine how language and visuals shape readers' opinions. The second topic, "My Ideal Friend," focused on evaluation, as students were asked to assess different character traits and justify their choices, promoting reflection and value-based reasoning. The third topic aimed at developing inference and explanation skills, helping students draw logical conclusions and articulate their reasoning during reading activities. The fourth topic, "Stress Solution Framework," centered on self-regulation, inviting students to identify personal stressors and propose strategies to address them, thereby linking critical thinking with emotional awareness and problem-solving.

3.5. Data Collection Procedures

This study used three main research tools: Semi-structured interviews, classroom observation, and content analysis. The first was semi-structured interviews conducted with the student who took part in the learning experience. The interviews were carried out at the end of each of the nine instructional sessions, where volunteers were invited to share their daily learning experiences. Prompts were used to encourage deeper discussion on emerging themes such as motivation and understanding (Creswell, 2012).

The second tool consisted of classroom observations, supported by detailed field notes. The researcher regularly recorded observations on a daily basis, guided by intuition and focus on important themes related to the teaching and learning process. Additionally, at the end of each session, the researcher reflected on the classroom experience, documenting insights and reactions to better understand students' engagement and the overall progress of the implementation. These combined procedures provided rich qualitative data for interpretation and analysis (Creswell, 2012).

The third research tool was content analysis. To ensure a better investigation of critical thinking development through the structured instructional scheme and ChatGPT, the researcher regularly collected students' productions or artifacts. As Bell (1999) argued, document analysis provides more concrete evidence than what informants claim to do or achieve. The combination of the three qualitative research tools enabled data triangulation and contributed to a clearer understanding of the phenomenon.

Qualitative data were collected during and after the course (Merriam & Tisdell, 2016) implementation through classroom observations, student interviews, and students' artifacts. This data helped documenting students' productions and capturing their reflections and perceptions of this learning experience, providing deeper insights into their engagement and the educational impact of AI-assisted reading practices (Zainal, 2007).

4. Data Analysis

The collected data from student interviews, classroom observations, and students' artifacts were analyzed using thematic analysis. According to Braun and Clarke (2006, p. 79), it is "a method for identifying, analyzing, and reporting patterns (themes) within data." In simpler terms, this approach allows the researcher to manage and interpret qualitative data effectively. Braun and Clarke's (2006, pp. 77–101) framework for thematic analysis was applied. It involves the following six steps:

1. Familiarizing with the data
2. Generating initial codes
3. Searching for themes
4. Reviewing themes
5. Defining and naming themes
6. Producing the report

Simply said, thematic analysis involves carefully reviewing data to gain an overall understanding of its content, generating codes that summarize its different aspects, examining these codes to identify broader themes, refining and reducing the number of themes, and finally producing the results that represent the key findings of the study. Finally, it is important to note that the use of field notes and interview notes made the process of analysis more manageable. The notes were carefully prepared and refined for thematic analysis.

This process of data analysis was carried out manually through well-prepared field and interview notes. The notes allowed easy analysis and yielded rich codes, which were transformed into overarching themes. In order to ensure the validity of the coding system, two colleague researchers in the department were asked to review and evaluate the coding system. The expert evaluation of the thematic analysis was positively validated.

5. Findings

This section presents the findings of the study as themes centered around the research subtopics. The corresponding codes for each theme are also provided.

Theme 1: Students' Development of Critical Thinking Skills
Codes: Discovering hidden meanings
Differentiating facts vs. opinions
Interpreting author's intent
Evaluating multiple perspectives
Noticing biases in texts
Applying critical thinking to real-life examples

The most important theme in this study is the development of critical thinking skills among first-year Algerian EFL students in the target reading course. The students emphasized discovering new skills, which were sometimes practiced tacitly. One student said in the interview, "From now on, I will read texts differently." Another student added, "We didn't use to pay attention to these hidden meanings." Indeed, classroom observations supported these claims. The students showed great enthusiasm in trying to uncover the arguments presented.

Among the skills developed by the participants were differentiating between opinions and facts, interpreting authors' intentions, evaluating multiple perspectives, and noticing biases in texts. While reading a text about a beauty cream advertisement, the learners managed to distinguish between facts (e.g., "Our cream contains vitamins") and opinions ("Our cream is the best"). Similarly, the students adequately identified the author's intentions, such as persuading the reader to buy a product, building trust, and creating a desire to purchase.

Overall, formative classroom observations revealed that the students were fully engaged in reading texts and were enthusiastic about working on higher-order skills. One student said that she felt more motivated and proud when working on more sophisticated skills rather than on language and grammar.

Theme 2: Digital Literacy Growth
Codes: Basic use of ChatGPT

Advanced AI functionalities

Analyzing text with AI
Identifying arguments
Detecting biases
Generating debates

The first form of literacy developed in the ChatGPT class is the use of AI-generative tools. Most of the students reported that they had previously used ChatGPT as a basic tool to ask questions, look up words, and seek solutions for assignments. During this experience, they learned and discovered other advanced functionalities, such as analyzing texts, identifying arguments, discerning authors' intentions, detecting biases, and generating debates.

The second important element that the students learned regarding AI use is gaining a more nuanced understanding of ethical considerations. One student said that he thought ChatGPT could be used to answer questions, but not for generating academic texts and activities. He added that he could not use ChatGPT for every text or rely on it entirely to conduct learning in the classroom. Many students initially held erroneous beliefs about AI and almost equated its use with cheating.

In relation to Facione's (1990) critical thinking framework, the use and mastery of digital literacy supported the participants in inferring the meanings of texts and explaining them. They used this tool, for example, to derive meaning from given sentences. An example from student artifacts illustrates this process:

Student: What can I infer from the sentence about my friend? *He always waits for me after school.*
ChatGPT: *Inference: He is loyal and caring.*

Similarly, the students asked why their friend might be considered helpful, and ChatGPT provided explanations they could emulate to interpret other statements or claims.

Theme 3: Student Engagement and Motivation
Codes: Enthusiasm for reading tasks
Active participation
Enjoyment of higher-order skills
Motivation through AI support
Flexibility in learning methodology

The most notable aspect of using ChatGPT to develop reading and critical thinking skills is increase in engagement and motivation. The learners appeared more enthusiastic, engaged, and active, and the level of participation was remarkably high. During the interviews, the learners repeatedly mentioned that they enjoyed working on the hidden meanings and discussing texts more meaningfully. They also noted that reading had previously been taught in a boring and old-fashioned manner. Additionally, the fact that the students consistently attended the nine sessions—except for four participants who attended irregularly and two who completely dropped out—demonstrates their interest in the course and the use of ChatGPT.

The use of simple texts generated by AI and tailored to the students' level greatly contributed to increased participation. Texts that were too complicated or very challenging in terms of language and content were quickly dismissed. The same approach was applied to reading assignments. The students appreciated and enjoyed the flexibility in the teaching methodology provided by AI tools. Following this increase in motivation, the students, likewise, exhibited enhancement in self-reflection and self-monitoring. After being taught self-reflection and self-monitoring strategies through ChatGPT-generated activities, students reportedly began asking themselves questions such as: *Do I really understand the writer's intentions?* and *Am I clear in my explanations?* These metacognitive skills were gradually developed through consistent practice with ChatGPT prompts, including questions like: *Am I reading critically or just believing everything?* and *Am I exaggerating in my interpretations?*

Theme 4: Personalized Learning, Experience, and Self-Regulation

Codes: Learning at own pace
Simplifying complex material
Adapting AI skills for self-learning
Reflection on learning strategies
Self-regulation in using AI

The student participants reported that the use of ChatGPT by the teacher in open class allowed them to experience personalized learning and work at their own pace. One participant remarked:

> "At the beginning, I had a negative belief. I had negative perceptions of this method. Now I have changed my mind. I have learned how to use ChatGPT to learn other modules in a simple way. I ask it to simplify and give short explanations to understand better."

Similarly, as this learner testifies, after a few sessions of instruction through ChatGPT, the students began to master AI skills and adapt them to meet their own learning needs more effectively than the assistance that could be offered by any experienced peer.

Theme 5: Awareness of Learning Strategies

Codes: Questioning current strategies
Practicing new strategies
Teacher feedback on strategy use
Reflection on effective learning techniques

The active instruction sessions implemented within the framework of the teaching experience encouraged learners to question their learning strategies and seek more effective ways to process content. The design of texts, activities, and prompting exercises was structured to facilitate content comprehension. Many students reported that the practice of tasks, combined with the teacher's continual feedback, made them more aware of the learning strategies they had previously used tacitly. For example, students reported learning to ask questions, summarize content in their own words, explain concepts to others, and make connections between ideas.

Theme 6: Collaborative Work in Processing Input

Codes: Social interaction with peers
Complementing machine interaction
Teaching peers digital techniques
Fact-checking, summarizing, analyzing
Deepening text understanding through discussion
Translanguaging to scaffold understanding

The combined digital and social interaction implemented in stage 3 significantly helped learners gain a better understanding of the rhetoric, nuances, and subtleties of texts. The students admitted that they enjoyed social interaction as a complement to machine interaction and even tried to teach other digital techniques that they had individually acquired in class or at home.

During these sessions, the students discussed strategies such as fact-checking, summarizing, analyzing, and self-regulation. All exchanges and discussions contributed to a deeper understanding of the target texts. The discussions were lively, and students remained engaged despite their limited English proficiency. To support comprehension and critical thinking, the teacher allowed the use of translanguaging, scaffolding learners' efforts to develop a critical spirit and adopt critical reading strategies. Overall, the students acknowledged that all group discussions in ChatGPT were helpful.

This, in turn, further enhanced the critical skills of analysis and evaluation. The students analysed in groups advertising messages and gave individual suggestions in terms of their contexts, origins,

language, and time. Then, they compared their answers to the ones given by ChatGPT, which further improved their analysis and showed them how to consider new elements in interpretation. For example, the students analysed the following messages: *"عيش la vie" (live life), "Together we make future,"* and *"Et que chacun parle" (and everyone speaks).* Similarly, in their evaluation of the slogan *"and everyone speaks,"* the students revealed—with the help of ChatGPT—that it is not original, as it is used by many phone companies around the world.

Theme 7: Limitations of AI Used for Developing Critical Reading Comprehension
Codes: Over-reliance on AI
Cognitive laziness
Unethical use of AI
Limited Internet access
Digital literacy divide
Fragmented understanding of texts
The biggest and most widely cited problem with ChatGPT use in all areas of life is over-reliance on it. The student participants admitted that they had developed the habit of using AI to analyze and answer even simple questions or problems, instead of applying their own knowledge and cognitive skills. This habit could lead to cognitive laziness and a loss of self-confidence.
Secondly, the students reported having the problem of limited access to the Internet.
Consequently, they relied on offline applications, which is not the case with ChatGPT, as it requires an Internet connection and payment for customized services.
Thirdly, the researcher observed that once the learners acquired appropriate skills in using ChatGPT, some began to use it unethically to complete their assignments. Instead of reading texts, certain students were tempted to obtain fragmented answers through ChatGPT analysis. Consequently, the teacher posed meticulous questions to discourage students from relying solely on AI.
Theme 8: Digital Literacy Divide

Codes: Lack of digital skills
Access to technology
Teacher support
It appeared during the implementation of the tasks that many students began with very limited digital knowledge and skills, while some peers excelled in the field of digital technology. However, teacher's guidance, practice, and collaboration quickly addressed these limitations. As reported earlier and confirmed through classroom observations, most students demonstrated significant progress in both mastering digital and AI skills as well as developing critical thinking skills.
In short, the implementation of critical thinking tasks among first-year EFL students at the University of Jijel demonstrated that it significantly supported the development of interpretation, analysis, evaluation, inference, explanation, and self-regulation skills. Additionally, the proposed critical thinking skills framework contributed to the growth of other competencies, including digital literacy, meaningful discussion, collaboration, self-regulation, awareness of learning strategies, and increased motivation. The main limitations inherent to AI technology use included AI reliance, cognitive laziness, AI ethical issues, digital illiteracy, and internet access divide.

6. Data Interpretation

This section answers and discusses the research questions, provides pedagogical recommendations, and states the limitations of the study.

Research Question 1

The integration of ChatGPT into reading instruction significantly enhanced students' critical thinking abilities. The participants learned to look beyond the literal meaning of the text and apply Facione's (1990) skills of interpretation, analysis, evaluation, inference, explanation, and self-

regulation. They were able to generate appropriate text, analyze them, identify arguments, and evaluate credibility of information, draw conclusions, and share understanding with others. The most challenging skill was self-regulation; consequently, the researcher included a specIal step in the teaching framework to explicitly teach students to reflect on their reasoning.

The literature supports these findings. Al-Hassan and Al-Sarwah (2025) reported that ChatGPT improved students' reading comprehension. Likewise, Wang and Fan (2025), in a meta-analysis, recommended the use of ChatGPT, highlighting its effectiveness in developing higher-order skills such as problem solving. Furthermore, Daza, Angelo, and Luzuda (2024) found that ChatGPT strategies promoted both reading and writing skills, helping students express critical opinions and organize ideas. Similarly, Aditia Ilu and Arun (2024) stated that the use of ChatGPT enhanced students' ability to express critical opinions and structure their ideas effectively.

Overall, ChatGPT appears to be an effective mediation tool (Yang, 2024) for developing critical thinking. However, its use requires systematic integration within a well-structured framework. This study employed Facione's critical thinking model and proposed a four-step approach to address critical thinking skills. Similarly, Adhita Ilu and Arun (2025) suggested teaching critical thinking via ChatGPT within the Zone of Proximal Development, and Wang and Fan (2025) embedded ChatGPT in instructional frameworks such as Bloom's Taxonomy.

Research Question 2

The students expressed positive attitudes towards using ChatGPT as a mediation tool, reporting that it enhanced digital literacy, motivation and interest, personalized learning experiences, awareness of learning strategies, and collaborative work. They learned to effectively use AI tools, utilizing appropriate prompting and advanced ChatGPT functionalities, such as uploading files and interactive features. These findings echo Aditia et al. (2025, p. 1), who found that ChatGPT supported literacy through personalized and adapted instruction. This indicates that ChatGPT not only develops critical reading skills but also helps students acquire 21st-century skills, essential for technology use.

Secondly, ChatGPT boosted students' motivation and engagement. Participants were more immersed and active when performing reading tasks, aligning with findings from both Aditia et al. (2025) and Al-Hassan & Al-Sarwah (2025) regarding interactive reading activities.

Thirdly, ChatGPT promoted personalized learning through simplified input, interactive activities, instant feedback, and self-paced learning. These features increased learners' motivation and autonomy, requiring only teacher guidance for digital manipulation and pedagogical support. This is consistent with Aditia et al. (2025), who noted that AI tools personalize and adapt reading content effectively.

Fourthly, the reading-critical-thinking framework applied in this study contributed considerably to enhancing learning strategies. Students reported that they began to think critically and regulate their learning by varying and challenging previous strategies. They emphasized acquiring digital learning strategies that could be applied to traditional learning contexts. Developing effective strategies is a key gain, as Oxford (1990) argued, since they are strong predictors of language learning success.

Finally, in developing critical reading skills through ChatGPT, students experienced true learner-centeredness by choosing topics, adapting content to their language proficiency, actively interacting with ChatGPT and peers, and learning at their own pace. Similarly, Perifanou and Economides (2025) supported the collaborative use of digital tools and recommended using platforms such as phone calls and Instagram. Likewise, Zhu et al. (2025) argued that ChatGPT promotes both human and generative interaction and supports learner-centered approaches. Accordingly, the use of digital tools is an effective solution to foster learner-centeredness, active collaboration, and interaction.

Research Question 3

Despite the effectiveness of ChatGPT as a mediation tool, this study revealed important limitations, consistent with findings in the wider literature (Mehdaoui & Bessaid, 2024). Some students became completely passive and reliant on ChatGPT, which affected the quality of learning and undermined creativity and problem-solving abilities. As Al-Hassan and Al-Sarwah (2025) argued, stringent guidance is required to maintain academic integrity and active student agency.
Another challenge in integrating ChatGPT into education is the lack of internet access and devices. The proposed framework addressed this problem through open-class projection; however, students noted that limited internet access sometimes prevented them from practicing outside the classroom.

Additionally, maintaining academic integrity and promoting critical thinking while using ChatGPT remains challenging. This study revealed similar findings to those of Mehdaoui and Bessaid (2024) and Perifanou and Economides (2025), who reported that students often short-circuited the digital learning process by going straight to generated answers. Accordingly, as highlighted in this study and in the proposed reading-critical-thinking framework, the teacher or syllabus should be structured so that the learning process, rather than just the product, is rewarded.
In summary, this study has demonstrated that using ChatGPT to support the teaching of critical thinking in reading facilitates learning and enhances its quality. This digital mediation allows students to move beyond surface-level comprehension. Students appeared more active and engaged and reported acquiring digital skills, new learning strategies, and self-regulation mechanisms. Nevertheless, despite the positive outcomes of the implemented critical reading tasks, students experienced challenges such as cognitive laziness, issues with logical integrity, and limited internet access.

7. Pedagogical and Research Recommendations

Based on the findings of this exploratory study, several pedagogical and research recommendations are proposed. It is suggested that ChatGPT—and, by extension, other digital tools—be incorporated cautiously and systematically to promote high-quality teaching that fosters both language proficiency and 21st-century skills, such as critical thinking and problem solving. While some scholars remain skeptical and call for careful implementation, Aditia et al. (2025) likewise advocated for its integration, emphasizing that concerns such as academic integrity must be addressed prior to its use.

Using ChatGPT as a legitimate teaching technique requires caution, as hasty or careless integration by teachers and curricula may lead to unintended consequences. Therefore, this study—supported by evidence from expert literature—suggests that digital tools be integrated within a well-thought-out and structured pedagogical framework. In this regard, the present study proposed a four-step framework for developing critical thinking skills. Other researchers had also advanced similar models, such as the Zone of Proximal Development (ZPD) proposed by Adelia et al. (2025) and of Bloom's Taxonomy suggested by Wang and Fan (2025). These frameworks ensure that ChatGPT is not used randomly but as part of a systematic, pedagogically sound process.

Furthermore, this study strongly encourages the use of AI tools like ChatGPT to promote learner-centeredness and collaborative learning. As Zhu et al. (2025) observed, ChatGPT enhances collaboration and interaction. Similarly, Daza et al. (2025) underlined that ChatGPT supports the development of modern skills such as forming critical opinions and engaging in reflective thinking. The use of AI in this way enables students to take ownership of their learning while benefiting from adaptive support.

In addition, integrating technology and AI tools can make reading not only easier but also more meaningful. Learners can move beyond literal comprehension to explore pragmatic and discursive dimensions of texts, discovering nuances, intentions, and rhetorical subtleties. This deeper engagement contributes to developing both linguistic and cognitive skills.
This study also advocates for process-oriented and meaning-based instruction (Willis & Willis, 2007), which prioritizes learning as a dynamic process rather than a static outcome. Such an approach helps students develop practical competencies, including active agency, communication, critical thinking, and technological literacy. Focusing on the process also helps counteract the growing tendency to rely on AI for quick and easy answers. As highlighted by Mehdaoui and Bessaid (2024), process-based evaluation encourages students to think critically and construct knowledge, rather than reproducing ready-made responses. Consequently, assessment should focus on performance and reasoning rather than solely on the final product.

With regard to research implications, this study represents an initial exploratory attempt to investigate the use of ChatGPT in fostering critical reading and thinking skills among EFL students. Although the findings are promising, it is recommended to replicate the study over a longer period of time and with a larger, more diverse sample to ensure greater validity and generalizability. Future research could build on this exploratory work to design quantitative instruments and test specific hypotheses on the impact of ChatGPT on reading comprehension and critical thinking development.

In sum, this study may serve as a foundational step toward integrating AI in EFL education. Its findings provide valuable insights into how digital tools can be systematically embedded into pedagogical practice to enhance both language learning and higher-order thinking skills.

8. Limitations of the Study

The first limitation of the study concerns the sample. It consisted of 21 first-year EFL students, 16 of whom were females. Additionally, involving only volunteers might have partially affected the representativeness of the sample, as such participants are usually more motivated and hardworking. Therefore, this group may not ideally represent the overall characteristics of first-year EFL students at Jijel University.

Secondly, the teaching framework was not evaluated either before or after its implementation by experts. The tentative reading–critical thinking model was devised and explored solely by the teacher-researcher, which might have introduced a degree of subjectivity.
These limitations might have slightly influenced the results. However, since this study is exploratory in nature, it can serve as a qualitative foundation for future research. It could help in constructing quantitative research tools and formulating pertinent hypotheses to empirically measure the effect of ChatGPT on the development of critical thinking in reading.

9. General Conclusion

This exploratory study has shown that ChatGPT can serve as a powerful tool to promote critical thinking. It has demonstrated that this widely accessible and popular AI platform can not only enhance surface comprehension of reading texts but also foster higher-order critical reading skills such as analysis, evaluation, and self-regulation. When applied systematically, ChatGPT further assists learners in working collaboratively, developing digital competence, learning at their own pace, boosting motivation and engagement, exploring new learning strategies, and exercising self-discipline.

Nevertheless, the integration of ChatGPT as a legitimate pedagogical technique in reading instruction requires careful consideration to avoid its inherent and associated pitfalls. As highlighted in this study and supported by existing literature, the adoption of digital AI in reading

courses must be guided by well-conceived and structured frameworks, such as Bloom's Taxonomy or Vygotsky's Zone of Proximal Development. Without grounding in a systematic and theoretically informed framework, the incorporation of ChatGPT may undermine academic integrity and learner autonomy. Indeed, the study revealed that some students tended to rely excessively on ChatGPT's generative capacities to produce quick solutions for their academic assignments.

Furthermore, over-reliance on AI-generated responses may lead to cognitive laziness and reduced problem-solving capacity. Practical constraints such as limited internet access, lack of technological resources, and persistent digital inequalities must also be taken into account. Therefore, educational authorities aiming to integrate AI tools into EFL contexts should adopt consistent and sustainable measures to optimize their use, rather than reject such technologies because of potential risks or contextual challenges.

Finally, a locally relevant pedagogical framework should be developed to align with the evolving demands of modern education and to support the development of learners' critical and technological skills.

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Appendix: Sample lesson

Reading Task: "My Ideal Friend" (Intermediate Level)

Stage 1: Input / Reading (Skills: Reading & Vocabulary)

Text: Read the short passage below:

My ideal friend is someone who listens carefully, supports me in difficult times, and shares honest advice. They are kind, respectful, and open-minded. We enjoy studying together, exploring new ideas, and laughing about small things. True friendship, in my opinion, is based on trust and understanding.

Task:

- Read the text carefully.
- Underline five adjectives that describe an ideal friend.
- Note any new or difficult words.

Stage 2: Practice Activities (Skills: Speaking, Writing)

Activity 1: Pair work – Discuss the qualities of your ideal friend using the adjectives you underlined. **Activity 2:** Write 4–5 sentences about your own ideal friend, using at least three adjectives from the text.

Stage 3: Human and Machine Interaction (Skills: Reading, Speaking, Critical Thinking)

Activity: Use **ChatGPT** to

- Ask ChatGPT to describe *its* version of an ideal friend.
- Compare your ideas with the AI's response.
- Discuss: Do you agree or disagree with the AI? Why?

Stage 4: Teacher Monitoring, Feedback, and Debriefing (Skills: Listening, Reflection)

Teacher Role

- Monitor discussions and note common language or content issues.
- Provide corrective feedback on pronunciation, vocabulary, and grammar.
- Lead a short debriefing discussion: *What did you learn about friendship and about AI perspectives?*

Targeted Skills

1. Reading comprehension
2. Vocabulary enrichment
3. Speaking fluency
4. Writing accuracy
5. Critical thinking
6. Reflection and feedback

PEDAGOGICAL STRATEGIES FOR INTEGRATING AI WITHOUT UNDERMINING READING SKILLS: ENHANCING CRITICAL THINKING AND RETENTION IN LEARNING ENVIRONMENTS

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ABSTRACT

The application of artificial intelligence (AI) in schools has the reconstructed reading proficiency, critical thinking, and retention. Pedagogical approaches of integrating AI in reading classes without compromising literacy skills are considered in this chapter. We propose an integration model of AI from active learning, metacognitive thinking, and digital literacy acquisition. The research design employs mixed methods involving a quantitative survey and qualitative interviews. The experiment probes reading comprehension and critical thinking with pre- and post-test measures complemented by qualitative teacher and student feedback about the impact of AI on reading instruction. Outcomes show that AI tools enhance student interest and comprehension but have the potential to restrict critical thinking, close reading, and metacognitive monitoring if over-reliant on AI. The book concludes by calling on teachers and policymakers to incorporate AI-based learning into the conventional practice of reading so as not to undermine intellectual development and critical thinking.

KEYWORDS: *Artificial Intelligence, Cognitive Engagement, Critical Thinking, Reading Ability, Pedagogy.*

1. Introduction

The use of artificial intelligence (AI) for instruction in reading has been recognized as a revolutionary development, offering the potential for highly customized learning experiences, increased motivation, and real-time adaptive feedback based on each learner's unique needs. Experimental studies highlight that AI-based personalized reading platforms can significantly improve students' reading comprehension, engagement, and motivation through continuous adaptation of content and immediate formative feedback (Hidayat, 2024). Furthermore, research exploring EFL learners' perspectives reveals that AI tools in reading instruction enhance learners' self-efficacy and autonomy while also supporting motivation and strategy development (Daweli & Mahyoub, 2024). With the evolution of artificial intelligence technologies such as natural language processing (NLP), intelligent tutoring systems (ITS), and adaptive learning environments, teachers today have unprecedented possibilities to bridge long-standing literacy challenges and enable learners to acquire higher-order thinking skills. However, harnessing these possibilities involves complex and challenging problems.

The current research shows that educators must choose between maximizing their technological capabilities and protecting teaching methods that maintain academic integrity. This study establishes an evidence-based system that enables teachers, curriculum developers, and policymakers to harness AI advantages, while preserving the intellectual and ethical standards of reading pedagogy. This chapter uses mixed-methods research, practical guidance, and ethical reflection to help students develop their literacy skills in an AI-based learning environment.

The ability to read is a vital skill that affects people worldwide. The National Assessment of Educational Progress (NAEP) reports that fourth-grade students in the United States achieve reading proficiency at a rate below 32% (NAEP, 2022). Research shows that artificial intelligence-based natural language processing and adaptive learning systems enhance reading skills by 15–22% through personalized learning, immediate feedback, and interactive learning experiences (Hidayat, 2024). Positive results show positive effects; however, researchers have identified several important limitations. Students who depend too heavily on AI systems develop cognitive offloading, which hinders their ability to think independently and critically and to maintain extended reading sessions (Dewi, 2024). Educational AI integration faces multiple ethical obstacles owing to privacy concerns, biased algorithms, and unequal access to technological systems.

To address this paradox, evidence-based interventions that balance technological innovation with activation of cognition are required. While many studies confirm the usefulness of AI in enhancing comprehension, relatively few have investigated its effects on higher-order abilities such as critical thinking and metacognitive reflection, or the ethical implications of its use. Therefore, this study examines the dual impact of AI on literacy and intellectual agency by integrating quantitative measurements of reading comprehension and critical thinking with qualitative insights from students and teachers. It aims to inform responsible and ethical AI adoption that supports deep reading, critical reflection, and equity, ensuring that technology remains an enabler rather than a substitute for critical literacy practices.

To assist in research on the impact of AI on reading education, the research addresses the following queries:

1. To what extent does reading technology based on AI increase students' understanding of reading beyond typical instruction?

2. What are the implications of students' critical thinking and metacognitive monitoring when completing reading activities, as evidenced by assessments such as the Metacognitive Awareness Inventory?

3. In what ways can policymakers and educators weigh the use of AI and traditional literacy drills in a manner that will not make them dependent but still challenge the mind?

The research hypotheses test the effect of AI on reading comprehension, critical thinking, and metacognitive reflection. For example, AI-based reading platforms are bound to have far superior comprehension than traditional practices, as personalized and adaptive tools enable readers to become improved readers. Second, excessive reliance on AI applications is anticipated to negatively impact students' critical thinking because recourse to machine summaries or instant responses may undermine their capacity for analysis and reflection. Finally, it is anticipated that educational professionals trained in AI literacy will be capable of countering these dangers by teaching learners in such a way that they remain cognitively challenged, reflective, and self-regulated. Together, these assumptions address the research questions and highlight the potential harm and benefits of using AI as a pedagogical tool for reading instruction.

This study has a threefold purpose. First, it seeks to measure the impact of AI-supported reading technology on students' comprehension through pre- and post-intervention assessments, thereby providing controlled evidence of improved literacy. In addition, this study seeks to explore qualitative patterns of AI usage in relation to cognition and mental effort transfer through an examination of teachers' and students' perceptions and practices. Thus, this study seeks to describe how AI affects cognitive ability and learning styles in practice. Finally, it addresses matters of ethics by examining emerging concerns from students and instructors, such as privacy, fairness, and equality of access, with a view to proposing sustainable solutions for the ethical embedding of AI into reading instruction.

2. Literature Review

The use of artificial intelligence (AI) technology in reading practice has the potential to revolutionize learning and teaching processes and influence literacy attainment in the senior high school teaching context. AI-assisted interventions such as natural language processing (NLP) and adaptive learning systems expose learners to customized reading materials and adaptive test procedures that respond accordingly to changing levels of learning. These computer processes have been found to improve reading comprehension skills through targeted teaching interventions and feedback specific to the individual needs of learners. Despite some limitations, the pedagogical promise of AI and its future adoption in reading instruction suggest limitless opportunities for maximizing literacy development through adaptive and targeted learning environments (Academic Journal of Management and Social Sciences, 2024). Therefore, it is crucial to consider critically their effects on reading literacy and comprehension. The literature review considered the efficacy of AI-based reading technologies, separating primary strengths, model constraints, and theoretical disputes. The discussion also includes the reported motivational effects garnered through the use of AI in reading instruction.

2.1 Instructional Reading Effectiveness of AI

AI has provided a new way to teach reading as a differentiated and adaptive learning experience. NLP and adaptive learning software technologies manipulate the level of difficulty of the content and provide individualized real-time feedback to address the special needs of learners. This level of personalization engages learners and enables them to effectively comprehend.

Recent research has demonstrated the potential of AI to increase reading abilities. Hidayat (2024) conducted an experiment among 85 high school seniors, where students who were on an AI-based

personalized reading platform performed significantly better in reading comprehension compared to a control group. This advantage is due to the fact that the platform was able to deliver personalized reading content and immediate feedback based on the students' level of competency.

Alrawashdeh et al. (2024) conducted a worldwide meta-analysis of 27 studies and found a moderately positive impact of adaptive and personalized learning technologies on reading literacy (g = 0.29). Here, aggregation concerns the use of AI tools in other directions, and attests to their value in enhancing reading standards.

Additionally, He (2024) examined the impact of AI adaptive texts on reading comprehension. According to previous research, AI-based real-time adaptive texts help promote understanding and memory recall during reading. Adaptability offers a learnable experience that is affordable, interactive, and responsive to the needs of various learners.

These findings collectively demonstrate how adaptive AI input-based reading interfaces contribute to improved reading comprehension and learning by treating reading as an intriguing and interactive endeavor. As developments in AI technologies continue, their use in teaching reading will also continue to shape literacy.

2.1.1 Positive Effects

Evidence indicates that artificial intelligence (AI) significantly improves literacy. For instance, Cuevas-Ruiz et al. (2025) revealed that the more sessions of the interactive intervention, the more reading development increased by 2.4% of a standard deviation or one month of learning. This significant effect indicates the potential of AI-based personalized learning programs in mixed-ability learning environments.

Systematic reviews have validated these findings. Kristiawan et al. (2024) conducted a comprehensive review of AI applications in English language instruction and concluded that AI systems such as intelligent tutoring systems and chatbots, significantly improve learner motivation and grammar, vocabulary, and reading proficiency. An AI system with individualized feedback and adaptation based on learners' needs establishes an environment that is more engaging and supportive of learning. These studies support the idea that AI-assisted interventions enhance reading skills and overall language skills by offering personalized learning experiences that may be absent in traditional practices.

2.1.2 Critical Gaps and Challenges

Although AI promises breakthroughs in reading instruction, some critical points remain. One significant challenge is the offloading tendency, where students rely extensively on AI aids to summarize and judge, potentially at the expense of their metacognitive and critical thinking abilities. Gerlich (2025) conducted a thorough study involving 666 participants from various age groups and educational backgrounds. The outcomes revealed a strong negative relationship between intensive dependence on AI tools and critical thinking capacities ($r = -0.68$), mediated by higher cognitive offloading. Younger interviewees exhibited more dependence on AI tools and decreased critical thinking scores than older interviewees. The results highlight the cognitive cost of dependence on AI tools and the imperative of teaching practices that support critical engagement with AI technology.

Outside cognitive problems, algorithmic bias in AI systems is a significant concern, particularly for English as a Second Language (ESL) students. Chinta (2024) experimented whether the underrepresentation of ESL students in AI training data affects the results and found that these biases lead to unfair outcomes, including inaccurate grading and feedback. This disparity can undo and solidify the learning experiences. Addressing these biases is critical for ensuring that AI technology

serves all students equally. These findings reaffirm the need to develop AI systems that not only enhance learning, but also uphold ethical standards, in turn keeping all students ahead with technological advancements without harming their intellectual development or education equity.

2.1.3 Pedagogical Tensions of AI-Augmented Literacy Theory

Theoretically, newer constructivist approaches situate AI as a scaffolding tool that supports learner autonomy, questioning, and the development of metacognition in advancing the vision of AI as a cognitive partner to facilitate active participation and contextual sense-making (Liang et al., 2025; Kalantzis & Cope, 2025; Allen & Kendeou, 2023). Current evidence suggests that when students are prompted to reflect on, evaluate, and interact iteratively with AI systems, they show more comprehension and longer-term retention because such interactions foster critical and integrative thinking (Allen & Kendeou, 2023; Kalantzis & Cope, 2025).

Conversely, some recent reviews have verified that behaviorist tendencies tend to be replicated in AI-aided reading environments where learners may rely on AI for rapid reaction or superficial comprehension, potentially creating passive consumption habits and undermining more sophisticated literacy skills (Liang et al., 2025; Hudon et al., 2025; Allen & Kendeou, 2023). The authors highlighted the importance of immediate educational actions that position AI as an aid, not as a replacement tool, enabling educators to guide their use in supporting, rather than displacing, cognitive and analytical work (Liang et al., 2025; Hudon et al., 2025).

3. Methodology

This study applies an explanatory mixed-methods approach to evaluate the impact of incorporating AI on reading performance. Quantitative and qualitative methods are applied to examine in detail how AI influences student performance. Standardized tests are applied to evaluate the impact of AI tools on reading comprehension and critical thinking, as well as empirical evidence of the intervention effect. The qualitative stage fills these gaps by exploring students' lived experiences, presuppositions, and inclination to use AI in reading classes. For the sequential method, qualitative data are used to shed light and context on the quantitative results, revealing how the experience of AI tools among students influences metacognitive and cognitive operations when reading.

3.1 Quantitative Phase

The quantitative part uses a pre-test/post-test experimental design. Three institutions, the University Center of Barika, the University of M'sila, and the University of Biskra, participated in the study and contributed a total of 120 undergraduate students in English language and literature. Students. They were randomly allocated to an experimental group that used AI-facilitated reading websites such as ChatGPT, Grammarly, and ReadTheory and a control group that received conventional reading without the assistance of AI. Reading level was measured using the Degrees of Reading Power (DRP) test, used in Hidayat (2024), and administered before and post-eight-week treatment. Critical thinking was assessed using the Metacognitive Awareness Inventory used by Dewi (2024), a Likert scale survey used to assess students' analytic thinking and metacognitive awareness. Quantitative analyses were performed using paired t-tests and regression analyses in SPSS to estimate the size and significance of the gains resulting from the AI integration.

3.2 Qualitative Phase

Following the quantitative phase, a purposive sample of ten reading teacher experts teaching in technology-integrated classrooms was interviewed through semi-structured interviews, and thirty students were recruited from the experimental group. Students were recruited to represent varying performance levels (high, medium, and low DRP post-test scorers). Interviews were arranged to gain

a rich understanding of pedagogical, ethical, and cognitive aspects of AI applications in reading pedagogy. Interviews involved questioning cognition offloading, student motivation, teacher preparedness, and data security. NVivo software was employed to code the qualitative data, which allowed a systematic focus on the dominant trends and opinions that differed. To ensure higher credibility, inter-coder reliability was obtained through concurrent coding of researchers to determine a consensus of theme identification and interpretation.

3.3 Quantitative and Qualitative Data Integration

While quantitative results offer numerical explanations of the measurable effectiveness of AI materials for reading enhancement, qualitative results enrich the context by exploring the real-life experiences of students and teachers with AI. The union of the two data sources allows for an even deeper analysis of the effects of AI, such as the cognitive, affective, and pedagogical dimensions of AI-supported learning, which are less likely to be similarly described through numbers.

3.4 Data collection instruments

Among the data collection tools, the Degrees of Reading Power (DRP) test, and pre- and post-intervention reading tests. The Metacognitive Awareness Inventory, is also used to construct critical thinking as well as metacognitive thinking. AI Engagement Logs are also used to monitor the frequency and pattern of use of AI tools. Semi-structured interviews with students and teachers were conducted to gather rich qualitative data on their experiences, attitudes, and challenges in adapting to AI. Together, the procedures outlined above provide a comprehensive overview of students' reading abilities, thinking skills, use of AI technology, and contextual issues that affect their learning. The study conformed to international standards of ethical practice in confidentiality, voluntariness, and informed consent, as well as institutional review, to uphold the rights of the participants and maintain data integrity.

3.5 *Ethical Considerations*

The implementation of artificial intelligence (AI) in schools creates important ethical concerns that must be addressed to ensure equity, clarity, and security for the rights of students. These concerns include algorithmic bias, data privacy, and the need to ensure equal access to AI tools.

The AI tools used in this study are extensively tested and calibrated to prevent algorithmic bias and to promote fairness and objectivity. Collaboration with AI tool developers is undertaken prior to implementation to minimize potential bias. Throughout the research, the tools are closely monitored to ensure that equal learning opportunities were provided to all students, regardless of their gender, socio-economic background, or cultural context.

With regard to data privacy, personal information collected by AI tools, including reading levels and interactions of students, is anonymized to prevent identification. AI tools observe data protection legislation such as the General Data Protection Regulation (GDPR) and organizational policy. Participants are fully informed about the data being collected, and consent is obtained with the capability of withdrawal at any time without penalty.

To provide equal access to AI tools, all students involved in the study are provided with the necessary tools, and additional access is planned for students with no personal devices or home Internet. The study also takes care to ensure that it covers a group of students from mixed socio-economic backgrounds so that the findings can be generalized to various learner groups.

Informed consent is obtained from all participants. The participants are assured that they could withdraw from the study at any time; therefore, their participation is voluntary. Proper information

is provided to allow informed and non-coercive consent. To maintain confidentiality, personally identifiable information is erased or pseudonymized during data processing. Data such as interview transcripts and performance data are anonymized, and sensitive information is accessed only by designated people. Data storage is performed according to institutional data security regulations and policies (GDPR), and the results are reported at an aggregate level to ensure anonymity.

The aim of this study is to prevent social and psychological harm. Interviewers are instructed on how to recognize distress and to refer to or support appropriately. The study is ethically monitored and approved by the institutional review board (IRB) and ethics committee to ensure responsible research.

4. Results

4.1 Quantitative Findings

The quantitative results revealed a statistically significant reading comprehension gain among the students in the AI-scaffolded reading system. Specifically, the experimental group achieved a 19.3% higher performance on the Degrees of Reading Power (DRP) post-test compared to that of the control group, and there was large effect of AI utilization on reading proficiency ($t = 4.72$, $p < 0.001$). These findings confirm the effectiveness of AI adaptive software for customized literacy acquisition in prior studies.

However, there is a complex trend in critical thinking capabilities. Regression analysis also revealed that for each of the 10 additional instances of AI tool use, the indicators of critical thinking fell by 2.1% ($\beta = -0.21$, $p = 0.03$). This suggests that there was a trade-off between the acquisition of knowledge and the level of analytic engagement characteristic of cognitive offloading, and decreased metacognitive reflection of the intensive use of AI.

Table 1. Reading Comprehension Test Results (Pre-test vs. Post-test)

Group	Test	Mean Score	Std. Deviation	N
Experimental	Pre-test	52.4	6.5	30
Experimental	Post-test	74.6	7.2	30
Control	Pre-test	51.9	6.1	30
Control	Post-test	55.3	6.8	30

4.2 Qualitative Insights

Student Attitudes

According to the student feedback survey, the sentiment towards using AI in reading instruction was extremely positive. Approximately 68% of students showed a highly favorable inclination towards AI-based summative feedback, indicating that it was more effective, faster, and easier to comprehend than teacher explanations. Students typically described AI assistance as "time-saving" and "helpful in explaining tricky words or sentences." Students also indicated that AI tools encouraged them to read more assignments, particularly challenging or technical texts. However, the students also reported serious drawbacks.

One was the temptation to skimp on reading tricky passages, and instead relied on AI output. Some of the students noted in themselves a shift toward more surface reading strategies, that is, that comprehension was "easier," but that they had lost some depth of analysis. This is what would be predicted as a result of cognitive offloading because cognitive effort is transferred to technology, thus, decreasing opportunities for metacognitive awareness and critical thinking. Overall, students valued AI as easy to use and transparent but also as having the power to invert traditional literacy practices. Ambivalence reflects motivational value and intellectual risk in reading with AI support and once again suggests the need for reflective pedagogical scaffolding to align efficaciousness and deep learning.

Table 2. Summary of Student Attitudes toward AI in Reading Instruction

Theme	% of Students	Illustrative Comment
Preference for AI feedback	68%	"AI makes reading tasks easier to follow."
Efficiency and time-saving	54%	"Summaries save time when texts are long."
Motivation and confidence	46%	"I feel more motivated to read with AI help."
Shallow reading habits	39%	"I don't read hard texts as carefully when AI gives me a summary."

Teacher Feedback

Qualitative content analysis of the findings from teacher responses revealed widespread anxiety regarding the pedagogical consequences of integrating AI. Almost 90% of the teachers were concerned about losing valuable "teachable moments", specifically, those related to error correction, questioning probe thinking, and the unscripted critical discussion characteristic of the act of reading instruction. Most stressed that while AI feedback was effective, it tended to overlook the possibility of students being able to look back at their errors and participate in more in-depth class discussions.

The instructors also noted learner agency gaps, in which learners in AI-facilitated learning spaces were sometimes less accountable for learning. Instead of actively learning from mistakes or recalcitrant texts, the learners were prone to follow machine-led instructions. The instructors also noted the absence of depth in deep textual work, with reliance on AI possibly reinforcing surface learning over interpretive and critical skills.

In general, teacher talk raises the issue of the balance between the efficiency of AI support and the pedagogic merit of human interaction, suggesting that while AI can assist with literacy work, its use must be strictly controlled to preserve the important thinking and conversational elements of pedagogy.

Table 3. Summary of Teacher Feedback on AI in Reading Instruction

Theme	*% of Teachers*	*Illustrative Comment*
Loss of "teachable moments"	90%	"AI corrects errors quickly, but students miss the chance to reflect."
Reduced learner accountability	76%	"Students rely on AI guidance instead of taking responsibility."
Shallow textual engagement	71%	"AI support limits deeper discussions and interpretive analysis."
Efficiency in basic tasks	42%	"AI speeds up routine feedback, freeing time for other activities."

5. Discussion

The findings of this study provide rich evidence of the complex contribution of AI to literacy learning. On one hand, they point to substantial strengths in reading comprehension, but on the other hand, they pose deep questions concerning critical thinking, student agency, and pedagogical integrity. These are elaborated below.

5.1 Reading Comprehension Gains

The quantitative results indicated that the experimental group achieved 19.3% better on the DRP post-test than did the control group with an enormous effect size ($t = 4.72$, $p < 0.001$). This kind of significant improvement confirms Hypothesis 1, which states the effectiveness of AI-supported platforms in enhancing reading comprehension. This gain testifies to adaptive AI-based instruction having the capacity to cater to students' unique needs, as might not be the case with conventional approaches. The system's ability to adjust to students' performance in real time enabled scaffolding and immediate feedback, thereby assisting learners in resolving misconceptions in one go and focusing on meaning rather than being overwhelmed by decoding or interpretation.

The qualitative data also confirmed this trend. Sixty-eight percent of the students preferred AI-generated feedback and summarization, describing it as faster, more transparent, and more stimulating than teacher explanations. The students provided feedback indicating that AI support reduced the complexity of lengthy texts and encouraged them to attempt more reading assignments, particularly those perceived as challenging. The motivational effect suggests that not only is AI capable of improving understanding performance, but it also raises the willingness to work with texts. Teachers also noted benefits: 42% agreed that AI made feedback tasks more effective when they were routine, thus freeing more teaching time for other teaching processes. Together, these findings are supported by prior work (such as Hidayat, 2024) illustrating that AI enhances learning by reducing cognitive load and providing individualized scaffolding.

5.2 Shortage of Critical Thinking and Cognitive Offloading

While reading comprehension can be quantified as enhanced, regression analysis also confirmed that with each additional use of AI tools by 10, a 2.1% reduction in critical thinking was observed ($\beta = -0.21$, $p = 0.03$). Therefore, Hypothesis 2 is confirmed, and the finding is that there is a cognitive cost wherein the advantage is harvested by using AI. Offloading higher-order cognitive processes onto a machine or cognitive offloading is a real risk. As better task handling for comprehension is obtained, the chances for close reading, personal analysis, and interpretive interaction are reduced.

Qualitative responses strongly supported this trend. Thirty-nine percent of the students acknowledged that when using AI, they read challenging passages less attentively and relied on summaries generated by AI. Some acknowledged less active participation in building a personal sense or questioning the text, despite understanding "felt easier". Teachers were even more candid: 90% worried about losing "teachable moments", understood-in-the-moment possibilities for questioning student thinking, correcting misconceptions, and encouraging critical dialogue. Seventy-one percent of the educators also identified superficial textual engagement, noting that students relied on the "ready answers" of AI instead of struggling with interpretive difficulties. These findings support Dewi's (2024) finding that excessive reliance on AI threatens to collapse independent reasoning and rich literacy practices.

Hence, although AI software necessarily facilitates understanding, it also reveals unanticipated implications detrimental to the development of higher-order abilities. This tension is a warning to invoke a pedagogic remedy for fostering more reflective, metacognitive processing together with the utility of AI aid.

5.3 Student Agency and Accountability

Another key issue identified through the qualitative analysis was learner responsibility. Seventy-six percent of educators indicated that learners in AI-aided learning settings tended to become passive receivers of content instead of being proactive knowledge creators. Educators cited that when AI automatically corrected mistakes or offered direct answers, learners did not often take responsibility for recognizing, knowing, or learning from them. This indicates that AI inadvertently undermines learner agency the linchpin of enduring literacy acquisition.

This study aligns with self-regulation learning theories that confirm the implication that learners must regulate, reflect, and adapt their higher-order processes in a bid to become successful learners. When the AI becomes the controller of feedback and correction, this form of regulation becomes limited. Learners acquire short-term knowledge, but long-term gains in persistence, tenacity, and problem-solving capacity may erode. This finding is in line with the quantitative deterioration in critical thinking, and suggests that cognitive offloading and student responsibility are interlinked sides of the same overarching problem.

5.4 Balancing Benefits and Risks

Overall, these results provide ambivalent understanding. AI unequivocally improves knowledge, engagement, and sharpening of teaching qualities. However, overdependence threatens shallow reading and diminishes critical analysis and learner control. The ambiguity expressed by teachers and students alike mirrors this ambivalence: AI works well, is interactive, and is helpful but poisonous to deep reading and critical analysis as well.

This tension lies beneath Hypothesis 3, which premised that the adverse effects of AI could be avoided if its uptake is managed by teachers in a discretionary manner. Teachers remain centrally involved in the transmission of questioning skills, promoting thought and intellectual curiosity among students. Therefore, pedagogical integrity should be placed at the top of the agenda for AI uptake. The right ethical response would be to construct curricula so that AI helps with the tedium of routine drudgery but never substitutes for defining literacy practices such as close reading, thinking talk, and metacognitive asking.

6. Implications

The results indicate an urgent need for balanced adoption models that integrate AI's adaptive benefits without eroding the foundations of literacy and critical thinking. Three implications have emerged:

1. Pedagogical Scaffolding: Teachers should design lessons where AI provides efficiency (such as summarization, error correction) but are always paired with reflective exercises requiring students to question, critique, and analyze texts independently.

2. AI Literacy of Teachers: Teachers must be professionally trained to such an extent that they understand the potential and danger of AI tools and can utilize them in a moral and proper manner.

3. AI Equity and Ethics Problems: Developers and policymakers must be careful so that AI platforms are being developed in such a manner that it ensures equity, security of the students' data, and access regardless of socio-economic and cultural backgrounds.

Briefly, the study explains how AI can be a great facilitative means of reading and understanding, but perilous for intellectual freedom. Its utilization within the classroom should be so prudent that it does not fall into the trap of trusting technology as an alternative to deep learning.

7. Limitations of the Study

This study adds new knowledge to the literature on the effects of AI on metacognitive thought, critical thought, and reading; however, the research is limited. First, the intervention was only eight weeks long, which might be brief to quantify the long-term impact on critical thinking and reading capability. Although it is beginning in its impact on AI and students, having a longer intervention time will provide more accurate answers regarding its long-term impact on cognition.

Second, the population sample for the current study was limited to students pursuing undergraduate English language courses, which may be significant in terms of generalizing to other student populations. Various student groups based on academic discipline, age category, and course level may have different uses for AI tools. Future studies should include a more diverse sample.

Third, it does not account for students' levels of technological savvy. Students with different levels of digital literacy have different levels of experience with AI tools. More technically savvy students might potentially benefit greatly from the adaptive nature of AI, but others may pull them back. Additional research would have to determine whether it is experience-dependent to learn with AI regarding previous technology experience and whether AI technologies must change to fit varying levels of digital literacy.

Finally, the study did not consider differences among teachers. Teachers vary depending on their level of exposure to AI and how they would use it differently, which affects the performance of the AI tools. Future research could measure the extent to which teacher experience and teaching style affect the efficiency of AI-assisted reading instruction.

8. Pedagogical Implications

Although AI technologies provide numerous benefits in developing reading comprehension and motivation, educators must balance such innovations with conventional teaching practices. Overuse of AI risks devalues the merits of independent reading, critical thinking, and metacognitive reflection. As such, AI can supplement, but never substitute, conventional teaching practices. To duly harness the potential of AI to develop an independent reading and critical thinking, educators may employ the range of pedagogical strategies outlined below:

- ***Structured reflection activities:*** Written activities such as reflective diaries or group reflection engage students in reflecting more deeply on reading texts than AI feedback, enabling critical internalization and blocking reliance on AI summaries.
- ***Inquiry-based learning:*** Combining AI tools and inquiry pedagogies enables students to ask questions, assume different roles, and solve problems. AI can offer individualized content, and teachers can guide students through debates, Socratic seminars, and the unpacking of complex issues.
- ***Collaborative learning:*** AI can be used to offer individualized feedback to supplement collaborative learning activities aimed at critical thinking, peer discussion, and integration of information learned with the help of AI assistance.
- ***Metacognitive instruction****:* Instructors should instruct learners to manage and monitor their thinking processes using AI tools, such as pre-reading goal-setting and reconciling AI feedback with their own reflection in a bid to develop sensitivity to their learning strategies.
- ***Hybrid of instructor intervention and AI feedback:*** With AI providing instant feedback, active intervention of instructors becomes necessary for enabling learning processes, answering with personalized feedback, and supplementing the capabilities of AI support with human wisdom.

With these practices, AI will be an augmentation instead of an interference with effective teaching interaction and learning of reading proficiency, independence, critical thinking, and reflective capacity on the part of the students. These practices are utilized to maintain intellectual engagement while harvesting the advantages of individualized benefits from AI technology.

9. Future Research Directions

Given these limitations, future research could offer additional information regarding the contribution of AI to reading instruction:

- ***Longitudinal Studies:*** Longitudinal studies are necessary to examine the sustained impacts of AI on critical thinking, metacognitive skills, and reading over an extended period, assessing whether the benefits persist and whether any negative effects, such as cognitive offloading, become exaggerated with long-term use.
- **Diverse Populations:** Future studies should involve more diverse populations of students, such as K-12 students, students from diverse fields of study, and socio-economically

diverse students. This would inform us about the impact of AI technologies on multiple populations and whether specific populations are more or less helped by AI-based reading interventions.

- **Technological Competence and Flexibility*:*** Future research should investigate the extent to which students' experiences with AI technology support its efficacy. Research can examine how AI-based learning environments are made more flexible in supporting a variety of students' digital literacy skills and technological competence.
- **Instructor Training and Variation*:*** Investigating the effects of instructor training and AI literacy skills on how successfully AI tools can be applied in the classroom. Future studies should examine whether and how teacher training would allow for smoother incorporation of AI tools into practice teaching, and how and whether to do so, with complete access to AI-enhanced learning environments provided to all learners.
- **Objective Data Collection:** To minimize self-reporting bias, future research could utilize more objective methods of data collection, such as tracking students' activities on AI platforms or monitoring their classroom participation. This allowed to obtain a richer picture of the effects of AI tools on the cognitive participation and learning outcomes of students.

10. Conclusion

Artificial intelligence applications in reading instruction hold revolutionary promise for stimulating literacy attainment gains through adaptable, customized learning experiences. This study substantiates the argument that AI-enabled tools seriously enhance reading comprehension skills with differentiated support to address diverse learner needs. The above benefits present the prevailing set of difficult critical questions to be addressed with delicacy in avoiding intellectual hubris and superficiality of thought.

To chart this complex landscape, the pedagogical model in question makes calls for the balanced and reflective integration of AI into reading pedagogy. First, balanced adoption comes first; limiting interaction with AI to around three sessions a week avoids over-reliance and compels learners to remain engaged and independent readers of the texts. Second, metacognitive anchoring, a conscious connection between AI-provided summaries and student-composed analyses, fosters critical thinking and enables learners to seize control of meaning construction. Finally, there is a need for ongoing auditing of NLP programs and stock recommendation algorithms to identify and remove bias so that AI-based solutions can reach all students on an equal and unbiased platform.

Lastly, the promise of AI in teaching literacy does not hinge on a technical breakthrough but on the intentional design of human and machine collaboration. By integrating AI within educational activities that most squarely express critical thinking, moral awareness, and student autonomy, teachers can make AI a force for profound intellectual growth and not an omnipresent attendant.

11. Recommendations

To Educators

Design blended learning spaces where AI models enhance, rather than dilute, traditional pedagogical practices. In particular, AI-based systems are used to analyze 30–40% of formative tests, thereby creating a space for teachers to cultivate critical thinking, encourage in-depth discussions, and engage in one-on-one mentorship. Blended synergy encourages learners to receive adaptive feedback without sacrificing intellectual stimulation or metacognitive sensitivity.

To Policymakers

Teachers professional development must be invested in programming to generate pedagogical capacity and AI literacy. The HHH policy structure (Harnessing, Handling, and Humanizing AI) must be prioritized to allow teachers to critically assess AI tools, integrate them ethically into curricula, and teach digital resilience to students. Policy intervention is also needed to ensure equal access to AI tools for any kind of educational institution to prevent further exacerbating current achievement gaps. For Developers

AI systems were created with implicit critical thinking structures that guide learners to query, examine, and think deeply, rather than passively absorbing knowledge. Dynamic critical thinking and metacognitive questions are integrated into the AI feedback loops to encourage deep processing and intellectual independence. This approach was refined with transparency and equity in algorithmic design through periodic bias tests and close collaboration with educators to ensure AI functions align with pedagogical objectives.

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AI SUMMARIZATION TOOLS' IMPACT ON MASTER II LITERATURE STUDENTS' READING AND CRITICAL ANALYSIS

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ABSTRACT

This chapter examines the impact of AI summarization tools like ChatGPT and QuillBot on reading habits and critical engagement among 43 Master II literature students at the University of 8 May 1945, Guelma, Algeria, during dissertation research. Employing a mixed-methods design—questionnaires and semi-structured interviews with five students—it assesses AI usage frequency, contexts, and perceptions, emphasizing effects on reading depth, critical thinking, and dissertation quality. Results show 65% of students, especially those aged 20-24, rely on AI for time management and secondary source processing, with ChatGPT favoured (23.3%). Tools boost efficiency (mean: 3.79) and theme identification (mean: 3.77) but are rarely applied to primary texts (mean: 2.29) to maintain analytical rigor. Strong verification habits (42% always cross-check) and endorsement of guided integration (56%) indicate a balanced strategy. Although AI alleviates cognitive load, it may promote intellectual passivity and shallow analyses. The study calls for curricula cultivating a biliterate reading brain, thoughtfully blending AI with deep reading to sustain reflective scholarship and original literary insight.

KEYWORDS: *AI Summarization Tools, Reading Habits, Critical Thinking, Dissertation Research, Biliterate Reading.*

1. Introduction

Master II students at institutions like the University of 8 May 1945, Guelma-Algeria, face challenges in dissertation writing, requiring deep engagement with complex literary texts to analyze themes, narrative structures, and cultural contexts. This fosters critical thinking, reflection, imagination, and empathy—skills nurtured by deep reading (Wolf, 2018). However, AI-driven summarization tools like ChatGPT, QuillBot, and Grammarly transform literary scholarship by providing efficient access to condensed texts, raising concerns about their impact on traditional practices (Mangen & van der Weel, 2016). Deep reading, defined as slow, reflective engagement (Baron, 2021), is vital for nuanced analysis, but AI tools create tension between efficiency and reflective scholarship needed for original work. Vygotsky's (1978) sociocultural theory suggests higher-order thinking develops through social mediation, yet AI summaries may bypass this, producing static responses. Cognitive load theory (Sweller, 1988) indicates AI reduces extraneous cognitive load but may hinder schema construction essential for deep learning, aligning with concerns about digital tools fostering shallow interactions (Baron, 2021; Birkerts, 1994).

This study investigates AI summarization tools' impact on literary practices, hypothesizing that while they ease cognitive demands, they may undermine reflective processes crucial for dissertation writing. It aims to address a novel gap in postcolonial educational contexts by exploring: (1) To what extent do Master II literature students in a postcolonial Algerian context employ AI summarization tools during dissertation phases, and how does this vary by text type (primary vs. secondary)? (2) How do these students perceive AI's role in modulating their deep reading practices and fostering or impeding critical interpretive skills unique to literary analysis? (3) In what ways does AI integration affect the authenticity and profundity of thematic and theoretical interpretations in their dissertations? (4) What tailored pedagogical interventions can cultivate a hybrid literacy ecosystem that leverages AI efficiencies while safeguarding the reflective essence of literary scholarship? These questions address a gap in understanding AI's role in literary education, advocating for a "biliterate reading brain" that balances digital efficiency with print-based depth (Wolf, 2018; Baron, 2021). Using a mixed-methods approach, combining questionnaires and semi-structured interviews, this research seeks to provide evidence-based insights for curriculum design, ensuring AI complements rather than replaces reflective literary scholarship.

2. Literature Review

The integration of artificial intelligence (AI) in education has revolutionized teaching and learning processes by enhancing accessibility, personalization, and efficiency. AI tools, such as summarization algorithms, adaptive learning platforms, and natural language processing systems, enable educators to tailor content to individual needs while providing students with instant feedback and resources. In the context of literary analysis, AI applications like text summarizers and analytical software assist in processing complex texts, identifying themes, and generating insights, potentially streamlining research for advanced students. However, this raises concerns about over-reliance, which may undermine deep engagement and original thinking, particularly in dissertation-level work where critical interpretation is paramount. This review explores theoretical foundations and empirical evidence to examine these dynamics. Recent scholarship on generative AI (GenAI) technologies, such as ChatGPT, further illuminates these tensions, revealing students' enthusiasm for AI's role in supporting personalized learning and writing while highlighting risks to critical thinking and ethical academic practices (Chan & Hu, 2023). Studies like Crompton and Burke (2023) synthesize the state of AI in higher education, emphasizing its potential to foster self-directed learning but underscoring the need for ethical guidelines to mitigate over-dependence.

2.1. Constructivist Learning Theory and Deep Reading in Literature

Vygotsky's (1978) sociocultural theory posits that higher psychological functions, shaped by cultural and social interactions, first emerge interpsychologically through social exchanges before becoming intrapsychological within the individual (p. 57). He emphasizes tools like language and signs as critical for knowledge construction, noting that the convergence of speech and practical activity marks a key moment in intellectual development (p. 24). This framework highlights the role of social interactions in education, fostering cognitive growth through collaborative and culturally mediated experiences. Complementing this, Piaget's (2001) constructivist theory views cognitive development as an active process of knowledge construction through assimilation and accommodation, describing intelligence as an adaptive organization that structures the universe (p. 4; original work published 1947). In literary studies, this supports deep reading, where readers infer, reflect, and synthesize to uncover complex meanings, adapting prior knowledge to new contexts for original interpretations.

Recent applications of these theories in AI contexts, such as Chan and Hu (2023), underscore how constructivist principles can guide AI integration to enhance rather than supplant social mediation in higher education, particularly for fostering interpretive depth in multicultural literary curricula. Vygotsky's (1978) Zone of Proximal Development (ZPD), defined as the gap between independent and guided capabilities (p. 86), facilitates the transformation of external textual interactions into internal critical insights, crucial for deep reading. Learning within the ZPD awakens developmental processes through social and cooperative engagement (p. 90). Together, these constructivist frameworks emphasize social mediation and active engagement in literary education, enabling reflective and analytical skills for nuanced literary scholarship. GenAI tools align with constructivist principles by acting as virtual tutors within the ZPD, offering immediate, personalized feedback to scaffold deep reading and interpretation (Chan & Hu, 2023). For instance, generative AI models like ChatGPT can serve as virtual tutors that answer students' questions and provide explanations across a wide range of subjects, which is particularly useful for learners struggling with complex concepts outside the classroom and aligns with ZPD scaffolding to transform external interactions into internal insights (Baidoo-Anu & Owusu-Ansah, 2023, p. 58). However, without guided integration, they may disrupt intrapsychological development by encouraging passive assimilation over active synthesis, defaulting to an AI-directed paradigm influenced by behaviorism where learners act as passive recipients of AI services rather than active collaborators in cognitive and social constructivist processes (Adiguzel et al., 2023, p. 5).

2.2. Cognitive Load Theory and the Role of AI Summarization Tools

Sweller's (1988) cognitive load theory suggests that complex tasks like problem-solving can overwhelm cognitive capacity, limiting schema acquisition even when tasks are completed (p. 261). Strategies such as means-ends analysis increase cognitive load, prioritizing goal attainment over knowledge construction, potentially hindering learning (p. 283). This indicates that problem-solving and schema-building processes are often distinct and sometimes incompatible (p. 284). Effective cognitive load management is critical in educational settings, especially with new technologies.

AI summarization tools and digital platforms reduce extraneous cognitive load by delivering condensed content, improving efficiency and accessibility. Mangen and van der Weel (2016) highlight that digital reading technologies offer unique affordances compared to paper, necessitating research into their impact on reading for different purposes (p. 116). While AI tools streamline information processing, they risk promoting superficial engagement if not carefully implemented. Thoughtful integration is essential to ensure these tools support deep learning and schema acquisition without undermining educational outcomes (p. 116). In literary contexts, GenAI summarizers can offload initial text processing to free cognitive resources for higher-order analysis, such as theme identification, but students report concerns that this may erode schema-building for original insights (Chan & Hu, 2023; Warschauer et al., 2023). This

aligns with findings that generative AI automates routine tasks, such as exam creation, reducing the time educators spend on administrative burdens from 30 hours to 15 hours per task and freeing cognitive resources for higher-order pedagogical activities like student interaction (Baidoo-Anu & Owusu-Ansah, 2023, p. 58).

2.3. Prior Studies on Technology's Impact on Reading Habits and Critical Thinking

Prior studies have explored technology's impact on reading habits and critical thinking, revealing both advantages and challenges. Clinton (2019) conducted a meta-analysis showing a modest advantage for print over screens in reading comprehension, particularly for tasks requiring deeper analysis, with stronger effects for adults than children. Similarly, Delgado et al. (2018) found a small but consistent print advantage, especially under time constraints and for informational or mixed-genre texts, supporting the "shallowing hypothesis" that digital environments foster superficial processing, impairing critical interpretation of complex content. Mangen et al. (2013) demonstrated that paper readers outperformed screen readers in comprehension, attributing this to navigational challenges like scrolling, which disrupt spatial text representation and metacognitive monitoring essential for inference.

On the positive side, Singer and Alexander (2017) noted that undergraduates often prefer digital reading for accessibility and familiarity, with most owning digital devices and accessing texts daily. However, print still yielded better comprehension for detailed questions, despite students' overconfidence in digital performance, suggesting calibration issues that may hinder reflective habits. Li and Yan (2024) found no overall comprehension difference between digital and paper reading but highlighted context-specific effects: print advantages for university students, informational texts, longer texts, and time-constrained settings, while digital excelled for literary texts, younger readers, self-paced reading, and interactive formats with tools like note-taking. These findings underscore digital's potential to enhance motivation and access for narrative content, while print supports deeper processing in demanding scenarios. Extending this to GenAI, Chan and Hu (2023) surveyed university students, finding high willingness to use tools like ChatGPT for personalized literary support—such as brainstorming themes or generating hypotheses from texts—but persistent concerns over accuracy, plagiarism, and diminished critical thinking, echoing the shallowing hypothesis in AI contexts. Similarly, in a mixed-methods study of 60 Chinese college EFL students, Deng (2024) examined the impact of ChatGPT-generated summaries on reading comprehension, finding that while these summaries significantly supported basic comprehension (e.g., main ideas and details) compared to full-text reading, they were less effective for deeper inferential understanding, as evidenced by lower performance on inferential questions and student perceptions of occasional lacks in detail and comprehensiveness. Also, Sumakul et al. (2022, p. 54) reported positive perceptions of AI in writing classes for idea generation, where the Plot Generator app assisted EFL students in developing story ideas, overcoming writer's block, and structuring narratives with elements like hooks and plot twists, yet noted risks to originality in literary analysis, as generated stories often produced incoherent or repetitive patterns that merely rephrased inputs without true innovation (p. 55), while Gayed et al. (2022) showed AI writing assistants boosted engagement for English language learners but required scaffolding to avoid over-reliance on generated content. In a counter-balanced experiment with 10 Japanese adult EFL students, Gayed et al. (2022) evaluated AI KAKU, an AI-based writing assistant using GPT-2-driven word suggestions and reverse translation to ease cognitive load in L2 writing (pp. 1–2). Results showed no significant gains in lexical diversity or production rate but a notable increase in syntactic complexity (pp. 5–6), indicating improved fluency for complex ideas. Participants viewed the tool positively for ease of use (M = 5.5/6; 95% affirmative), though minimal suggestion use underscored the value of additional training to enhance engagement (pp. 5–6). In educational applications, generative AI like ChatGPT supports interactive learning by enabling conversational virtual tutors that adapt to learners' needs, potentially enhancing critical thinking through real-time feedback, though this benefit is tempered by risks of over-reliance that could shallow analytical depth (Baidoo-Anu & Owusu-Ansah, 2023, pp. 55-56). Deng (2024)

further aligns with this by grounding findings in cognitive load theory, suggesting AI summaries aid EFL learners in managing cognitive resources for non-native texts but may limit higher-order skills without supplementary engagement.

A recurring concern is multitasking, which Baron (2015) links to reduced reading depth and cognitive efficiency. Neuroimaging and behavioral data suggest multitasking strains the brain's processing capacity, shifting reliance from flexible critical thinking to habitual processing. Studies show multitasking during reading, common among adolescents, leads to factual recall loss, with cross-cultural surveys indicating most students concentrate better with print yet frequently multitask on screens, driven by novelty-seeking. This aligns with the "shallowing hypothesis," as multitasking fosters overconfidence and inattentional blindness, undermining literary analysis.

Digital environments, including AI summaries, further influence reading processes. Deep reading, crucial for critical thinking and empathy, is often disrupted by screens that promote skimming. Singer and Alexander (2017) noted technology's motivational benefits but highlighted its disruption of detailed processing. Mangen et al. (2013) emphasized that screen reading impairs metacognitive monitoring due to the intangibility of digital texts. Clinton (2019) found no consistent differences in reading time by medium, suggesting print's efficiency for sustained engagement. Delgado et al. (2018) noted a growing screen inferiority over time, likely due to increased digital immersion fostering shallow habits. Li and Yan (2024) highlighted digital's potential for enriching sensory experiences when interactive, though Baron (2015) warned of risks like internet addiction, which impairs cognitive control, as seen in global trends and educational policy shifts.

Despite these insights, gaps persist, particularly for advanced literature students and dissertation contexts. Most studies (e.g., Clinton, 2019; Delgado et al., 2018; Li & Yan, 2024) focus on K-12 or undergraduate populations, with limited data on graduate-level effects, such as dissertation writers' use of AI for original interpretations or long-form critical thinking. Future research should explore device-specific effects, individual digital exposure, and interventions to counter multitasking's impact on reflective reading. Emerging calls emphasize AI literacy interventions to bridge these gaps, integrating GenAI ethically to support dissertation-level deep reading without compromising authenticity (Chan, 2023; Crompton & Burke, 2023).

3. Methodology

3.1. Method

The present research aims at exploring the reality behind using AI-driven summarization tools in literature dissertation work. This implies how Master II literature students use such tools in their reading and analytical processes. In this respect, we designed a descriptive case study of research with Master II students at the University of 8 May 1945, Guelma-Algeria.

3.2. Population and Sampling

The participants were Master II literature students at the University of 8 May 1945, Guelma-Algeria. Because it is difficult to conduct a study on the whole population, a sample has been selected. For the sample of students, we randomly selected 43 Master II students from the Department of English, who were actively engaged in dissertation writing. A random sampling technique is opted for in order to give the opportunity to each member of the population to be selected. Besides, Master II students are alleged to have an advanced level of literary competence as compared with lower levels, which saves us from the burden of focusing on basic literacy aspects. Therefore, we emphasise the impact of AI tools on their reading depth, critical engagement, and dissertation quality, instead. These students represent an ideal population due to their intensive engagement with complex literary texts and reliance on critical analysis,

making their experiences relevant to the study's objectives of examining AI's effects on reading habits and original interpretations.

3.3. Data Gathering Tools

Data were collected by means of students' questionnaires and semi-structured interviews.

3.3.1. Data Gathering Tools

We selected the questionnaire as the main method and tool of data collection because it requires little time to administer. Brown (1988) claims that "the questionnaire, therefore, is an easy and practical means of gathering data from a large population" (p. 3). Thus, it is a tool which is used in most of the research works because of its advantages in covering large-scale data, and in helping the researcher to collect unobservable data.

In this study, the questionnaire was addressed to 43 Master II students of English Literature at the University of 8 May 1945, Guelma-Algeria. It sought to obtain their opinions about the use of AI-driven summarization tools (e.g., ChatGPT, QuillBot), and to probe into their role in improving efficiency, supporting critical thinking, and affecting dissertation quality. The questionnaire follows a mixed-methods approach, combining quantitative and qualitative data as outlined by Creswell and Poth (2018). It consists of sixteen questions that are divided into five sections. Section 1 seeks general information with three questions devoted to age group, enrollment duration, and dissertation focus, while Sections 2–5 focus on collecting the needed information concerning the frequency and context of AI tool usage, perceptions of impact on reading habits and critical thinking, effects on dissertation quality, and pedagogical preferences (See Appendix A). In this research work, we used close-ended questions, multiple choice questions, and Likert-scale items alongside open-ended questions.

3.3.2. Data Gathering Tools

Semi-structured interviews were conducted as another data collection tool. The interviews are intended to discover students' nuanced experiences with AI-driven summarization tools as a supporting aid in their dissertation research. The interview questions followed the same objectives of the survey study, exploring aspects such as reading habit evolution, intellectual passivity versus efficiency, critical thinking and originality, trade-offs, and pedagogical needs. The interviews consist of six main open-ended questions with probes for depth (See Appendix B), lasting 30–45 minutes each, and were conducted with 5 purposively selected participants from the questionnaire respondents to ensure diverse perspectives on AI usage.

4. Results and Analysis

The data obtained through the survey were analysed quantitatively using the descriptive analyses of the Statistical Package for Social Sciences (SPSS 31 programme). However, the open-ended questions are interpretively discussed.

4.1. Analysis of the Questionnaire

The present research aims at exploring the reality behind using AI-driven summarization tools in literature dissertation work. This implies how Master II literature students use such tools in their reading and analytical processes. In this respect, we designed a descriptive case study of research with Master II students at the University of 8 May 1945, Guelma-Algeria.

4.1.1. Section One: Demographic and Academic Background

		What is your age group?			
		20–24	25–29	30 or older	Total
What is the primary focus of your dissertation? (e.g., specific literary period, author, theme, or theoretical framework)	Author	1	0	0	1
	Literary Period	2	1	1	4
	Theme	5	13	6	24
	Theoretical framework	3	1	1	5
	Theoretical Framework	0	1	2	3
	Theoretical Framework.	0	0	1	1
	Theoritical Framework	3	1	1	5
Total		14	17	12	43

Table 1. Q1, and Q3: Participants' age group and dissertation primary focus.

The table above reveals the distribution of participants across three age groups within the selected sample. The majority of the students, accounting for approximately 72% (31 out of 43), fall within the 20-29 age range, with 14 individuals aged 20-24 and 17 aged 25-29. The second largest group, representing about 28% (12 out of 43), consists of participants aged 30 or older. Notably, all participants have completed their master's degrees and successfully finished their dissertation writing. Regarding the primary focus of their dissertations, the data indicates a strong emphasis on "Theme" (24 participants), followed by "Theoretical Framework" (15 participants across multiple categories), "Literary Period" (4 participants), and "Author" (1 participant). This suggests a diverse range of academic interests, with a predominant focus on thematic and theoretical aspects among the participants. This diversity aligns with Vygotsky's (1978) sociocultural theory, which emphasizes how varied social and cultural contexts, such as thematic or theoretical explorations, shape higher-order thinking through collaborative engagement with texts (p. 57).

4.1.2. Section Two: Frequency and Context of AI Tool Usage

		What is your age group?		
		20–24	25–29	30 or older
Do you use AI-driven summarization tools (e.g., chatbots, summarization apps, or platforms like ChatGPT, QuillBot, or others) for your dissertation research?	No, (If No, skip to Section 3)	1	6	8
	Yes	13	11	4
Total		14	17	12

Table 2. Q4: Do you use AI-driven summarization tools for your dissertation research?

The table illustrates the distribution of participants across three age groups regarding their use of AI-driven summarization tools for dissertation research, designed to compare these preferences across age cohorts. The sample includes 14 participants aged 20-24, 17 aged 25-29, and 12 aged 30 or older, with all having completed their master's degrees. Among these, 28 participants reported using tools like ChatGPT or QuillBot, while 15 did not. Specifically, the 20-24 age group shows 13 users and 1 non-user, the 25-29 group has 11 users and 6 non-users, and the 30 or older group includes 4 users and 8 non-users. This pattern suggests a higher adoption rate among younger participants, with usage decreasing as age increases. This trend may reflect the limited availability and cultural acceptance of AI tools during the academic journeys of older

graduates, who likely encountered fewer opportunities to integrate such technology into their research, making their lower usage rates understandable given the historical context. This generational shift supports Mangen and van der Weel's (2016) observation that digital substrates have become social staples in education, particularly among younger learners accustomed to their affordances (p. 116).

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid		10	23,3	23,3	23,3
	ChatGPT	9	20,9	20,9	44,2
	ChatGPT, Grammarly	2	4,7	4,7	48,8
	ChatGPT, QuillBot	5	11,6	11,6	60,5
	ChatGPT, QuillBot, Grammarly	4	9,3	9,3	69,8
	ChatGPT, QuillBot, Grammarly, Scispace	1	2,3	2,3	72,1
	Deepseek	1	2,3	2,3	74,4
	Grammarly	4	9,3	9,3	83,7
	I used my own summarization skills that time . I never used summarization tools .	1	2,3	2,3	86,0
	QuillBot	5	11,6	11,6	97,7
	QuillBot, Deepseek	1	2,3	2,3	100,0
	Total	43	100,0	100,0	

Table 3. Q5: Which AI-driven summarization tools do you use?

The table presents the frequency and percentage of AI-driven summarization tools used by 43 participants for their dissertation research. The data indicates that ChatGPT is the most utilized tool, with 10 participants (23.3%), followed closely by ChatGPT with Grammarly at 9 participants (20.9%). Combinations such as ChatGPT, QuillBot at 5 participants (11.6%), and QuillBot alone at 5 participants (11.6%) also show notable usage. Other tools like Deepseek and Grammarly individually, or in combination with others (e.g., ChatGPT, QuillBot, Grammarly, Scispace), were used by 1 to 4 participants each, ranging from 2.3% to 9.3%. Interestingly, 1 participant (2.3%) relied solely on their own summarization skills, avoiding AI tools entirely. All participants have completed their master's degrees. This distribution highlights a strong preference for ChatGPT-based tools, possibly due to their accessibility and effectiveness, while the minimal use of personal skills suggests a widespread adoption of AI technology among the group. This preference for accessible digital tools aligns with Mangen and van der Weel's (2016) argument that digital reading platforms offer flexibility in accessing resources, reshaping traditional reading practices (p. 116).

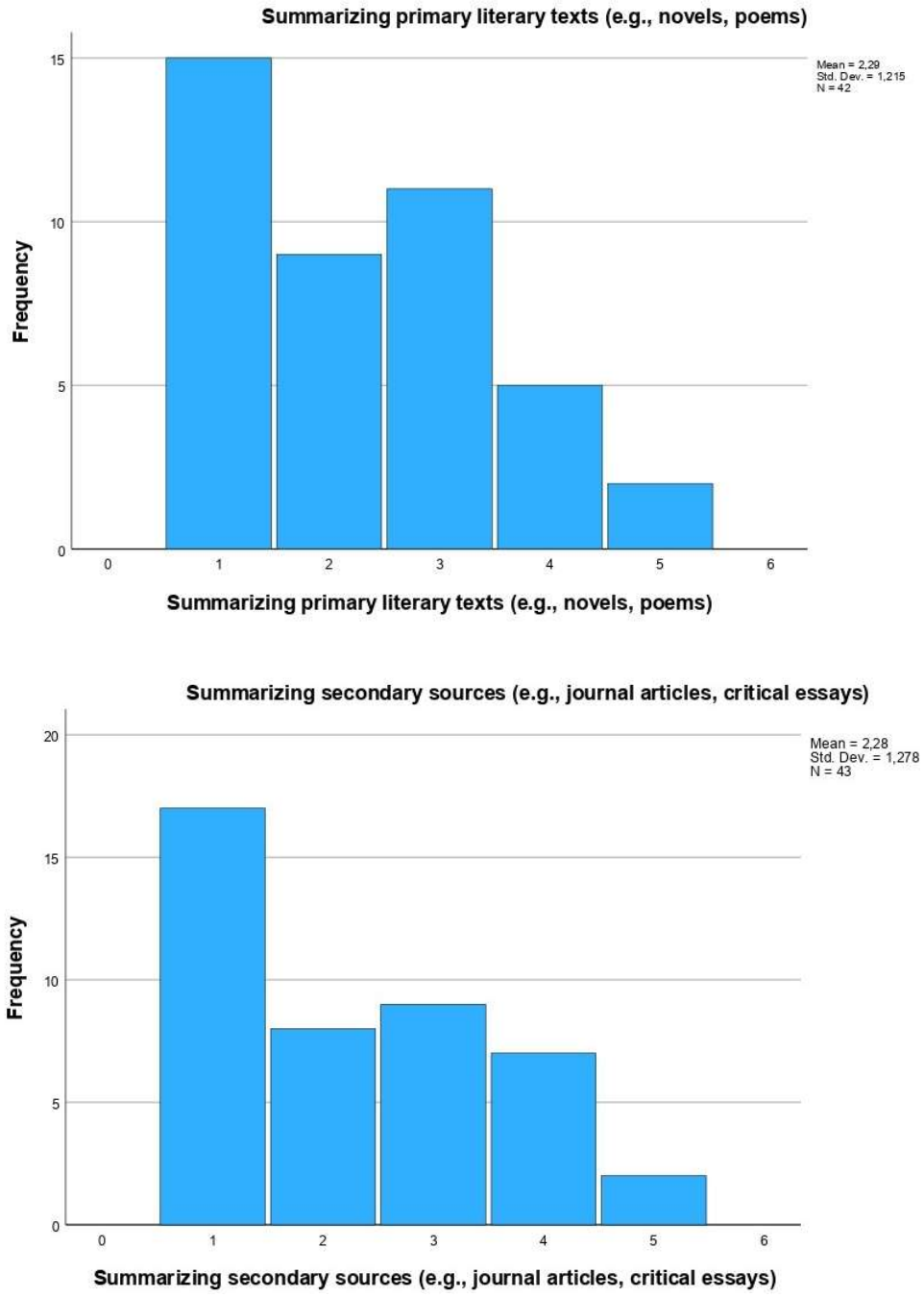


Figure 1. Q6: How often do you use AI summarization tools for the following purposes?

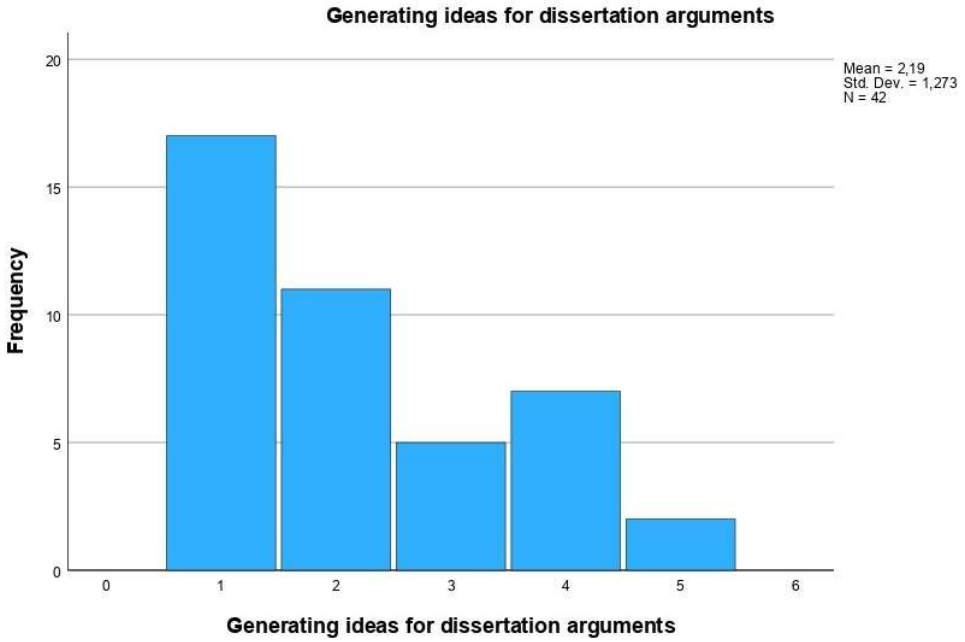
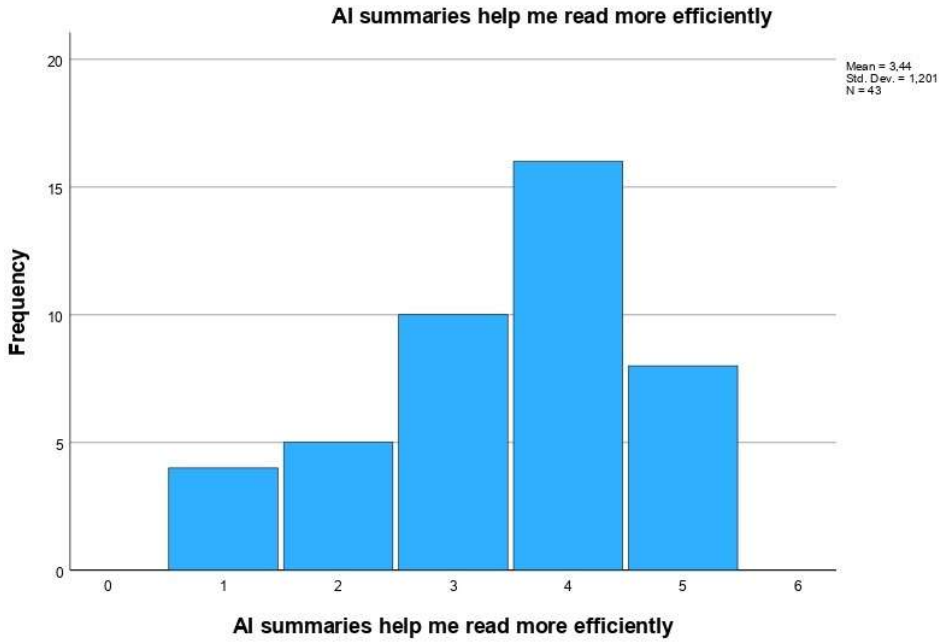


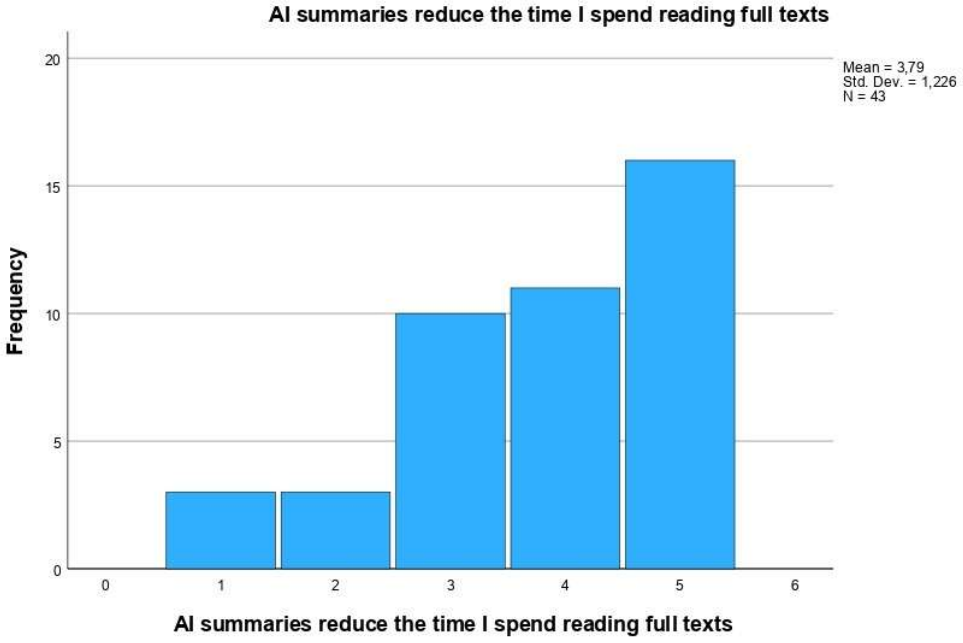
Figure 1. Q7: In what contexts do you use AI summarization tools?

The histograms depict the frequency of AI summarization tool usage among 43 master's graduates for four dissertation tasks. Summarizing primary texts (e.g., novels, poems) shows a right-skewed distribution, peaking at "Never" (15 participants), with a mean of 2.29 (SD 1.215, 42 responses). Summarizing secondary sources (e.g., journal articles) also peaks at "Never" (17 participants), with a mean of 2.28 (SD 1.278). Idea generation for arguments follows a similar trend, peaking at "Never" (17 participants), with a mean of 2.19 (SD 1.273, 42 responses). Paraphrasing shows a more balanced pattern, with peaks at "Sometimes" and "Often" (both ~11), and the highest mean of 2.93 (SD 1.404). AI tools are underutilized for analytical tasks but see higher use for paraphrasing, aligning with Sweller's (1988) cognitive load theory, where AI reduces extraneous load for manageable tasks but is less used for schema-building activities like deep analysis (p. 283). Wolf (2018) notes limited engagement with primary texts risks undermining deep reading (p. 122).

The 43 participants cited efficiency and practical needs as primary contexts for using AI summarization tools. Common reasons include managing time constraints, processing large volumes of secondary literature, and overcoming language barriers. Responses like "To quickly understand complex texts, To manage time constraints, To process large volumes of secondary literature" highlight streamlined synthesis. Strategic uses, such as verifying relevance ("To find whether the text talks about the idea I need"), were noted, alongside minor mentions of avoiding plagiarism. Some resisted AI use, preferring traditional methods. These patterns support Sweller's (1988) view that AI mitigates extraneous load (p. 261) and align with Mangen and van der Weel's (2016) call to examine digital tools' impact on reading purposes (p. 116).

4.1.3. Section Three: Perceptions of AI Summaries' Impact on Reading and Critical Thinking





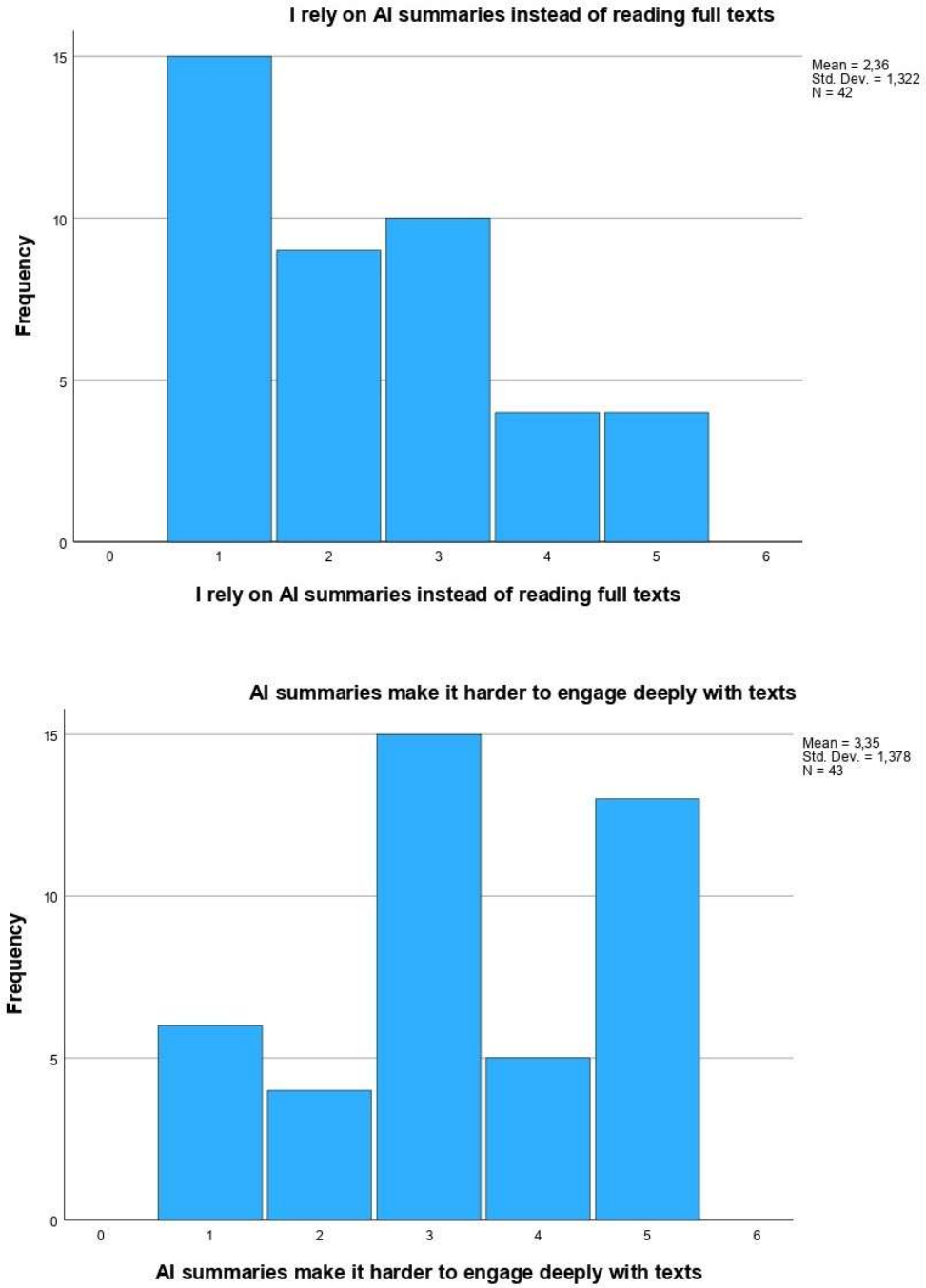
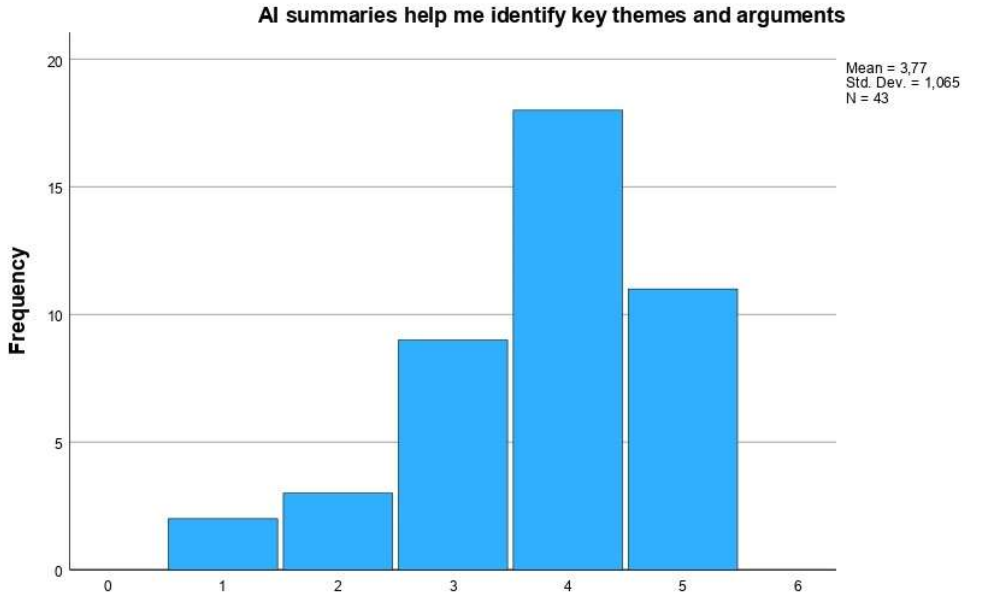
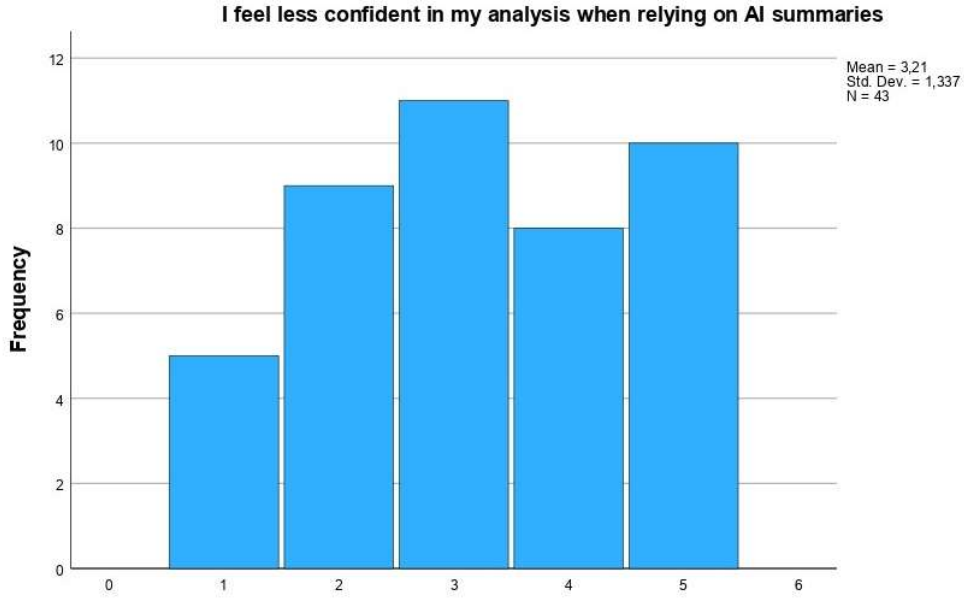


Figure 2. Q8: How do you perceive the impact of AI summarization tools on your reading habits?

Histograms based on a Likert scale (1=Strongly Disagree, 5=Strongly Agree) show perceptions of AI summaries' effects. For "AI summaries help me read more efficiently," responses skew left, peaking at Agree (~16), with a mean of 3.44 (SD 1.201). "AI summaries reduce time spent reading full texts" peaks at Strongly Agree (~16), with a mean of 3.79 (SD 1.226). "I rely on AI summaries instead of full texts" peaks at Strongly Disagree (~15), with a mean of 2.36 (SD 1.322, 42 responses). "AI summaries make it harder to engage deeply with texts" shows a bimodal pattern, peaking at Neutral (~15) and Strongly Agree (~13), with a mean of 3.35 (SD 1.378). AI is valued for efficiency but raises concerns about deep engagement, aligning with Baron's (2021)

paradox of efficiency versus shallow interaction (p. 260) and Wolf's (2018) warning about eroded contemplative capacities (p. 122).





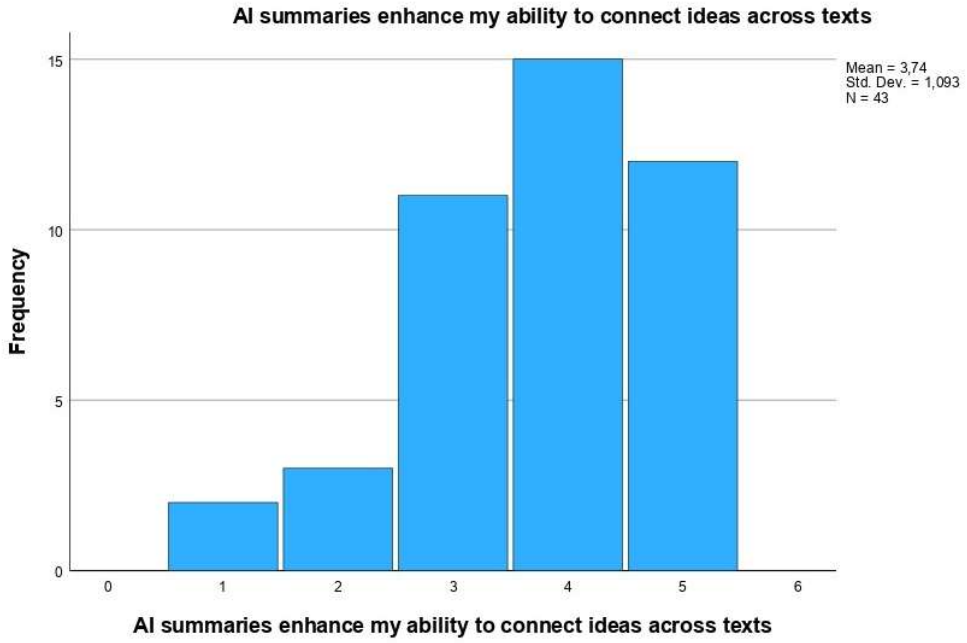


Figure 3. Q9: How do AI summarization tools affect your critical thinking and analysis?

For "AI summaries help identify key themes and arguments," responses skew left, peaking at Agree (~18), with a mean of 3.77 (SD 1.065). "I feel less confident in my analysis when relying on AI summaries" shows a balanced pattern, peaking at Neutral (~11), with a mean of 3.21 (SD 1.337). "AI summaries enhance my ability to connect ideas across texts" peaks at Agree (~15), with a mean of 3.74 (SD 1.093). AI supports theme identification but evokes mixed confidence, reflecting Vygotsky's (1978) theory that bypassing deep interaction may limit knowledge internalization (p. 69) and Sweller's (1988) view that AI reduces extraneous load but may impede germane load for original analysis (p. 284).

Q10: Describe how AI summarization tools have influenced your approach to reading and analyzing literary texts for your dissertation

Responses highlight AI tools' role in enhancing speed and accessibility, with comments like "AI summarization tools helped me grasp key ideas quickly, allowing focus on critical analysis." Time management is key, though some note quality trade-offs, e.g., "I used ChatGPT to summarize articles due to time issues, but the chapter felt weaker." Many emphasize using AI as a supplement, with remarks like "I used them as guides, not replacements for close reading." Concerns include oversimplification, especially for poetry, and reduced creativity, as in "It doesn't leave room for personal interpretation." Non-users cite traditional methods or historical context. AI aids efficiency but requires oversight to maintain analytical integrity, resonating with Wolf's (2018) concerns about eroded deep reading (p. 122) and Baron's (2021) note on ephemeral digital texts (p. 264).

4.1.4. Section Four: Impact on Dissertation Quality

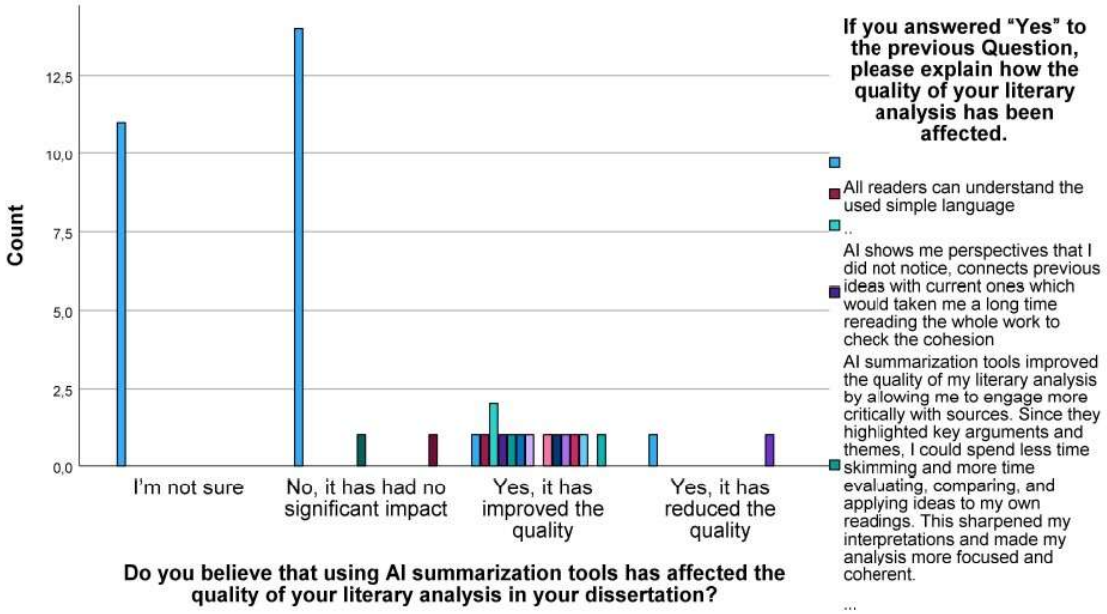


Figure 4. Q11 and Q12. Do you believe that using AI summarization tools has affected the quality of your literary analysis in your dissertation? If you answered "Yes" to Question 11, please explain how the quality of your literary analysis has been affected

Among 28 master's graduates who used AI summarization tools, a bar chart shows ~12 reporting "No significant impact" on their literary analysis quality, ~10 selecting "I'm not sure," ~5 noting "Improved quality," and ~1 indicating "Reduced quality," reflecting a largely neutral-to-uncertain stance. Positive responses highlight enhanced efficiency and focus, with one stating, "AI summarization improved my analysis by highlighting key arguments, allowing more time for critical evaluation and coherent interpretations," aligning with Sweller's (1988) theory that AI reduces extraneous cognitive load (p. 283). Negative views, though rare, cite reduced depth, particularly for primary texts like poetry, with one noting AI's oversimplification risked missing nuances, echoing Wolf's (2018) concern that deep reading, essential for critical engagement, may be compromised (p. 5). Uncertainty among many suggests AI's supplementary role, used cautiously to balance efficiency with traditional methods, though concerns about creativity align with Vygotsky's (1978) view that bypassing direct textual interaction may limit dynamic knowledge internalization (p. 69), and Baron's (2021) note on digital tools' ephemeral nature reducing analytical depth (p. 264).

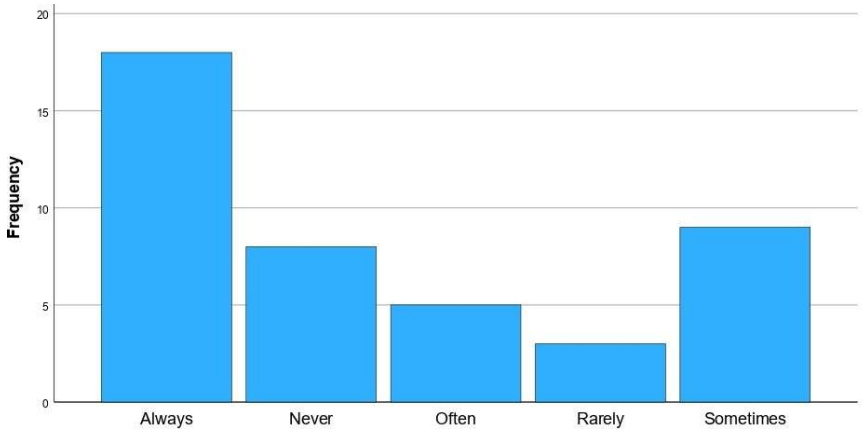


Figure 5. Q13: How often do you cross-check AI-generated summaries with the original texts to ensure accuracy?

The bar chart depicts the self-reported verification habits of the 43 participants—all of whom have completed their master's degrees and dissertation writing—when using AI-generated summaries, categorized on a scale from "Never" to "Always." It features the tallest bar at "Always" (approximately 18 participants), signifying a substantial commitment to thorough checking among over 40% of the group. This is followed by a notable bar at "Sometimes" (around 9), and a similar height at "Never" (near 8), highlighting a divide between consistent verifiers and those who bypass this step. Lower bars appear at "Often" (about 5) and "Rarely" (roughly 3), suggesting moderate engagement in occasional verification. Overall, the visualization indicates a predominant practice of regular cross-checking to maintain accuracy, though a minority opts out entirely, reflecting varied levels of trust in AI outputs within literary analysis workflows. This verification practice supports Baron's (2021) call for active engagement strategies, such as annotation, to counteract digital mindsets and ensure critical analysis, preserving the depth required for literary scholarship (p. 251).

4.1.5. Section Five: Pedagogical Preferences and Suggestions

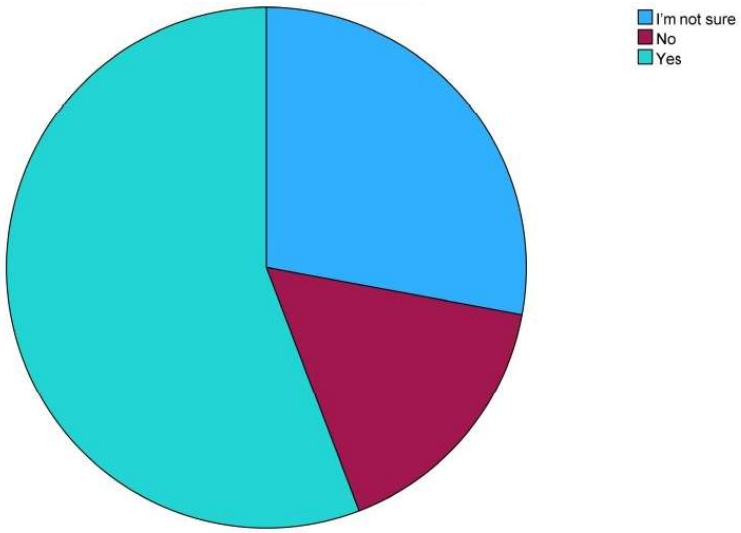


Figure 6. Q14: Would you support the integration of AI summarization tools into your literature curriculum if guided by instructors?

The pie chart represents the opinions of the 43 participants—all master's graduates who have completed their dissertations—on supporting the guided integration of AI summarization tools into literature curricula, divided into three categories: "Yes," "I'm not sure," and "No." The largest segment, in teal and comprising approximately 56% of the pie, indicates strong affirmative support, suggesting a majority view these tools as potentially beneficial when instructor-led. A medium-sized light blue slice, accounting for about 28%, reflects uncertainty among a notable portion, possibly due to concerns over implementation or effects on traditional skills. The smallest maroon segment, at around 16%, denotes opposition, implying a minority resistance perhaps rooted in preferences for conventional methods or worries about over-reliance. This distribution overall highlights an openness to AI incorporation under guidance, with enthusiasm outweighing skepticism and indecision. This openness aligns with Baron's (2021) advocacy for a biliterate reading brain, capable of switching between digital and print mediums to balance efficiency with reflective depth, particularly under guided instruction (p. 251).

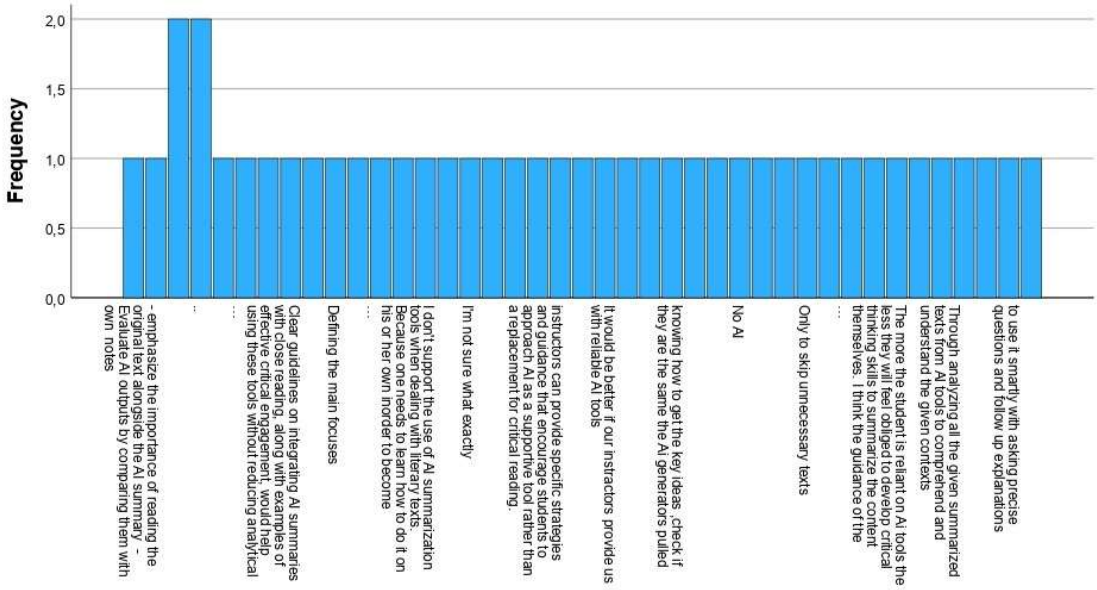


Figure 7. Q15: What strategies or guidance from instructors would help you use AI summarization tools more effectively while maintaining deep engagement with texts?

Responses from 43 master's graduates who completed dissertation writing reflect a balanced approach to using AI summarization tools while preserving critical engagement with literary texts. Key strategies emphasize cross-verification, with one participant noting, "Read the original text alongside AI summaries and compare with personal notes," highlighting AI as a supportive tool. Another suggests, "Summarization tools are a starting point, not the final destination, providing context and using multiple tools for diverse perspectives," advocating a multi-tool approach to avoid over-reliance. Ethical considerations are raised, with a response stating, "Ethical issues may go unnoticed by AI detection but not by self-awareness," stressing academic integrity. Structured guidance combines these ideas: "Use summarization tools for context, employ multiple tools for diversity, and maintain ethical mindfulness." These strategies align with Wolf's (2018) biliterate reading brain, switching between mediums to internalize knowledge through annotation and discussion (p. 126). Mangen and van der Weel (2016) support evaluating digital tools' effects to ensure they enhance, not replace, deep engagement (p. 116).

Q16: Do you have any additional comments or experiences regarding the use of AI tools in your dissertation research?

Participants valued AI for organizing ideas and outlining (~27.9%), but cautioned against dependency, which could hinder creativity and critical thinking. Comments like "AI may make our minds lazy" and "use it in restrictions" highlight the need for moderation and discernment. Strategic use, knowing when and where not to rely on AI, was emphasized for balanced dissertation writing. These insights align with Birkerts' (1994) warning against eroding deep attention (p. 18) and Wolf (2018) and Baron's (2021) call for a biliterate approach to preserve reflective scholarship (Wolf, p. 149; Baron, p. 250). Kuzmičová (2016) and Mangen and van der Weel (2016) further highlight the role of the reading environment, noting that digital platforms' dynamic representations may prioritize speed over depth, necessitating guided strategies to foster critical reflection (Mangen & van der Weel, p. 116).

4.2. Analysis of the Interview

The interview responses from five Master II literature students (Interviewees A, B, C, D, and E) provide nuanced insights into their approaches to reading complex texts, their selective use of AI summarization tools, and the tools' perceived impact on their dissertation research. These findings align with Vygotsky's (1978) sociocultural theory, which emphasizes that higher psychological functions, such as critical reading, are shaped through social and cultural interactions before becoming internalized (p. 57). The students' structured reading strategies and cautious integration of AI tools reflect a socially mediated process of knowledge construction, while Piaget's (2001) constructivist theory underscores their active engagement in adapting prior knowledge through assimilation and accommodation to interpret texts (p. 4). However, Sweller's (1988) cognitive load theory highlights potential tensions, as AI tools may reduce extraneous cognitive load but risk undermining the germane load needed for deep schema acquisition (p. 283). The analysis below integrates these frameworks to explore how AI tools influence reading practices and critical thinking.

Question 1: How do you typically approach reading complex texts for your dissertation?

Interviewee A: "I usually start by focusing on the key terms and main concepts. I take notes on the central ideas so I can organize them clearly. Rereading is also an important part of my process and not only when a section is hard to understand, but also to deepen my grasp of the argument and notice details I may have missed the first time."
Interviewee B: "I usually break the long paragraphs into small sentences and try to understand each sentence on its own. Sometimes I google the meaning or synonyms of the hard words for a deeper understanding. Moreover, I usually reread the section until it is clear and go to AI tools when necessary."
Interviewee C: "I usually start by reading the text slowly and taking notes. If I don't understand something, I reread the section. I also like to compare different sources to see how critics interpret the same passage. Writing down key ideas in my own words helps me remember and stay focused."
Interviewee D: "When reading complex texts related to my topic, I try first to skim it if it is a long text to see what parts of it are relevant to what I am looking for, then I focus on those parts by dissecting them into smaller pieces of information through taking notes and reformulating them using my own words. Sometimes I try to find the same information in different sources that might explain it in a simpler way or add to it."
Interviewee E: "For complex texts, I usually start by scanning the title, introduction, and conclusion, then I proceed with an online search to attempt to establish a solid foreground so that reading would not take time and effort to be absorbed." According to the above answers, all interviewees employ a structured approach to reading complex texts, incorporating note-taking, rereading, and, in some cases, external resources or skimming. This reflects a common strategy among Master II literature students to manage dense academic material effectively.

Question 2: Which AI tools (e.g., ChatGPT, Claude) do you use, if any, to assist with literary analysis or summarization?

Interviewee A: "I mainly use ChatGPT, but not for every text. I turn to it when a reading feels particularly heavy, usually after I read it a few times and still feel mentally blocked. I ask ChatGPT to summarize so I can get a clearer sense of the main ideas. I never summarize primary texts; I only use this strategy for secondary sources, and only when the situation really calls for it."
Interviewee B: "I mostly use ChatGPT, Quillbot, and DeepSeek. I do not overuse these tools; I sometimes turn back to them to help me have a deeper view of the literary materials. Also, I tend to use them for both primary and secondary sources."

Interviewee C: "Sometimes I use ChatGPT, but not for academic writing. I use it mostly for fun reading, quick summaries, to check grammatical structures or to check my understanding after I've already read the text. It's more like a leisure tool for me, not my main method of study."
Interviewee D: "I haven't yet used ChatGPT specifically for my dissertation topic, but sometimes I use it to give me a quick review for a book or an article. I cannot recall using another AI tool (except DeepSeek once or twice)."
Interviewee E: "I use tools like ChatGPT very often, mainly for summaries of long secondary sources, however I do not rely on them for primary texts because it could flatten the nuances that ultimately make the difference between different eyes of people." In this vein, the findings reveal that all interviewees use AI tools, primarily ChatGPT, with varying frequency and purpose. Most limit their use to secondary sources or specific needs, indicating a selective integration of AI to support, rather than replace, traditional reading and analysis.

Question 3: How has your reading process changed since you began using AI summaries?

Interviewee A: "My reading process has not changed very much since I began using AI summaries, because I still prefer to read the entire text before considering any summarization. I do not skim more or reduce the number of full texts I read; in fact, engaging with the whole work remains central to my process."
Interviewee B: "I am trying not to rely mainly on AI tools so I read full texts whenever I have time, and turn to AI summaries when I have a very limited time or a due date."
Interviewee C: "Honestly, my process hasn't changed much. I still rely on full texts, because for literature you can't skip the details. Sometimes, though, I use an AI summary just to get a quick overview before reading."
Interviewee D: "I think using AI made me lazier to read long texts as my attention span got shorter. So either I skim quickly and focus only on the relevant parts or read shorter texts."
Interviewee E: "Since I began using AI summaries, my reading process has definitely shifted. I notice that I skim more often now, especially when I just need the central argument or context." The findings show that while most interviewees maintain a preference for reading full texts, some report increased skimming or reduced engagement with long texts, suggesting a mixed impact where AI summaries support efficiency but may occasionally encourage less thorough reading habits.

Question 4: Can you describe a recent example where you used an AI summary instead of reading the full text? What was the outcome?

Interviewee A: "A recent example is when I worked with Homi Bhabha's article on mimicry. The text was so dense and complex that I turned to an AI summary to help me identify the main ideas and unpack some of the difficult terms. This process allowed me to explain the arguments more clearly to myself, and eventually I was able to address the central points with confidence."
Interviewee B: "I asked ChatGPT for a summary of a book, and it made it easier for me to understand the content of that book in a very short time."
Interviewee C: "Once I was curious about a novel, The Alchemist, I didn't have time to read fully. I asked for a short summary just to know the story. The outcome was that I understood the main plot, but I also realized how many details and emotions were missing."
Interviewee D: "A recent example was when I used ChatGPT summary of a book to grasp the main points because I needed it for a homework and I could not possibly read that full book. Using this AI tool saved me time and energy."
Interviewee E: "Depends on the text, sometimes I use it for secondary literature when I read the piece again I find that I left many critical points behind, other times, especially when looking for is the piece is relevant or not, the outcome is time and effort economy." The informants support the idea that AI summaries provide a quick understanding or time-saving benefit, though some note a loss of depth or critical points, reinforcing the need to revisit original texts for comprehensive analysis.

Question 5: Do you feel AI tools save time? If so, how do you use the extra time?

Interviewee A: "Yes, I do feel that AI tools save time. The summaries help me reach the main points more quickly, which frees up time to focus on other tasks if I have them."
Interviewee B: "Yes, I believe that AI tools save time. I usually use the extra time trying to have a deeper analysis of the materials or to search for more literature."
Interviewee C: "Yes, they save a bit of time when I want a quick explanation. The extra time usually goes into deeper reading, preparing notes, or checking more sources."
Interviewee D: "Yes I totally believe that using AI tools saves time; however, it effects one's ability to form his/her own critical analysis of the subject matter or the topic of research. Personally, I might use that extra time either to consult and gather information from other sources or simply to do something else that's not related to research."
Interviewee E: "Definitely save time if used correctly, however one should know their limits. I try to use that time to go deeper into primary texts or to refine my writing." The findings reveal that all teachers believe that AI tools stimulate and arouse students' motivation to learn EFL, with the extra time often reinvested in deeper analysis or additional research, though some express concern about potential impacts on critical thinking.

Question 6: Have you ever noticed gaps or inaccuracies in AI summaries? How did you respond?

Interviewee A: "Yes, I have noticed gaps or inaccuracies in AI summaries. Sometimes they oversimplify or miss important nuances. When that happens, I go back to the original source to check and make sure I understand it correctly."
Interviewee B: "Yes I did! Luckily, I had an overall idea of the text and could recognize that the given idea did not belong to that text. I tried to respond to the AI to omit it, and it definitely affected my trust in AI tools."
Interviewee C: "Yes, sometimes the summaries leave out important themes or even make small mistakes. When I notice that, I don't rely on it therefore I go back to the book."
Interviewee D: "Yes, using AI tools doesn't always guarantee a perfect accuracy, sometimes it even derives from the original question/topic or gives false information that are not reliably supported. In this case, I find it crucial to read carefully the results given by the tool, then reformulate the prompt explaining more the exact request."
Interviewee E: "Indeed, I have noticed inaccuracies. Sometimes the summary overgeneralizes and AI based not quite taken from the sources presented. When that happens, I double check with the original text." The findings show that interviewee A is against the idea of allowing students to use mobile technologies because they distract learners' attention and concentration; they are also the source of disturbance. However, the three other teachers state that they permit their students to use their mobile devices inside the classroom for learning purposes relying on the students' mobile technologies as a supporting tool.
Interviewees demonstrate a structured approach to reading complex texts for their dissertations, employing note-taking, rereading, and occasionally skimming or using external resources to manage dense academic material effectively. All utilize AI tools, primarily ChatGPT, as a supplementary resource for secondary sources or specific tasks, maintaining a preference for full text reading despite some reporting increased skimming or reduced engagement with lengthy texts. This suggests a mixed impact on efficiency, with AI summaries providing quick understanding and time savings but occasionally leading to depth loss, prompting a return to original texts for comprehensive analysis. All interviewees agree that AI tools save time, which they often reinvest in deeper analysis or additional research, though some note potential risks to critical thinking. However, they consistently report gaps or inaccuracies in AI summaries, addressing these by revisiting original texts or refining prompts, reflecting a critical and selective approach to AI integration in their academic work.

5. Discussion of the Results

The study reveals that AI summarization tools, such as ChatGPT and QuillBot, are integral to Master II literature students' dissertation research, particularly among younger cohorts (20-24 years), with 65% (28/43) adoption compared to lower rates among older participants (30+), reflecting Mangen and van der Weel's (2016) observation of digital substrates as social staples among younger learners (p. 116). This generational shift aligns with the finding that older students (30+) show lower adoption due to limited historical exposure to such technologies. Yet, this disparity raises critical questions about equity in a postcolonial Algerian context, where access to advanced digital tools may be unevenly distributed due to infrastructural challenges, potentially widening gaps in scholarly preparation between tech-savvy younger students and those from less resourced backgrounds. Such divides could inadvertently reinforce colonial legacies of unequal knowledge production, as Vygotsky's (1978) sociocultural theory implies that uneven mediation tools hinder the interpsychological foundations of higher-order thinking (p. 57), prompting educators to interrogate how AI adoption might exacerbate rather than democratize access to reflective literary scholarship. ChatGPT's dominance (23.3% alone, 20.9% with Grammarly) underscores its accessibility and effectiveness in managing voluminous literature, supporting Mangen and van der Weel's (2016) argument that digital tools reshape knowledge processing (p. 116).

Students frequently use AI for paraphrasing (mean: 2.93), aligning with Sweller's (1988) view that AI mitigates extraneous cognitive load for manageable tasks (p. 261). The tools are also employed to manage time constraints and process large volumes of secondary sources, creating an efficient research environment. However, lower usage for summarizing primary texts (mean: 2.29) or generating ideas (mean: 2.19) reflects Wolf's (2018) concern that deep reading, requiring direct engagement, is essential for connecting knowledge to emotional and analytical insights (p. 122). Interviewees, such as A and C, emphasize using AI selectively for secondary sources to preserve the nuances of primary texts, reflecting a balanced approach to technology integration. This selectivity, while pragmatic, critically underscores a tension in dissertation workflows: by offloading routine processing to AI, students may inadvertently prioritize speed over the slow, empathetic immersion that Wolf (2018) describes as vital for fostering imagination and cultural empathy in literary analysis (p. 122). In a field like postcolonial literature—implicit in the Algerian university setting—such shortcuts risk diluting the very interpretive depth needed to unpack hybrid identities and power dynamics, as direct engagement with primary texts allows for the kind of personal, reflective synthesis that AI's static outputs cannot replicate.

Vygotsky's (1978) ZPD framework explains how AI tools act as scaffolds, facilitating initial comprehension within students' guided capabilities, but their limited use for primary texts suggests a recognition that deep reading requires internalization beyond external summaries (p. 86). Piaget's (2001) constructivist theory supports students' active engagement, as seen in their reinvestment of saved time into deeper analysis or additional research, adapting schemas to new contexts (p. 4). Interviewees' selective use, prioritizing full-text reading for primary sources, aligns with Baron's (2021) biliterate reading brain, balancing digital efficiency with reflective depth (p. 251). High verification rates (42% always cross-check) further support this, counteracting Birkerts' (1994) warning about eroded attention from digital tools (p. 18).

Students perceive AI as enhancing efficiency (mean: 3.44) and theme identification (mean: 3.77), with many strongly agreeing that AI summaries foster a structured approach to literary analysis by connecting ideas across texts (mean: 3.74). However, mixed views on confidence (mean: 3.21) and deep engagement (mean: 3.35) reflect Sweller's (1988) tension between extraneous load reduction and germane load for schema acquisition (p. 284). Wolf's (2018) concern about altered cognition from digital reliance is evident in concerns about reduced creativity or depth, particularly for poetry (p. 122). The 56% support for guided AI integration in curricula aligns with Mangen and van der Weel's (2016) call for research on digital tools' contextual effects (p. 116), while suggested strategies like cross-verification and ethical mindfulness echo Wolf's (2018) biliterate brain, ensuring AI complements rather than replaces deep reading (p. 126).

Kuzmičová's (2016) emphasis on the reading environment further highlights the need for guided strategies to maintain critical reflection in digital contexts (p. 116). Critically, these perceptions invite a deeper scrutiny of AI's role in shaping not just individual habits but collective scholarly discourses: if tools like ChatGPT homogenize theme identification by drawing from aggregated data, they may subtly impose Western-centric interpretive biases on postcolonial texts, undermining the originality Piaget (2001) champions through active accommodation (p. 4). This calls for a reflexive pedagogical pivot, where instructors actively deconstruct AI outputs in class to reveal their limitations, thereby transforming potential intellectual passivity into a site for empowered critique.

In conclusion, AI tools enhance efficiency and accessibility in literary research but require cautious integration to preserve deep reading and critical thinking. Both survey and interview responses confirm that AI tools save time, with students reinvesting this time in deeper analysis or additional research, enhancing their academic output. Vygotsky's (1978) sociocultural theory and Piaget's (2001) constructivism underscore the importance of active, socially mediated engagement, while Sweller's (1988) cognitive load theory and warnings from Wolf (2018), Baron (2021), and Birkerts (1994) highlight the need to balance efficiency with analytical depth. By promoting guided usage, educators can address concerns about over-reliance, ensuring AI serves as a supplementary aid to foster motivation and support students in navigating complex literary scholarship. This balanced integration holds transformative potential for postcolonial literary education, where AI could amplify underrepresented voices by easing access to global archives, yet only if critically harnessed to safeguard the reflective essence that distinguishes authentic scholarship from algorithmic approximation.

6. Conclusion

This study underscores the transformative yet complex role of AI summarization tools in the dissertation research of Master II literature students at the University of 8 May 1945, Guelma-Algeria, revealing their potential to enhance efficiency and accessibility while posing risks to deep reading and critical thinking. With 65% of participants utilizing tools like ChatGPT to manage time constraints and process voluminous texts, the findings highlight a generational shift toward digital integration, particularly among younger students, aligning with broader educational technology trends. However, selective use for tasks like paraphrasing, coupled with high verification rates (42% always cross-check), reflects a cautious approach to preserve analytical depth, especially for primary texts. The strong support for guided AI integration (56%) and strategies emphasizing cross-verification and ethical use suggest a path toward a biliterate reading brain, balancing digital efficiency with reflective scholarship (Wolf, 2018; Baron, 2021). These insights advocate for curricula that strategically incorporate AI to complement, rather than supplant, the critical engagement essential for original literary analysis, ensuring students navigate the evolving landscape of literary scholarship with both technological proficiency and intellectual rigor.

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Appendices

Appendix A

Questionnaire

The Impact of AI-Driven Summarization Tools on Master II Literature Students' Reading Habits and Critical Engagement

Dear Master II Literature Student,

This questionnaire is part of a research study exploring how AI-driven summarization tools affect your reading habits and critical engagement with literary texts during your dissertation work. Your responses will help us understand the role of AI tools in literature studies and inform pedagogical strategies. The questionnaire is anonymous, and your participation is voluntary. It will take approximately 10-15 minutes to complete.

Section 1: Demographic and Academic Background

1. **What is your age group?**
   - [ ] 20–24
   - [ ] 25–29
   - [ ] 30 or older
2. **Have you completed your master's degree? (Did you graduate?)**
   - [ ] Yes
   - [ ] No
3. **What is the primary focus of your dissertation?** (e.g., specific literary period, author, theme, or theoretical framework)

Section 2: Frequency and Context of AI Tool Usage

4. **Do you use AI-driven summarization tools (e.g., chatbots, summarization apps, or platforms like ChatGPT, QuillBot, or others) for your dissertation research?**
   - [ ] Yes
   - [ ] No (If No, skip to Section 3)
5. **Which AI-driven summarization tools do you use?** (Select all that apply)
   - [ ] ChatGPT
   - [ ] QuillBot
   - [ ] Grammarly
   - [ ] Other (please specify): _____
6. **How often do you use AI summarization tools for the following purposes?** (1 = Never, 2 = Rarely, 3 = Sometimes, 4 = Often, 5 = Always)

Purpose	**1**	**2**	**3**	**4**	**5**
Summarizing primary literary texts (e.g., novels, poems)	[ ]	[ ]	[ ]	[ ]	[ ]
Summarizing secondary sources (e.g., journal articles, critical essays)	[ ]	[ ]	[ ]	[ ]	[ ]
Generating ideas for dissertation arguments	[ ]	[ ]	[ ]	[ ]	[ ]
Paraphrasing or rephrasing text	[ ]	[ ]	[ ]	[ ]	[ ]

7. **In what contexts do you use AI summarization tools?** (Select all that apply)
   - [ ] To quickly understand complex texts
   - [ ] To manage time constraints
   - [ ] To process large volumes of secondary literature
   - [ ] To overcome language barriers (e.g., texts in a second language)
   - [ ] Other (please specify): _____

Section 3: Perceptions of AI Summaries' Impact on Reading and Critical Thinking

8. **How do you perceive the impact of AI summarization tools on your reading habits?**

(1 = Strongly Disagree, 2 = Disagree, 3 = Neutral, 4 = Agree, 5 = Strongly Agree)

Statement	1	2	3	4	5
AI summaries help me read more efficiently	[ ]	[ ]	[ ]	[ ]	[ ]
AI summaries reduce the time I spend reading full texts	[ ]	[ ]	[ ]	[ ]	[ ]
I rely on AI summaries instead of reading full texts	[ ]	[ ]	[ ]	[ ]	[ ]
AI summaries make it harder to engage deeply with texts	[ ]	[ ]	[ ]	[ ]	[ ]

9. **How do AI summarization tools affect your critical thinking and analysis?** (1 = Strongly Disagree, 2 = Disagree, 3 = Neutral, 4 = Agree, 5 = Strongly Agree)

Statement	1	2	3	4	5
AI summaries help me identify key themes and arguments	[ ]	[ ]	[ ]	[ ]	[ ]
I feel less confident in my analysis when relying on AI summaries	[ ]	[ ]	[ ]	[ ]	[ ]
AI summaries enhance my ability to connect ideas across texts	[ ]	[ ]	[ ]	[ ]	[ ]

10. **Describe how AI summarization tools have influenced your approach to reading and analyzing literary texts for your dissertation.** (Open-ended)

Section 4: Impact on Dissertation Quality

11. **Do you believe that using AI summarization tools has affected the quality of your literary analysis in your dissertation?**
    - [ ] Yes, it has improved the quality
    - [ ] Yes, it has reduced the quality
    - [ ] No, it has had no significant impact
    - [ ] I'm not sure

12. **If you answered "Yes" to Question 11, please explain how the quality of your literary analysis has been affected.** (Open-ended)

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13. **How often do you cross-check AI-generated summaries with the original texts to ensure accuracy?**
    - [ ] Always
    - [ ] Often
    - [ ] Sometimes
    - [ ] Rarely
    - [ ] Never

Section 5: Pedagogical Preferences and Suggestions

14. **Would you support the integration of AI summarization tools into your literature curriculum if guided by instructors?**
    - [ ] Yes
    - [ ] No
    - [ ] I'm not sure

15. **What strategies or guidance from instructors would help you use AI summarization tools more effectively while maintaining deep engagement with texts?** (Open-ended)

16. **Do you have any additional comments or experiences regarding the use of AI tools in your dissertation research?** (Open-ended)

Thank you for your participation! Your responses are valuable to our research.

Appendix B

Semi-Structured Interview

Study Title: The Impact of AI-Driven Summarization Tools on Master II Literature Students' Critical Engagement
Researcher: Dr. Khawla BENDJEMIL
Date/Location:
Duration: 30-45 minutes

I. Introduction (5 minutes)

Interviewer:
Thank you for participating in this interview. My research explores how AI summarization tools influence literature students' reading habits and critical analysis skills. Your insights will be invaluable.

This interview will take about 30-45 minutes. With your permission, I'll audio-record it to ensure accuracy. All responses will be anonymized—your name won't appear in any reports.

Before we begin:

1. Do you consent to being recorded?
2. Do you have any questions about the study?

II. Interview Questions

1. Background and AI Tool Usage

- "How do you typically approach reading complex texts for your dissertation?"
- "Which AI tools (e.g., ChatGPT, Claude) do you use, if any, to assist with literary analysis or summarization?"

2. Reading Habit Evolution

- "How has your reading process changed since you began using AI summaries?"
- "Can you describe a recent example where you used an AI summary instead of reading the full text? What was the outcome?"

3. Intellectual Passivity vs. Efficiency

- "Do you feel AI tools save time? If so, how do you use the extra time?"
- "Have you ever noticed gaps or inaccuracies in AI summaries? How did you respond?"

4. Critical Thinking and Originality

- "Do AI summaries help or hinder your ability to form original interpretations?"
- "Do you feel your engagement with texts is more active or passive when using AI?"

5. Trade-offs and Self-Awareness

- "What do you gain and lose by using AI summaries in your research?"
- "How do you decide when to use an AI summary versus reading the full text?"

6. Pedagogical Needs

- "What guidance would help students use AI tools more critically in literary research?"
- "Should AI tool training be part of the curriculum? Why or why not?"

III. Closing (5 minutes)

Interviewer:

We're nearly done. Is there anything else you'd like to share about your experience with AI tools or their impact on your academic work?

Finally, how would you summarize, in your own words, the biggest advantage and disadvantage of using AI summaries for literary analysis?

NATURALLY SET OR ARTIFICIALLY COLLECTED: HOW AI TOOLS AND APPLICATIONS ALTER STUDENTS' PROCESSES OF KNOWLEDGE RETENTION AND LANGUAGE EXPRESSION

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ABSTRACT

The rapid integration of AI-driven tools and applications into educational contexts is increasingly reshaping students' cognitive engagement with knowledge retention and language expression. This paper seeks to provide a theoretical framework for interrogating how the overreliance on AI–driven tools and applications affect students' abilities to independently express, receive, and retain knowledge. It examines students' emerging shift from active knowledge producers to passive knowledge consumers, as they increasingly depend on automated information and ready-made knowledge rather than engaging in active mental mechanisms required to organize new information for comprehension and long-term retention. This paper argues that the overreliance on AI driven tools restricts students' cognitive autonomy, weakening their abilities to express new ideas, receive information, and retain knowledge. Premised on the argument that students' dependence on AI tools can impede their natural thinking processes, affect their knowledge retention, and restrict their capacity for adequate language expression, this paper offers a theoretical lens. The theoretical lens posits that since language development relies on active cognitive modes, valid mental mechanisms, and other functional frames to form meaningful connections between new and prior knowledge, an overdependence on AI-driven tools and applications can impede these essential cognitive and mental mechanisms. The paper concludes that despite the overdependence on AI-driven tools, it is crucial to examine how such reliance may disrupt students' natural processes of knowledge retention and language expression. By highlighting the effects of AI on cognitive and mental mechanisms, this paper investigates how the overreliance on such tools and applications may disrupt students' natural thinking processes and create emerging challenges in both knowledge retention and language expression.

KEYWORDS: *AI Tools And Applications, Mental Abilities, Cognitive Mechanisms, Knowledge Retention, Language Expression.*

1. Introduction

The human mind receives, retains, and stores knowledge through different cognitive processes. The complex interplay of these processes is systematically set to organize the mental mechanisms through meaningful frames of knowledge retention. Students depend on their cognitive mechanisms and mental processes to develop the brain's capacity for enhancing knowledge storage, reception and perception as well. "Our brain, therefore, learns by making and strengthening connections between brain cells." As Cunnington (2019) noted. Knowledge processing and cognitive functions include sensory input, working memory, perception, attention, temporary and permanent information storage operations. Knowledge retention (KR) has a significant role in constructing meaningful codes which facilitates the process of learning language through productive operational modes. The human brain depends on such operational modes to significantly activate new areas of knowledge development. Knowledge development strategies are meaningful only when the working memory responds to what is actively processed and systematically treated. This paper argues that the excessive dependence on AI tools and applications can impede students from activating their cognitive reasoning modes and other mental mechanisms essential for naturally developing knowledge retention skills and language expression abilities. The paper starts by presenting the problem statement, which is followed by a theoretical background on the influence of cognitive and mental mechanisms on information storage processes, knowledge retention skills, and language expression abilities. Then, it discusses how the overreliance on AI-driven tools and applications can hinder students from activating their natural modes of cognitive functioning.

1.1. Problem Statement

The author relies on different theoretical perspectives to analyze the following question: To what extent does students' overdependence on AI-driven tools and applications affect their cognitive mechanisms and impede their ability to store, retain, and express language, and what mental and cognitive processes are required for active information storage, language expression, and long-term knowledge retention? The theoretical framework is grounded in a set of fundamental theories that guide the interpretation of how students' overreliance on AI-driven applications influences their cognitive and mental mechanisms for storing information, expressing language, and retaining knowledge.

2. Core Cognitive and Mental Mechanisms Influencing Information Storage, Knowledge Retention, and Language Expression:

2.1. The brain's systematic operations

The active brain is distinguished by the selective operational models which foster its knowledge productivity and capacity of knowledge processing. Knowledge processing models include varied structures which represent the complex interactive cognition. The complex structures of knowledge processing incorporate diverse mechanisms that operate to evaluate the quality of storing and retrieving information. The human brain is systematically designed to process information either by accepting or rejecting the operational process being accurately activated. Active brain processes operate to support the natural flow of information. The complexity of the human thought relies on the possibilities of producing new information which is creatively re-generated. The natural mode of processing information is largely supported due to its systematic qualities which assert the human intelligence.

Different models of knowledge retention focus on how information is transmitted to the brain. Those models relate the memory working system to the information flow capacity. Such relation explains the complex interactive processes of the active human brain. This brain operates to determine the quality of storing and retrieving information by integrating diverse forms of cognitive and physical functioning. The human brain responds to the newly delivered information by incorporating various cognitive mechanisms which urge to deeply insert, structuralize, and memorize this information. These mechanisms interact with each other to naturally establish and constitute new frames of knowledge. The natural modes of knowledge processing combine different mechanisms all together to functionally activate their systematic productivity. More clearly, the degree of intelligence, reception and perception of knowledge are systematically activated by the working brain to demonstrate the cognitive processing of input and output operations.

The brain's systematic operations are naturally functioning and this indicates its powerful performance to re-generate, collect, and store knowledge. Unlike the natural processes of the human brain, the artificiality of the learning machine is programmed and assessed to deliver well-organized data that is based on multiple sources of intelligence. These sources of intelligence are mostly reinforced to re-generate new forms of knowledge. The rapidly re-generated knowledge is not limited or restricted to some cognitive operations. Instead, it is programmed, collected, and stocked to assert the connective patterns of the technological devices and the linear sequences of the learning machines. Machine language and computer learning operations establish highly-synthesized patterns that have parallel-processing functions as the human brain. The processing capacity of the intelligent machine is evaluated with reference to the degree of calculating the well- stocked information in its data-base.

Accordingly, the human brain processes information differently. It sets complex patterns of knowledge storage and retention. It also deals with different systematic variations that help to set the logical order of knowledge processing mechanisms. Moreover, the brain stocks information through different forms of storage patterns. These patterns activate the long-term memory which, in response, receives, collects, and stores the newly evaluated information. The brain monitors information and systematizes it to be in use. For instance, the information processing model that was developed by Robert Stahl (1985) clarifies how cognitive processing is important for developing high-order thinking skills and language learning. Stahl's model was used in classroom context to help teachers, educators, and practitioners promote critical thinking skills and improve learning styles.

This model explains how knowledge is collected and how it is transformed from the sensory perception to the working memory. The conscious processing operation helps students to understand the solid fusion between the sensory frames and meaning construction. Robert Stahl's model has been developed over the years so that it can be useful in the educational context. It was largely implemented by educators to facilitate the visual representation of objects in the human brain. This model clearly explains how the information is treated, processed, and transformed from the environment to the cognitive frames. In fact, it explains the solid interconnection between the human brain, sensory receivers, and external environment. Learners often attach sense and meaning to the learning process. This attachment facilitates the storage of information in the human brain easily without forcing it to make further complex connections.

Stahl's model provides a simplified description of how the brain treats, stores, and classifies information. The interconnections which the learner makes reflect how much attention is delivered to combine the sensory organ with external environment for providing self-processed operations. The learner treats the new information with reference to the major cerebral

operations. These operations urge for activating the human thought, behavior, and perception all together. These interrelated operations guarantee the successful storage of information in the memory. The learner will necessarily collect, evaluate, store, and retrieve the information by depending on his active cognitive frames. Such frames are very useful in the educational context. They clearly guarantee the successful development of learning. The development of learning competencies passes through important cognitive stages which demonstrate how the brain relates the sensory perception with environmental codes to foster the storage of new information. The freshness of knowledge in the learner's brain is the key determiner of the active cognitive processing and storage that happen at the level of the working memory.

2. 2. The body's sensory receptors

As being explained, the learner takes the information from the environment and starts to process it by applying his sensory qualifications. These sensory qualifications will automatically filter the received type of information and classify it to be progressively processed. Through the active memory working system, the processed information will be either stored or rejected. The learner's sensory perceptions prepare the memory to operate for permanent or temporary storage. The senses are the pre-determining factors which assert the cognitive integration of learning. Evidently, the five major senses facilitate the detection of information from the external environment. The body's sensory receptors deliver internal signals to the brain to cognitively start its processing mechanism. Such sensory delivery represents the brain's external stimuli for acquiring knowledge and learning skills. In this respect, the body organs and sensory receptors transmit signals to the brain to activate its cognitive processing activity.

Therefore, the conveyed electrical impulses from brain detect the sensory waves and start classifying the information into sounds and images. The brain perceives the newly delivered sounds and images as important data being received, collected, and transmitted from the sensory register. The first part of the perceived data is systematically located in the limbic system (Thalamus) whereas the other part is located in the Reticular Activating System (RAS). This classified data represents the cerebral balance which organizes the incoming sensory information. The sensory receptors contribute to achieve the learning progress. The learners often depend on their sensory markers to learn and acquire new knowledge. Visual learners, for instance, can easily detect the information being delivered through pictures, images, schemes, and figures. Unlike the visual learners, auditory learners do intensively relate their learning experiences to sounds and voices that are delivered from the external environment. By that, the learning style of each learner marks the efficiency behind his sensory perception.

2.3. Information processing and storage mechanisms

The human brain has a complex process of storing and processing information. It builds solid connections between different cognitive operations to integrate and synthesize information. The brain's capacity of storing is completely different from the computer. The brain collects patterns of information in terms of separate knowledge sequences that can be recalled and activated whenever the learner is in need of that knowledge. Due to this active brain, the learner has the possibility to identify different forms of knowledge storage and retention. By that, the learner can easily recognize and perceive what is happening in the surrounding environment by making connections between diverse internal cognitive capacities. These internal connections can further help to recognize who is walking or speaking by depending on the sensory receptors of the learner. These cognitive connections will reinforce the learning capacity and strengthen patterns of knowledge retention.

In a related issue, students' working memory is activated to process conscious and unconscious operations. This memory is activated to store information and develop the learning integrity skills. The information processing model represents the active interactions of students' working memory. Such interactions capture students' attention to store and retrieve

information from long-term memory. The storage and retrieval of information requires a highly engaging brain operation. All parts of the brain are called into action to guarantee the effective processing of the memory. The psychologist George Miller clarified that the working memory has the capacity to handle few items at once. This capacity changes with age to be more operational and functional as well. The cognitive expansion of the working memory gradually increases to determine the development of the learning quality from preschool to adulthood stages. Students' working memory is not limited or restricted, but rather exposed to affective external variables which control their learning style and quality. Due to these variables, students are classified to different categories. Each category distinguishes the learning style and capacity of students in processing information.

Some variables can greatly work to determine the limitations of the human brain. In other words, these variables serve to negatively affect the students' working memory. Variables such as time, interest, and distractions lead to hinder the memory's working processes. They further limit the cognitive capacities of storing and retrieving information. Students, by that, often look for more reliable sources to assert a particular learning style which facilitates their cognitive functioning. The limitations of the working memory can clearly affect the input learning strategies due to the passive cognitive processing of the student. Passive students fail to categorize the learning sequences. In addition, they fail to properly activate their cognitive processing style due to the asserted restrictions of the brain's operations. The limited capacity of the working memory explains how students fail to store and retrieve information. Such failure makes students unable to structuralize their cognitive functioning and diminish their learning efficiency. The progressive passivity of the working memory can successfully alter students' cognitive processing modes. Those students will be unable to make a spilt-second decision due to their cognitive passiveness.

Therefore, teachers have a significant role to play in the classroom context. Those teachers can greatly participate in developing students' learning abilities. In addition, they can successfully make students physically and psychologically motivated to learn. Students who receive positive feedback and highly inspiring expressions will feel energetic and ready to develop new learning sequences. The positive classroom interaction motivates students and refreshes their cognitive functioning. Such positive qualities of classroom interaction reduce feelings of stress, depression, and disappointment. In fact, well-motivated students have the capacity to perform varied tasks by depending on their cognitive operations. Such dependence guarantees the effective activation of students' natural learning processes. Through these natural processes, students will have the capacity to filter, store, and retrieve information without making extra efforts. Indeed, they will feel relaxed and ready to make complex cognitive connections in a short time. This ability facilitates the natural process of schematizing knowledge and empowers the functioning mode of the working memory as well.

Russell (1979) clarifies that the human memory has a very limited time for processing new information. As being already explained, students who are well-prepared and motivated will feel able to store, acquire, or filter a new set of knowledge before the brain becomes fatigued. The natural process of knowledge retention is systematically activated to measure out the progressive mode of cognitive functioning. More clearly, the natural processing of knowledge is one of the effective cognitive operations which assert the active functioning of the human brain. The brain or the working memory is naturally activated to process information before mental fatigue. This quick mental operation (for 10 to 20 minutes) goes through different stages of complex cognitive classification. The classification of knowledge is the process of perceptual determination. Evidently, this classification is mentally set to determine whether the information is processed for permanent storage or temporary retrieval. By that, knowledge reception and perception are important cognitive operations which indicate the complex functioning of the human brain.

Students in the classroom are mostly urged to effectuate different mental operations in a short time. Indeed, they are often asked to perform tasks which oblige them to recall what they have in mind. The stored knowledge is quickly recalled by activating complex mental connections. This quick process demonstrates the ability to filter and monitor the delivered information. Students' mental operations and cognitive perceptions are naturally activated to refresh the brain's work. The active brain is progressively trained to effectuate diverse mental operations which support its healthy design. By contrast, the passive brain will lose the ability to effectuate different mental operations. Students with mental passivity often look for other reliable sources which foster their learning process. They often depend on AI applications to reinforce their learning. The learning machine offers various strategies for students to help them mark their learning development. Students with active mental functioning usually assert their learning proficiency by depending on their naturally-activated cognitive processes.

The naturally activated mental processes help to refresh the brain. This brain performs activities encompassing the basic sensory input, complex reasoning, and emotional feedback. The natural connection between these cognitive operations demonstrates the capacity to construct solid mental frames which facilitates the process of interacting with knowledge. Evidently, students with active mental processing modes interact with knowledge differently. They often form thoughts and draw conclusions by referring to varied mental processing mechanisms which interpret their cognitive involvement. This involvement includes attention, perception, memory, thinking and reasoning, emotion, and finally language. Accordingly, active students go through these mental processing mechanisms before producing the language. They start internally designing, constructing, and schematizing language before producing it. Such cognitive order is naturally installed to facilitate the process of knowledge development.

Respectively, the naturally set cognitive frames facilitate the integration of incoming information with pre-existing knowledge structures. This integration has significant effects on students' produced language. In fact, students who are actively constructing new knowledge structures with reference to their natural cognitive mechanisms will take the habit to use and produce language independently. Those students have the ability to interpret what has been already processed in the brain without making extra efforts. The internal mode of cognitive processing fosters the ability to produce language for effective interaction. Students' produced language is designed with reference to their experiences of knowledge integration. This language reflects the internal behavior to interact with the pre-constituted knowledge. In this regard, mental actions and cognitive operations are important processes for guiding the conscious production of language. These processes construct the complex design of human interaction.

2.4. *Cognitive knowledge treatment*

In a related issue, cognitive models of knowledge processing have a significant role in developing the learning style. The natural treatment of knowledge leads to foster the cognitive connection with AI technologies and applications. Cognitive interaction modes develop the ability to make efficient decisions in different situations. These cognitive modes promote the human intelligence through stimulating the abilities of abstract thinking. The human intelligence enriches the natural form of creativity and innovation as well. The natural mode of thinking, reasoning, and solving problems reflect the capacity to transform abstract knowledge structures into valuable segments of information. The human intelligence capacity reflects the cognitive abilities of humans to construct solid frames of knowledge based on perception, reasoning, and recognition. These cognitive operations help to perform complex tasks and activities that require attention. The human intelligence, by that, is the natural force which logically makes sense to the human experience of knowledge development.

Students who systematically activate their cognitive abilities will be capable of perceiving the world around them. Such perception reinforces the systematic combination between diverse operational modes which clearly facilitate the human interaction. Evidently, students will use their sensory perception, recognition, and intelligence to diversify the strategies of knowledge retention and retrieval as well. Those students develop the learning experience by adapting strategic tools of self-empowerment. Students, with high levels of intelligence, depend on their perceptual framework to empower their learning experience. The human creativity which is developed and empowered by logical frameworks of perception, reasoning and intelligence constitutes the basic structure of knowledge development. Knowledge management structures facilitate the improvement of human performance. This performance urges students to think logically, creatively, and critically as well.

In this respect, students, due to their cognitive abilities, are able to make decisions and solve problems that computers cannot. The human intelligence does naturally foster the quality of creativity. This creativity cannot be technologically set with reference to applicable modes of cognitive reasoning. The learning machine can analyze large amounts of data and make logical decisions based on predictions and probabilities. The logical design of the learning machine reflects the artificiality of the implemented tool of knowledge retention or retrieval. The artificiality of the machine provides systematic tools of generating data. It further uses natural processing tools to facilitate the understanding of the human language.

3. Human intelligence

The human intelligence abilities are limitless. They reflect the basic cognitive processes which facilitate the learning quality. Humans make decisions and solve diverse problems by depending on their reasoning modes, emotional depth, and creative minds. The cognitive bases of intelligence help to recognize patterns of perceptual understanding. These patterns do significantly extend the deep analytical frames which facilitate the contextualization of information. By that, the human intelligence provides systematic insights into the appropriate performance of diverse intellectual activities. The complexity of the human cognitive design proves the natural mode of approaching knowledge. The natural modes of knowledge processing determine the logical manner being required for asserting the learning progress. This human progress is qualified by valuable characteristics of cognitive processing. Such cognitive characteristics require correct analytical tools which diversify the field of knowledge.

Cognitive analytical tools of knowledge development do completely differ from AI tools and applications. Such difference includes the analytical procedures of data collection. The artificial design of the learning machine provides complex performances of digital calculations and automation tasks. The computational power of AI lies in a collaborative approach of digital processing. This approach analyses data with reference to numerous calculation operations which combine the artificial processing capacities with complex algorithms and rule-based systems. The human processing mechanism is more energetic and analytical whereas the computer processing system is speedy and statistical. The human brain is significantly efficient due to its natural processing capacity which clearly demonstrates the collective design of diverse cognitive qualifications. As being already mentioned, these cognitive qualifications include human intelligence, reasoning, emotional depth, ethical experiences and creativity. These highly integrated cognitive qualifications help to achieve knowledge development. The human intelligence provides valid cognitive frameworks which support the ability to develop knowledge acquisition.

4. Traditional classroom teaching practices

In classroom context, the information which students receive from teachers is easily forgotten due to the traditionally implemented teaching practices. Those students cannot effectively retain knowledge simply because they are not actively engaged and involved in the tasks which the teacher designs to deliver information. The most useful technique to help students retain information is to make their brains well-engaged with the material. Through implementing effective knowledge retention strategies, the students will practically transfer information from short-term to long-term memory. In addition, they will store, recall, and remember information by activating the newly acquired knowledge and making it in use. The teacher's effective teaching methods can effectively foster the students' ability to remember and recall information. The active brain is systematically prepared to interact and respond to different learning experiences. Students' engagement with the material facilitates their cognitive interaction and promotes their skills to achieve a practical approach of knowledge development.

Active learning strategies for long-term knowledge retention prepare students to understand classroom tasks and practices. Balleck (2006) explained that "the use of active learning in the form of simulations, student presentations, and problem-solving situations will better prepare students to understand" (p. 1). The active engagement of students in collaborative classroom effectively develops their high-level thinking processes. Effective learning strategies in collaborative classroom context elevate students' satisfaction and self-esteem. Interactive classroom methods and active learning strategies guarantee the successful process of knowledge retention. Through such process, teachers ensure that the largest amount of information goes from students' short-term to long-term memory. This highly-engaging process of knowledge retention urges teachers to apply techniques that encourage students to activate their cognitive abilities to perceive the learning experience. The students' performance requires attention, perception and recognition to perfectly recall the information from the memory. The participation and performance of students connect what has been cognitively designed to what has been practically assigned in classroom to guide the stages of long-term knowledge retention.

On their studies about memory retention and learning processes, Kolb & Fry (1975) developed an experiential learning circle composed of four main elements: concrete experience, observation and reflection, the formation of abstract concepts and testing in new situations (Figure 1). This circle explains the basis of learning and the influence of retention on students' classroom performances. In their article "The learning way: Meta-cognitive aspects of experiential learning" A. Kolb and D.A. Kolb (2009) modify this circle by adding two elements which are: grasp experience and transform experience. The two-way arrow element "grasp experience" is added between concrete experience and abstract conceptualization whereas the two-way arrow element "transform experience" is added between active experimentation and reflective observation. These added elements demonstrate how the learning experience is cognitively characterized by different types of sensory receptors which influence the retention process.

Figure 1. *Kolb & Fry's experiential learning circle* (1975)

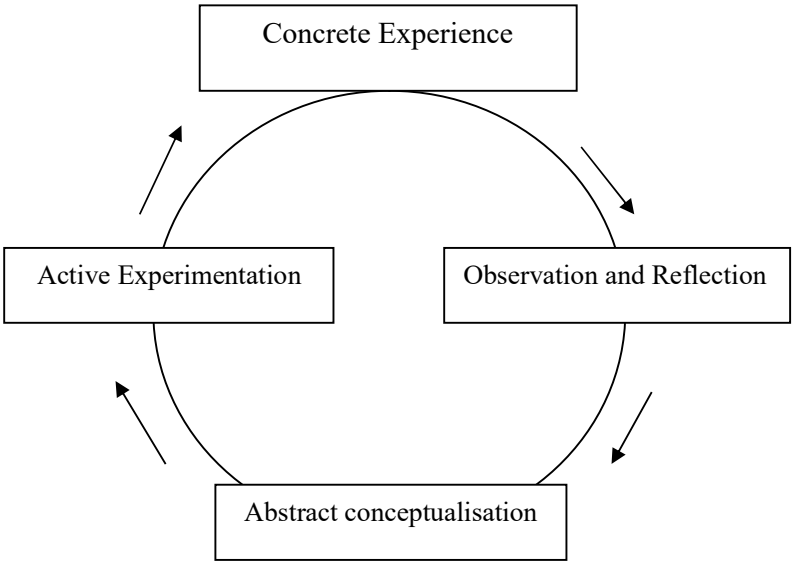

Figure 1. *Kolb & Fry's experiential learning circle* (1975)

Source: CARMEN PÉREZ-SABATER, BEGOÑA MONTERO-FLETA, MARISA PÉREZ-SABATER (2001)

Accordingly, students do progressively retain what has been learnt by activating diverse cognitive processes which stimulate their memory retention. Dale (1969) clarified that the cognitive activities that are involved in the process of memory retention represent the "cone of learning". He further added that visual and verbal receptors represent the passive involvement of cognitive processing. Sensory receptors help students to remember 10% of what has been read, 20% of what has been heard, 30% of what has been seen and 50% of what has been seen and heard. After the active involvement of these sensory receptors, students will be able to remember 70% of what has been said (participating in a discussion or giving a talk) and 90% of what has been said and done (doing a presentation or simulating a real experience). Stressing Dale's assumptions, the more students are actively involved, the better they will remember what has been learnt and experienced. Therefore, memory retention and knowledge learning require the involvement of different cognitive abilities. These abilities foster the quality of retention and stimulate the sensory recognition.

For the psychologist Ebbinghaus (1885), the active learning environment requires not only recognition but also the power of recalling information from the memory. The temporary retention of information from short-term memory helps students to put new concepts into practice. The employment of new concepts creates purposeful learning experiences. In addition to the effective role of short-term memory on knowledge retention, the permanent processing of long-term memory leads to develop complex mental models, frames, and schemes which reduce the cognitive load. Those mental models facilitate the retrieval of information and enable students to make decisions and solve problems. Active learning environment facilitates the cognitive stimulation of knowledge. The effective intervention of teachers reduces students' anxiety, stress, and withdrawal. Through this intervention, teachers will have the possibility to activate the perceptual register of their students. In addition, they allow students to employ

their sensory perceptions, emotional consciousness, and reflective feedback to better assert meaningful learning interaction.

5. AI based learning tools

It should be stated that teachers and students who direct their attention towards AI technologies may progressively lose the capacity to create interactive classroom environment. Under certain conditions, AI technologies will affect students' learning and attention as well. In fact, ready-made AI information can negatively affect the students' working memory. Teachers who were promoting the natural knowledge processing mechanisms may fail to guide classroom interactive practices. Those teachers may further find it difficult to control students' written performances and oral expressions due to the large reliance on ready-made AI re-generated data. Students will gradually establish a new interactive environment that is secured by AI sources. These sources are widely employed by students to reduce the cognitive costs. Students, who used to approach knowledge naturally, will manage to collect a wide set of knowledge that is artificially designed. Through this practice, students prefer to be cognitively relaxed while developing new strategies of knowledge retention and language expression as well.

Therefore, AI based learning tools have a significant impact on knowledge retention and language expression. These tools produce new data which typically reflect the data being naturally processed by the human mind. Such AI innovative technologies are challenging the natural processing mechanism of the human mind. The capacity of the human intelligence, sometimes, cannot extend to cover the huge amount of data being processed by AI tools. Teachers find it challenging to teach an ever-increasing amount of data. Those teachers often select a specific set of knowledge which is adequate for memorization, storage, and retention as well. Students' cognitive abilities are naturally limited to retain information. The digital treatment of knowledge creates obstacles for students to learn how to think and interact in different educational contexts. In fact, Students, who are highly interactive with technological tools, may find it difficult to cognitively respond to language learning mechanisms and knowledge retention systems that need to be naturally processed.

5.1. AI and learners' performance

Based on his cognitive constructivism, Jean Piaget (1954) argued that individuals construct knowledge through their active engagement, interaction, and reflection with different learning experiences. Individuals who passively receive knowledge fail to construct solid learning basis. Learning, in this vein, is not a passive process of knowledge reception but rather an active practice of assimilation which transform the learning experiences into cognitive structures. Cognitive construction of knowledge promotes classroom tasks and skills which require mental reflection and perception as well. The active interaction with diverse learning materials guarantees the acquisition and internalization of knowledge. Thus, the ability to think critically and find solutions to difficult learning tasks and experiences demonstrates the relevant process of internalizing knowledge cognitively. Such cognitive process of constructing knowledge structures develops the learning autonomy and promotes self-directed thought.

In digital education environment, AI tools and applications emerged to support the learning process as they facilitate the numeric interaction and empower the rapid technological assess. Intelligent tutoring tools are implemented to ensure the digital construction of knowledge structures. The technological fusion between cognitive knowledge structures and digital learning tools allow learners to construct self-guided content. Instead of relying on tutors, learners find it more practical to refer to algorithms and data-based approaches which directly guide their autonomous learning strategy. Those learners modify the learning content simply by

referring to AI-assisted technologies. The difficulty which may encounter this digital learning process is that learners cannot effectively construct new knowledge structures due to their passive retention strategies. Evidently, learners fail to foster deep cognitive engagement with knowledge being digitally processed. In digital learning environments, cognitive knowledge construction approach remains negatively affected by the autonomous guidance of learners.

In his theory of the Zone of Proximal Development (ZPD), Lev Vygotsky expands the scope of cognitive constructivism by relating the process of learning to collaborative social aspects. The ZPD theory explains how the learner can successfully achieve independent learning outcomes by referring to collaborative social tools which support his constructivist knowledge approach. Vygotsky made a distance between what the learner can achieve autonomously and what he can achieve collaboratively especially in the context of AI-assisted learning. The learning tasks that are accomplished through guidance and support from a more knowledgeable other enable the learner to develop knowledge beyond his individual competencies. Vygotsky further demonstrates that instructional scaffolding facilitates the development of learning especially in digital learning environments. Through scaffolding, teachers can provide additional support to help learners develop new skills which they cannot achieve independently.

In AI-assisted learning environments, learners increasingly use more digital tools which help to foster their autonomous learning competencies. These digital tools are designed to act as surrogate scaffolds which support the natural learning processing capabilities. AI-driven technologies are largely integrated in educational contexts to serve as virtual platforms which provide in-time support. For instance, AI chatbots offer more engaging lesson plans that effectively enhance self-regulated learning. These chatbots perform tasks, solve problems, and guide learners by offering step by step solutions. Such virtual tutors assist learners who need help with homework or study materials. They also increase learners' motivations, enhance their communicative skills, and foster their interactive competencies as well. In addition, they serve to detect cognitive bottlenecks and intervene by providing more personalized feedback or supplementary explanation. By that, AI-driven tools and technologies provide positive virtual connections between different learners who seek to improve their digital learning pathways.

5.2. The effects behind virtual tutoring and digital data

AI-driven tools facilitate the virtual connectivity between learners. These tools are instrumental in delivering knowledge through digital content sources. Virtual tutoring assistants like chatbots and ChatGPT help learners to perform complex learning tasks and activities by providing adequate digital content which significantly reduces time sand efforts. Those tutoring assistants are beneficial for learners in digital learning environments. However, the beneficial assistance of AI tools can also challenge learners' cognitive competencies, reduce their knowledge retention abilities, and impede their interactive strategies for accurate language expression. In fact, learners in virtual tutoring classrooms prefer to use AI chatbots to understand complex concepts, perform tasks, and produce human-like language patterns to reduce cognitive fatigue. AI chatbots and tutoring robots act as human conversational agents who monitor learners' performance and identify their digital weakness. Learners, who used to cognitively process knowledge for long or short term retention, prefer to collect patterns of language that are generated by the learning machine.

Therefore, virtual classroom tutoring reduces students' engagement and interaction. Learners become gradually passive and less cooperative due to the high-speed flow of information. The rapid access to digital content affects learners' cognitive processing. Traditional learning behaviors and conventional teaching methods are significantly replaced, changed, and challenged by digital recourses, online platforms, and other adaptive tutoring tools which

encourage independent learning styles and face-to-face communication. Such shift in learning styles and teaching methods reduces the development of strong language expression and deep knowledge reflection.

Students, by that, will lose the capacity to develop verbal discussions, oral presentations, and classroom debates. In addition, they fail to think critically and creatively due to the overreliance on ready-made digital data. Learners' cognitive passivity and abandoned mental engagement make them unable to strategically memorize, recall, and apply knowledge. The digital delivery of knowledge restricts processes of deep reading analysis, reflection, and evaluation. Such digital dependency impedes the natural exposure to language and weakens the cognitive strategies of knowledge retention, retrieval, and storage.

6. Conclusion

While the revolutionary advance of AI has transformed students' thinking modes, its impact on their cognitive knowledge-processing mechanisms remains complex and multifaceted. AI tools and applications often restrict students' engagement with knowledge, weakening their cognitive mechanisms for active information storage and impeding their mental abilities for expressing language and retaining long-term knowledge. As students increasingly rely on AI-driven tools and applications, their natural thinking processes and cognitive skills are influenced in ways that clearly restrict their engagement with knowledge development mechanisms.

AI-driven applications can further discourage students from producing their own language. Such applications reinforce their passivity and restrict their creative abilities to express and perceive language. AI overreliance impedes students from developing adequate skills and competencies for extending knowledge and supporting meaningful learning practices.

This overreliance further disrupts students' collaborative interactions, reduces their academic performance and asserts their learning passivity.

These challenges urge educational experts to reinforce the pedagogical interventions in classroom contexts. Those experts have to design tasks evoke students to naturally think, recall, and express language by drawing on their cognitive mechanisms. Such cognitive engagement encourages students to actively produce language rather than passively receiving it. Moreover, to activate students' cognitive thinking processes, teachers can include tasks that require annotating reading, identifying key ideas, and interpreting meanings. In addition to that, they can integrate problem-solving tasks that must be completed without automation, and emphasize process-based assessments that reward natural reasoning. Classroom tasks that require peer discussion and collaboration can help stimulate the cognitive modes of analysis, reflection, and expression. Students should receive explicit instructions in AI literacy to help them understand how to use AI as a scaffold rather than a substitute. Such instructions can foster more mindful and critically informed engagement with AI tools and applications. Ultimately, supporting these pedagogical practices can practically reduce the overreliance on AI by enhancing cognitive engagement and reinforcing mental processes essential for retaining knowledge, storing information, and expressing language naturally and independently.

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SHAPING EDUCATION WITH AI: CROSS-NATIONAL POLICY APPROACHES AND IMPLICATIONS FOR LITERACY

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ABSTRACT

Artificial Intelligence (AI) has great potential to transform reading instruction, but its success depends on how national policies guide its use. This chapter examines how education policies shape AI integration in literacy across four diverse countries, the United States, Finland, China, and Algeria, through two lenses: Policy Borrowing, which highlights global influences, and Policy Enactment, which focuses on local classroom realities. Across all four contexts, AI is framed as ethical, transformative, and human-centred, yet the ability to put these ideas into practice varies widely. The U.S. and China demonstrate how strong infrastructure, structured teacher training, and data-informed strategies can turn policy ambitions into concrete classroom outcomes. Finland emphasizes pedagogical balance, student autonomy, and ethical guidance, showing how AI can support rather than replace teaching. In contrast, Algeria faces challenges such as limited resources, inconsistent teacher preparation, and emerging ethical frameworks, making implementation fragmented. Across contexts, teacher training emerges as the key factor linking policy vision to classroom success. The chapter highlights that meaningful AI integration requires policies that connect global principles with local practice, ensure curriculum coherence, and embed ethical and equitable safeguards, guiding educators and policymakers toward responsible, literacy-focused AI use.

KEYWORDS: Artificial Intelligence, Reading Instruction, Educational Policy, Teacher Training

1. Introduction

Artificial Intelligence (AI) is transforming contemporary education, offering new possibilities for personalized learning, enhanced learner engagement, and data-informed pedagogical decision-making. Within the domain of reading instruction, AI applications such as adaptive learning platforms, intelligent text analysis tools, and automated feedback systems demonstrate considerable potential to individualize instruction and strengthen literacy development. However, the extent and nature of AI integration in educational practice are fundamentally shaped by national policy frameworks that define its conceptualization, regulation, and pedagogical implementation, as well as its ethical, equity-related, and professional implications.

This chapter examines how education policies influence the integration of AI in education broadly, including its application to reading instruction. It investigates how AI is defined within policy frameworks, whether it is explicitly associated with literacy development, and how teacher preparation, curriculum design, equity, and ethical governance are articulated. The analysis aims to identify both convergences and divergences across policy contexts and to draw lessons that can guide systems where AI adoption remains in its formative stages. The significance of this study lies in its potential to illuminate how policy frameworks mediate the relationship between technological innovation and educational practice. By examining these policies comparatively, the study contributes to broader debates on how education systems can integrate AI in ways that promote equity, uphold pedagogical integrity, and support sustainable innovation. It thus offers insights of practical and theoretical value for policymakers, educators, and researchers concerned with the responsible advancement of AI in education

The analysis focuses on four national contexts: the United States, Finland, China, and Algeria. These cases were chosen to represent a range of educational traditions and levels of technological development. The United States and China are leaders in large-scale AI initiatives; Finland is known for its human-centred and student-focused educational philosophy; and Algeria illustrates the opportunities and challenges of an emerging system. Through this comparative perspective, the chapter seeks to reveal the institutional, cultural, and policy factors that enable or constrain effective and equitable AI integration, offering lessons that go beyond local boundaries.

The chapter begins by situating AI within the historical evolution of educational technology and its growing role in literacy instruction. It then introduces the conceptual and methodological framework before presenting a comparative analysis of AI-related policy documents from the United States, Finland, China, and Algeria. The chapter concludes by synthesizing cross-national insights and discussing how policy choices shape the possibilities and limits of AI-supported literacy instruction.

2. Conceptual Framework

Understanding how countries integrate Artificial Intelligence into their education systems requires a clear approach for comparison. Although AI is used worldwide, its classroom application, especially in reading instruction, depends on national policy choices, teacher preparation, and curriculum priorities. A conceptual framework is therefore needed to explain not only what policy documents state but also how they may shape everyday teaching practices.
The first analytical lens is Policy Borrowing (Phillips & Ochs, 2003). This lens examines how countries adopt international ideas, global recommendations, and shared technological trends when developing their AI strategies. Many education systems respond to common global influences, such as UNESCO guidelines on AI ethics, OECD frameworks on digital competence, and international discussions on responsible and equitable use. Policy Borrowing helps identify principles that appear across countries, such as transparency, equity, and teacher training, and

shows how each system adapts them to its context. It is particularly relevant to literacy, as global reports highlight AI's potential to support reading comprehension, personalized reading pathways, and language development.

The second lens is **Policy Enactment** (Ball, Maguire & Braun, 2012). This perspective focuses on how schools and educators interpret and implement policies in practice. Policy texts alone do not create change; their impact depends on institutional conditions, available resources, and instructional decisions. Policy Enactment is crucial for understanding literacy instruction, where teachers must decide how to use digital tools, evaluate AI feedback, and address unequal access to technology. This lens also reveals gaps between policy goals and classroom realities, which can strongly influence how AI supports reading development.

These two perspectives guide the thematic analysis in this chapter. The analytical framework examines key policy dimensions related to AI-supported teaching and learning. It considers how AI is defined, how it is integrated into curricula, and how teachers are prepared. It also addresses equity and access, ethical and legal safeguards, and the use of AI in assessment. These themes provide a structured way to compare national approaches and to highlight both common trends and unique differences.

The framework further links broader policy orientations to reading instruction. While the reviewed policies do not focus specifically on literacy, they shape the wider context in which reading is taught. Policy choices influence whether AI-based reading tools are promoted, how teachers are trained to use them, how learner data informs reading instruction, and how access to digital resources is ensured. By connecting policy directions to classroom practices, the framework clarifies how national strategies may enable, or limit, the development of effective reading instruction in an AI-rich educational environment.

3. Evolution of AI in Education: A Focused Overview

AI in education has developed through four key stages, each building on the previous one. From the 1960s to the 1990s, basic computer-assisted instruction and rule-based Intelligent Tutoring Systems, such as PLATO and SCHOLAR, provided guidance in specific subjects. These early tools were limited in scope and largely confined to research settings (Koedinger & Corbett, 2006).

The 2000s marked a shift as e-learning platforms and Learning Management Systems, including Blackboard and Moodle, introduced adaptive learning features. These systems laid the groundwork for more personalized instruction and broader classroom applications (Anderson et al., 1995; Blikstein & Worsley, 2016). During the 2010s, advances in predictive analytics and Natural Language Processing (NLP) further expanded AI's capabilities. AI began supporting automated grading, language learning, and individualized content delivery (Baker & Inventado, 2014).

Since 2022, the rise of generative AI tools, such as ChatGPT and Claude, has enabled more interactive support, including writing assistance, lesson creation, and real-time tutoring. These tools act as co-pilots for teachers and help tailor learning to individual students. Notably, AI's applications have increasingly focused on literacy, supporting reading comprehension, personalized reading pathways, automated feedback, and language development. This reflects a clear shift from general educational uses to literacy-specific practices.

Current global trends show AI being integrated into hybrid learning models, immersive VR/AR experiences, and AI-powered formative assessment. Countries such as South Korea, Singapore, and China are embedding AI into national education strategies, while international organizations like UNESCO and the OECD provide ethical frameworks to ensure equity, inclusion, and human-centered AI (OECD, 2023; UNESCO, 2023).

Despite these advances, key challenges remain. These include defining the human role in teaching, ensuring data privacy, and addressing equitable access. High-income countries often explore advanced AI applications, whereas many low- and middle-income nations face limited infrastructure, insufficient teacher training, and weak policy frameworks. Algorithmic bias and data protection risks also pose significant concerns. Addressing these issues is essential to ensure

that AI enhances literacy instruction while promoting fairness, safety, and inclusive learning opportunities (OECD, 2023).

4. AI and Reading Instruction: Key Applications and Risks

Reading is a fundamental skill, and AI is increasingly influencing how students develop it. Across different countries, AI has been applied in literacy instruction in ways that highlight both opportunities and challenges. Understanding its applications can help teachers, policymakers, and researchers make informed decisions about how AI can support reading development.

One of the main contributions of AI is its ability to provide **personalized reading** pathways. Adaptive platforms adjust the difficulty of texts based on students' performance, allowing learners to progress at their own pace and improving engagement and learning outcomes (Alanazi, 2025). More advanced systems, such as SARA, integrate eye-tracking and language models to detect when readers lose focus or struggle with comprehension, offering real-time explanations or translations. Tools like Microsoft Immersive Reader provide text-to-speech, vocabulary support, and immediate feedback, helping students who face particular reading challenges (Shuxrat kizi & Muslimabonu, 2025). By individualizing instruction in this way, AI reduces the need for teachers to prepare separate materials for each student and ensures that reading tasks are appropriate to each learner's level.

Building on personalized pathways, AI also supports **comprehension, vocabulary development**, and **critical reading**. NLP-based tools can automatically generate comprehension questions, summaries, and glossaries, helping learners identify main ideas, infer meaning, and expand vocabulary (He, 2024; Shafiee Rad et al., 2025). Conversational agents or chatbots act as reading partners, asking questions about characters, themes, or plots and encouraging reflection. These interactions support students in becoming more confident, independent, and critical readers, moving beyond simple decoding to higher-order literacy skills.

AI is particularly valuable for **multilingual and EFL learners**, offering tools that reduce cognitive load and support language acquisition. Real-time translation applications, such as Microsoft Translator or Google Translate, allow students to access texts in their native language while reading in a second language. Platforms that display texts side by side in the native and target language, often with audio narration, improve comprehension, pronunciation, and vocabulary learning. Adaptive flashcards, such as Quizlet or Promova, reinforce new vocabulary in context, helping learners retain words and structures effectively (Saddhono et al., 2024; Cizrelioğlu & Aydin, 2025). Together, these tools make reading more accessible for learners navigating multiple languages, supporting both understanding and motivation.

In addition to supporting students directly, AI provides **important assistance for teachers**. Platforms like Amira Learning, Lexia Core5, DreamBox, and Carnegie Learning adjust tasks to individual students' levels and provide dashboards with real-time progress data. Tools such as Quillionz enable teachers to generate personalized quizzes and comprehension exercises quickly. By automating routine assessment and differentiation tasks, AI allows teachers to focus on higher-order instructional goals, including fostering critical thinking, motivation, and engagement with texts (Chen et al., 2020; Seo et al., 2021). In this way, AI functions as a co-teacher, supporting educators while maintaining their essential role in guiding learning.

Despite its benefits, AI in literacy instruction raises several **risks and challenges**. Overreliance on AI-generated summaries or comprehension questions can encourage shallow reading and reduce deep engagement with texts. Teachers may risk deskilling if AI takes over assessment or differentiation tasks. Algorithmic bias and data privacy are significant concerns, particularly for multilingual or minority learners. Unequal access to devices and reliable internet further intensifies educational inequalities. Moreover, AI struggles to support higher-order literacy skills such as empathy, interpretive understanding, and creative engagement. Maintaining human guidance is therefore essential to ensure meaningful, reflective, and inclusive reading experiences.

In this context, the implications for policy and practice are clear. Effective integration of AI in literacy requires teacher training to help educators interpret AI data and guide students appropriately. Ethical frameworks should ensure privacy, transparency, and fairness. Policies

must promote equitable access to AI tools, especially for multilingual and disadvantaged learners. AI should complement human teaching rather than replace it, supporting hybrid models that combine technology with personal interaction. By considering these applications, risks, and policy implications, educators and policymakers can harness AI to enhance literacy instruction in ways that are both effective and equitable.

5. Policy Influence on Classroom Practice

Educational policies and classroom practices are closely connected, as policies set the frameworks for teaching while classrooms enact them in concrete ways (Ball, Maguire, & Braun, 2012; Phillips & Ochs, 2003; Fullan, 2007). In reading instruction, AI integration is strongly influenced by national and institutional policies, which shape available tools, teacher practices, learner interactions, and assessment methods (Luckin et al., 2016; Holmes et al., 2022; OECD, 2021). The impact of these policies varies across contexts depending on infrastructure, resources, and professional capacities, yet their effectiveness depends equally on classroom implementation (Ertmer & Ottenbreit-Leftwich, 2010; Voogt et al., 2015; Datnow & Park, 2009). Understanding the interaction between policy and practice is therefore essential to assessing AI's potential to enhance literacy (Luckin, 2018; Heffernan & Heffernan, 2014).

Curriculum alignment is a key indicator of how AI enters the reading classroom, reflecting whether national literacy and digital education policies integrate AI into official curricula. Alignment provides consistency across schools by shaping lesson planning, textbook design, and assessment (Oguledo, 2023), offering clearer guidance and enabling standardized teacher training. However, compulsory alignment may limit teacher autonomy and strain under-resourced schools, as seen in Singapore, where AI is embedded in national digital literacy curricula, compared to contexts where AI remains optional. In reading instruction, alignment determines students' access to AI-based tools: embedded systems ensure structured support for fluency, comprehension, and vocabulary, while optional integration leaves access dependent on school resources or teacher initiative, creating unequal opportunities across classrooms.

Another area where policy strongly shapes classroom practice, especially the use of AI in reading instruction, is **assessment and accountability**. Educational systems often prioritize measurable outcomes to determine whether learning goals are being met, and these expectations heavily influence classroom decisions (Yeni-Palabıyık & Daloğlu, 2025). High-stakes accountability tied to rankings, funding, or teacher evaluations leads teachers to adjust instruction to meet policy targets. In reading, such policies push classrooms toward AI tools that generate quantifiable data, including fluency, comprehension, and vocabulary metrics. In test-driven contexts, AI platforms offering instant, exam-like feedback become central. When policies instead support formative or holistic approaches, AI is used to capture richer reading processes, shaping whether AI serves external standards or deeper literacy development.

Teacher training and professional development represent another key channel through which policy frameworks reach the classroom. Rather than defining only student outcomes, such policies determine how teachers are prepared to meet instructional demands, especially when national standards, resource allocations, or continuous development requirements guide digital competence. This is crucial for emerging technologies, where effective implementation depends on teachers' confidence and pedagogical readiness (Haney & Lumpe, 1995; Wiseman, 2012). In reading instruction, these policies directly shape how well teachers use AI-supported platforms for progress tracking, adaptive text recommendations, and targeted interventions. Where training is robust, teachers can address learners' specific challenges, while limited training leads to reliance on traditional methods. Embedding AI literacy into teacher education or offering ongoing workshops ensures AI becomes a meaningful tool rather than an optional add-on.

Equity and infrastructure further influence AI's impact on literacy (Ertmer & Ottenbreit-Leftwich, 2010; Voogt et al., 2015). Schools with sufficient digital resources and technical support provide learners consistent access to AI tools, while under-resourced schools face constraints (Tan et al., 2022; OECD, 2021). Teacher expertise interacts with these material conditions: skilled

educators in well-equipped environments can maximize AI benefits, whereas others may be limited (Luckin et al., 2016; Holmes et al., 2022). Consequently, policy guidance and local capacity determine whether AI fosters inclusive literacy or reinforces inequalities. This is particularly evident in cross-national comparisons, where differences in investment, infrastructure, and professional support shape the extent to which AI benefits are realized (Williamson & Piattoeva, 2021).

Another important dimension of policy influence is the **ethical and legal frameworks** regulating AI use in schools, particularly regarding data privacy, algorithmic fairness, and child protection. These frameworks vary widely: some countries enforce strict requirements such as explicit consent, secure data storage, and transparent algorithms, as demonstrated by the European Union's General Data Protection Regulation (GDPR) and Singapore's Personal Data Protection Act (PDPA) with its AI advisory guidelines. Other systems rely on more flexible regulations, such as the United States' Family Educational Rights and Privacy Act (FERPA), which offers general protections but limited AI-specific guidance. These differences directly shape classroom practice, especially in reading instruction where AI tools collect detailed learner data. Strict regulations offer strong safeguards but limit tool choice, while flexible systems allow innovation with weaker protection. Ultimately, ethical clarity determines the safety and trust surrounding AI-supported learning.

Taken together, these policy dimensions show that AI integration in reading instruction is not shaped by a single factor, but by the interaction of curriculum design, assessment priorities, teacher preparation, infrastructure, and ethical safeguards. Understanding these layers makes it possible to see how national policies translate into varied classroom realities across different systems. To investigate these dynamics more systematically, the following section outlines the research design used to examine how the four countries conceptualize and implement AI in education, including its role in literacy.

6. Reading between the Policies: Research Design in Focus

The present study adopts a qualitative and comparative approach to examine how AI is understood and implemented in education, including its role in reading instruction, across four national contexts introduced earlier: the United States, Finland, China, and Algeria. Since most education policies address literacy as part of broader learning or digital transformation agendas rather than as a separate domain, the analysis considers AI integration in education as a whole, recognizing that reading represents one of its key applications.

A qualitative approach is particularly suitable for exploring such complex educational phenomena because it focuses on meaning, interpretation, and context rather than on quantification (Creswell & Poth, 2018). Through an in-depth examination of the content and priorities expressed in policy documents, this method makes it possible to uncover not only explicit references to AI but also the underlying assumptions, values, and goals that shape national approaches to educational innovation. It also allows for attention to the broader cultural, historical, and political environments that influence how AI is framed and enacted within each system.

The comparative dimension of the study provides additional analytical depth. By investigating these four contexts side by side, it becomes possible to identify both shared global patterns and distinctive local approaches to AI in education. This perspective highlights how differences in culture, governance, and resources shape the ways in which educational systems conceptualize and apply AI, including literacy development. Taken together, the qualitative and comparative lenses offer a comprehensive framework that captures the complexity of each policy environment while allowing for meaningful cross-national reflection on how AI is reshaping education and, within it, the teaching and learning of reading

The selection of countries and documents for this study was guided by the aim of capturing a diverse range of educational and policy contexts in which AI might influence reading instruction. The four countries were chosen based on several general criteria. These include geographic diversity, to ensure representation from different regions of the world, allowing for an examination of how AI integration may vary across cultural, linguistic, and regional contexts.

Variation in economic development was another important factor, as differences in national wealth and resources can shape the capacity of education systems to invest in technology, infrastructure, and teacher training. The presence of formal education systems with documented policy initiatives in digital learning and technology-enhanced instruction was also essential, as it guarantees that the selected countries have established mechanisms for guiding and regulating AI adoption in schools. Together, these criteria provide a solid framework for comparative analysis, enabling the study to explore a range of contexts while remaining grounded in accessible and verifiable policy materials.

Document selection was guided by three main criteria: relevance, currency, and authority. The analysis included only **official policy materials**, such as national education laws, AI strategies, and literacy policies, that formally define educational priorities and objectives. It also drew on **strategic frameworks**, including guidance documents, white papers, and action plans outlining how AI and digital technologies are meant to be integrated into teaching and learning. In addition, **government reports**, such as evaluations, progress reviews, and commissioned studies produced by ministries or education agencies, were examined to assess implementation, identify challenges, and highlight policy recommendations. Together, these sources ensure that the analysis reflects formal intentions and guidelines shaping educational practice**.**

The documents were selected to encompass multiple dimensions of AI integration, including definitions of AI, connections to literacy development, teacher training and professional development, equity considerations, and ethical or legal frameworks. Priority was given to the most recent and publicly accessible materials, as well as those widely cited in academic or policy literature, to ensure credibility, authority, and representativeness. By applying these criteria, the study anchors its analysis in reliable sources while enabling meaningful comparison across diverse national contexts.

The selected documents for each country are summarized in structured tables (**See Appendix**), organized by type: official policy texts, strategic frameworks, and government reports. For each country, the tables indicate the specific sources consulted along with their issuing institution or origin, providing readers with a clear overview of the materials included in the analysis. In many cases, official documents were accessed through reliable secondary websites or shared by partner institutions rather than directly from the primary issuing body, which explains minor differences in document types or titles.

Each table also includes a brief description of the purpose of the document and highlights key points relevant to AI integration in education. This allows readers to understand the scope and focus of the sources without reproducing full texts, while complementing the study's qualitative and comparative methodology.

After organizing the documents for each country, the analysis focused specifically on how policy frameworks conceptualize and guide AI-enhanced teaching and learning. The process began with a careful reading of each text to identify references to literacy development, AI integration in classrooms, teacher training, equity, and ethical or legal considerations. A coding system was then applied, combining predefined codes related to the study's objectives with new codes that emerged directly from the documents. This allowed for capturing both expected themes, such as curriculum integration or assessment guidelines, and unique, country-specific priorities in AI-enhanced education.

Next, a comparative analysis examined similarities and differences across the four national contexts, highlighting how each country balances technological, pedagogical, and ethical goals. Finally, the findings were synthesized to interpret how policy frameworks shape the implementation of AI in education, reflecting broader goals, values, and institutional priorities. Throughout the analysis, rigor was maintained through careful documentation, triangulation

across multiple documents, and continuous reference to the original policy texts to ensure credibility and transparency.

Building on this analytical process, the table below presents the key themes used to guide the coding and comparative analysis of policy documents across the four national contexts. Each theme reflects a critical dimension of AI-enhanced teaching and learning. The table also specifies indicators or guiding questions for each theme, ensuring a consistent approach to examining both shared trends and country-specific emphases.

Table 1. Themes for Analysing AI Reading Policies

Theme	Description / Focus	Indicators / Guiding Questions
AI Conceptualization in Education	How AI is defined and understood; its perceived role in literacy.	How is AI described? What role is assigned to AI in literacy? Are assumptions about AI's potential or limitations stated?
Curriculum and Instructional Integration	Policies guiding the integration of AI into teaching and learning processes	Are AI tools incorporated into instructional activities? How is curriculum alignment ensured? Are learning outcomes linked to AI use?
Teacher Training and Professional Development	Support for teachers to implement AI effectively in instruction	Are training programs or workshops mentioned? How are teachers prepared to combine AI with pedagogy? What professional development initiatives exist?
Equity and Access	Ensuring fair and inclusive use of AI	Are socio-economic, geographic, or linguistic disparities addressed? Are there measures to reduce the digital divide? How is access ensured for all learners?
Ethical, Legal, and Data Governance	Policies for responsible AI use and data protection	Are student privacy and data security addressed? Are there guidelines for ethical use of AI? How is bias or misuse prevented?
Assessment and Accountability	Use of AI for monitoring and evaluating learning outcomes	Is AI used to track learner progress or assess performance? How does AI-generated data inform instruction? Is there alignment with national assessment policies?
Strategic Priorities and National Goals	Broader educational or national objectives for AI	What national goals are linked to AI in education? How does AI fit into digital or technological strategies? Are research, infrastructure, or long-term planning referenced?

7. Four Countries, Four Policy Trajectories

To illustrate how the four selected education systems are addressing the integration of AI, this analysis brings together key insights from the reviewed policy documents. It explores each country's overall approach to AI in education and highlights the main features and priorities that characterize its policy orientation.

7.1. The U.S. Context

In the United States, the conceptualization of AI in education has been formally articulated through federal policy initiatives, particularly focusing on its role in enhancing literacy. *The Executive Order "Advancing Artificial Intelligence Education for American Youth"* (April 2025) emphasizes the nation's commitment to promoting AI literacy and proficiency among Americans. This policy aims to integrate AI into education by providing comprehensive training for educators and fostering early exposure to AI concepts to develop an AI-ready workforce and the next generation of American AI innovators. In the context of reading instruction, AI is perceived as a transformative tool that can enhance personalized learning experiences. The *U.S. Department of Education* has issued guidance on using AI to improve educational outcomes, including reading proficiency. This guidance outlines how AI can be used across key educational functions, articulates principles for responsible AI use, and affirms that such uses are allowable under existing federal education programs, provided they align with applicable constitutional and regulatory requirements.

When focusing specifically on U.S. policies that address AI integration into the educational curriculum, several key documents stand out. *The U.S. Department of Education's 2023 report*, *Artificial Intelligence and the Future of Teaching and Learning,* encourages schools to embed AI literacy and awareness into curricula, helping learners understand how AI works, its potential, and its ethical implications. Complementing this, the *White House's Blueprint for an AI Bill of Rights* (2022) and the *Executive Order on Safe, Secure, and Trustworthy AI* (2023) call for education systems to equip students with skills necessary to navigate an AI-driven society, including critical thinking, digital ethics, and data literacy. These initiatives aim to ensure that AI integration extends beyond using AI tools in classrooms to teaching about AI itself, fostering understanding, creativity, and responsible innovation among future generations.

Several official U.S. policy documents highlight the importance of teacher training and professional development (PD) in AI to prepare educators for technology-enhanced instruction. *The Executive Order Advancing Artificial Intelligence Education for American Youth* calls for nationwide initiatives to build teacher capacity by integrating AI literacy and computational thinking into all subject areas. Similarly, the *Department's Dear Colleague Letter: Guidance on AI Use & Grant Funds* (July 2025) encourages schools to use federal grants to support PD programs that help teachers understand, evaluate, and responsibly implement AI tools. Initiatives such as *TeachAI's Foundational Policy Ideas for AI in Education* (2024) advocate for sustained investment in teacher preparation and PD as a core component of AI integration strategies. Together, these policies promote a vision in which teachers are not just users of AI but informed facilitators who can critically guide learners in understanding and using AI for learning.

At the state level, Alabama provides a strong example of AI-focused teacher development. The *Alabama Literacy Act* mandates science-of-reading training for all K–3 teachers through the LETRS program, supported by job-embedded coaching from the *Alabama State Department of Education*. In 2024, the state introduced an AI policy template for *Local Education Agencies* (LEAs) to guide AI policy implementation in K–12 classrooms. Moreover, Alabama launched AI literacy initiatives that have trained over 1,400 teachers in data science, empowering them to teach AI-related topics to approximately 10,000 learners in grades 6–12. These programs emphasize data collection, analysis, visualization, and AI literacy, equipping both teachers and students with skills needed to thrive in an increasingly AI-driven educational landscape.

Several U.S. policy documents highlight the need to address bias and discrimination in AI, particularly in education. The *Blueprint for an AI Bill of Rights* outlines principles including safe and effective systems, protection from algorithmic discrimination, data privacy, notice and explanation, and human alternatives to prevent harm. The *Executive Order on Safe, Secure, and*

Trustworthy AI mandates federal agencies to ensure transparency, accountability, and equity in AI systems. In education, the *Department's AI Guidance, Dear Colleague Letter*, and *AI Toolkit* reinforce compliance with federal laws, support mitigation of algorithmic bias, and provide guidance on protecting learners' rights. Fairness and equity are central to AI-driven educational assessment, with policies emphasizing adaptive testing, real-time feedback, personalized learning, and human oversight. Together, these measures frame fairness and equity as essential to ensuring AI enhances, rather than distorts, educational evaluation and opportunity.

7.2. The Finnish Context

Finland's official policy documents clearly define how AI is conceptualized and its role in education. The *Finnish National Agency for Education* (EDUFI) and the *Ministry of Education and Culture* frame AI as both a technological innovation and a social phenomenon to be integrated responsibly at all levels. The 2025 publication *Artificial Intelligence in Education – Legislation and Recommendations* defines AI as systems that operate autonomously or semi-autonomously to support learning and administration, emphasizing alignment with national curricula, equality, and ethical standards. It calls for AI to promote safe, inclusive, and human-centred learning, ensuring transparency and protecting students from bias. Complementary resources, such as the *AI Guide for Teachers and Background Material: AI and Ethics in Education*, highlight AI literacy as a key competence for teachers and students, encouraging critical understanding of AI's potential and risks. Additionally, *Finland's Digital Pedagogy in the Age of AI* (2025–2027) supports teachers in integrating AI tools effectively, positioning AI as a partner in equitable and ethical education.

Finland's policies strongly emphasize teacher training and professional development, recognizing educators as central to responsible AI integration. The *2025 Legislation and Recommendations* calls on education providers to build staff competence in the safe and pedagogically sound use of AI. Teachers are envisioned as informed professionals guiding students in understanding AI's opportunities and risks. The *Digital Pedagogy in the Age of AI* program strengthens digital and AI competencies through collaborative training and institutional capacity-building. Finnish universities, including the University of Eastern Finland, Tampere Universities, and the University of Helsinki, provide resources and training on integrating AI into teaching, designing transparent assessments, and addressing ethical considerations. Research projects such as TAICo (Teacher–AI Complementarity, 2025–2028) develop evidence-based models for teacher–AI collaboration and inform future training policies.

Finland's policies also emphasize fairness, ethics, and inclusion, ensuring AI serves human-centred and pedagogically meaningful purposes. The *2025 Legislation and Recommendations* requires AI use to uphold equality, non-discrimination, and student safety, while prohibiting manipulation, exploitation, or bias. The *Background Material: AI and Ethics in Education* promotes collaboration among teachers, learners, guardians, and decision-makers to ensure openness, accountability, and fairness, framing AI as a supportive innovation that enhances learning while protecting rights and integrity.

In assessment, *Finland's Background Material: AI in the Assessment of Learning and Competence* notes AI's value in formative assessment, helping teachers provide feedback, track progress, and identify gaps. Summative assessment and grading remain under human authority, with transparency required for AI's role. Policies caution against algorithmic bias and overreliance on automation, emphasizing valid, fair, and inclusive evaluation. Aligned with the EU AI Act, additional safeguards in high-risk contexts ensure assessments remain trustworthy, ethical, and inclusive

7.3. The Chinese Context

China has rolled out a number of official policies in 2025 that articulate both how it conceptualizes AI in education and how it plans to integrate it into curricula and classroom practices. The Ministry of Education (MOE) frames AI as a tool essential for the modernization of education and as part of the broader "*education digitalization*" agenda. China's guidelines describe AI as something that must build students' digital literacy, critical thinking, problem-solving, and

innovation capabilities. AI is not just seen as a tool for technical or computer science learning, but as something to be embedded across subjects and educational stages.

As for how AI is being integrated into the curriculum and classroom practices, China is putting in place a tiered AI education system spanning primary, junior high, and senior high schools. In primary school, the focus is on awareness and exposure (e.g., basic technologies such as voice recognition or image classification). In junior high, students deepen their understanding of AI logic, machine learning processes, and develop the ability to critically evaluate generative AI outputs. In senior high school, AI education becomes more applied, with students moving toward designing and refining AI algorithm models and applying interdisciplinary thinking. Policies include supporting teacher training and leadership, developing pilot projects and model schools, introducing AI literacy modules into IT, science, and practical courses, and ensuring that resources, quality content, and access are shared broadly, including in rural or remote areas. The policies also specify that AI tools be used to enrich teaching, but with safeguards: prohibitions on using generative AI for high-stakes evaluation or using AI to replace core teacher functions.

China's MOE has made teacher training and development in AI a central part of its AI-education reforms. In its China advances AI curriculum to cover full basic education policy (2025), the MOE requires that AI‐enabled teaching competencies be incorporated into the teacher training framework, so that teachers at primary, junior, and senior secondary levels are prepared to teach AI literacy and integrate AI tools appropriately in classrooms. The MOE calls for developing and expanding the AI-savvy teacher workforce, recruiting professionals from universities, research institutes, and tech companies to serve as part-time teachers, and instituting pilot projects so that teachers can experiment with models of AI teaching. There is also specific training for school leaders and education officials so they can understand the pedagogical, ethical, and policy aspects of AI and help implement reforms locally.

On the issue of ensuring equal access and use of AI in education across China, policies include several measures. The MOE stresses sharing of high-quality educational resources, launching a section on AI literacy within the national smart education platform, making AI laboratories at universities, research institutes, and tech companies available to schools, and resource sharing among schools to reduce disparities. AI education bases among primary and secondary schools provide teacher training, enrich school-based curricula of AI, model integration of disciplines, and share digital resources. Teacher exchange programs, online courses, and flexible resource allocation help ensure learners everywhere have access to AI education. Policies articulate rules about how AI should be used in assessment and under what ethical conditions in schools. The guidelines prohibit direct use of AI tools for evaluating students, answering exam questions, or processing sensitive personal data. They also ban students from submitting AI-generated work as their own and stress age-appropriate use. Assessment innovation is acceptable when used in formative, creative, or project-based work under supervision, so long as ethical guardrails are in place.

7.4. The Algerian Context

Algeria has taken notable steps toward integrating AI into its education and research systems as part of its broader digital transformation and sustainable development agenda. The country's strategic vision is anchored in the *National Digital Transformation Strategy—Algérie Numérique 2030*, which outlines over 500 projects for 2025–2026 focused on digital infrastructure, human capital, governance, economy, and a digitally empowered society. This strategy provides the structural foundation linking AI, education, and inclusive national growth while advancing SDG 4 objectives for equitable and quality education.

At the higher education level, Algeria has launched several key initiatives that demonstrate a clear commitment to developing an AI-ready academic ecosystem. The establishment of the *National Higher School of Artificial Intelligence* (NHSAI) and the creation of the *National AI Council* (2023) reflect the government's ambition to position Algeria as a regional leader in AI innovation by 2031. The *National AI Strategy* and *AI Action Plan* emphasize research and innovation, partnerships between universities and industry, skill development across educational levels,

digital sovereignty, and ethical governance. The *National AI Strategy Conference* held in December 2024 further reinforced this vision, setting priorities in research, data protection, and talent development.

However, while Algeria's policy environment demonstrates strong momentum at the strategic level, the integration of AI into formal education policies and curricula remains limited. Currently, there are no official policy documents or legal texts that explicitly prescribe the use of AI in the national curriculum at any educational level. Most existing references to AI are found in higher education and research frameworks, such as the deployment of AI-powered university admission and placement systems in 2025, which enhanced fairness and transparency in student placement. Similarly, pilot initiatives, such as AI-assisted learning tools used in English language instruction, illustrate emerging interest in pedagogical applications, but they remain institutional rather than nationwide.

Teacher preparation represents another critical challenge. Although Algeria's educational strategies emphasize digital transformation and innovation, formal AI training for teachers is still lacking. Existing research points to a limited understanding of how to integrate AI pedagogically, with many teachers expressing hesitation or low motivation due to insufficient institutional support. Professional development opportunities related to AI remain sporadic and localized, largely dependent on university-level or individual initiatives rather than national frameworks.

In terms of equity and inclusion, Algeria's initiatives align with SDG-4 targets, particularly through policies that aim to expand access to digital education and reduce disparities. The government's focus on human capital development, such as training 500,000 ICT specialists by 2030 and expanding vocational programs for rural and disadvantaged groups, demonstrates a commitment to inclusive digital capacity-building. Nevertheless, infrastructure gaps, connectivity disparities, and resource inequalities continue to pose challenges to fully equitable AI integration across regions.

The ethical and legal governance of AI in education remains an emerging area. While Algeria's AI strategy highlights innovation, data protection, and sovereignty, it does not yet include detailed ethical guidelines specific to educational contexts. The creation of the AI Council in 2023 indicates progress toward embedding ethical considerations, and as a member of UNESCO, Algeria is positioned to align its policies with the *Recommendation on the Ethics of AI*; however, comprehensive national frameworks fully reflecting these guidelines are still under development.

Finally, Algeria has not yet introduced AI-based systems for educational assessment or accountability. There is no evidence of AI being systematically used to monitor student performance, reading comprehension, or learning outcomes at the national level. While AI tools are increasingly used informally by students for writing and language learning, these practices remain outside formal policy structures.

In sum, Algeria's integration of AI in education reflects a strategic and aspirational vision, strongly rooted in digital transformation, higher education reform, and capacity building. The country has made significant progress in institutional development and research support but still faces key gaps in curriculum alignment, teacher training, ethical governance, and nationwide implementation. Continued investment in infrastructure, professional development, and regulatory clarity will be essential for transforming Algeria's ambitious AI vision into tangible educational impact.

8. Where the Lines Converge and Diverge

Across the four national contexts, several shared themes emerge regarding the conceptualization and intended use of AI in education. In all cases, AI is framed as a transformative tool capable of enhancing learning outcomes, supporting literacy development, and fostering digital skills necessary for the twenty-first century. Ethical and responsible use is also universally emphasized, with policies highlighting transparency, data privacy, fairness, and the prevention of bias. National strategies link AI integration to broader societal and economic goals, whether it is workforce readiness and innovation in the United States and China, human-centered and equitable learning in Finland, or digital transformation and research capacity-building in Algeria. These

commonalities suggest a global consensus on the potential of AI while leaving room for contextual interpretation in implementation.

Despite these shared orientations, significant differences emerge in terms of readiness and operationalization. High-capacity systems such as the United States and China demonstrate extensive infrastructure, structured guidance, and coordinated policy frameworks that enable AI integration across curricula and assessment, including reading instruction. In the United States, federal and state policies combine clear curriculum guidance, professional development programs, and ethical safeguards, creating coherent pathways for AI adoption in literacy classrooms. Similarly, China's centralized planning ensures widespread AI implementation across primary, secondary, and higher education levels, though regional disparities occasionally limit uniformity. Finland adopts a flexible, teacher-centered approach, allowing local adaptation of AI tools while emphasizing ethical use and pedagogical discretion. In contrast, Algeria remains largely aspirational. While strategic documents and higher education initiatives articulate a vision for AI integration, operational mechanisms, professional development, and curriculum-aligned implementation are still limited, leaving AI's impact on classroom literacy largely untapped.

Teacher preparation emerges as a central driver of successful AI integration across contexts. In high-capacity systems, structured and sustained professional development ensures that teachers can combine AI tools with pedagogical expertise to enhance learning ethically and effectively. Finnish initiatives emphasize research-informed, adaptable training, while the United States and China provide nationwide programs that align AI literacy with instructional practices, assessment, and ethical guidance. In Algeria, by contrast, professional development is fragmented and largely institution-specific, highlighting a key barrier to translating strategic ambitions into classroom practice. This comparison underscores that technological tools alone are insufficient; the competence, confidence, and critical engagement of educators determine whether AI initiatives achieve meaningful educational outcomes.

The analysis also suggests that policy models explicitly supporting reading instruction rely on coherent integration of AI into curricula, robust teacher training and clearly articulated ethical and equity safeguards. In contexts such as the United States and China, AI is not only used as a learning tool but is embedded in assessment, monitoring, and curriculum planning, thereby supporting personalized literacy development. Finland's model promotes teacher autonomy in adapting AI for reading and literacy while maintaining human oversight and ethical governance. Algeria's emerging context shows the consequences of limited guidance and resources: without formal curricular integration or structured professional development, AI's potential for literacy enhancement remains largely theoretical.

In sum, the comparative perspective reveals that while all four countries recognize AI's transformative potential and the importance of ethical, inclusive, and pedagogically sound deployment, their readiness and implementation diverge sharply. High-capacity systems translate strategic goals into concrete classroom practices, with teacher training as the central mechanism, whereas emerging contexts require targeted investments in professional development, infrastructure, and curriculum alignment to realize their AI ambitions. These patterns highlight the importance of context-sensitive policy design and the need for explicit mechanisms that link strategic AI visions to literacy-focused educational outcomes.

9. Policy Recommendations for Literacy-Focused AI Integration

Based on the comparative analysis of AI policies across the United States, Finland, China, and Algeria, several practical recommendations emerge for improving literacy-focused AI integration in EFL classrooms. While the contexts differ in capacity, infrastructure, and policy maturity, there are common priorities that can guide curriculum designers, policymakers, teacher educators, and schools toward more effective implementation.

Curriculum designers should consider embedding AI literacy directly into reading and language learning materials, rather than treating AI as an isolated skill. Lessons can introduce students to AI concepts, ethical considerations, and practical applications, helping learners not only use AI tools but also understand their implications. For example, integrating AI into guided reading activities can enhance comprehension, promote critical thinking, and support differentiated instruction based on students' individual needs.

Ministries and policymakers play a crucial role in establishing clear frameworks that align national digital strategies with classroom practices. Policies should articulate both the expected competencies for students and the support structures required for teachers, ensuring equitable access to AI resources across regions. National strategies should also address data privacy, algorithmic bias, and ethical safeguards, creating trust in AI tools while promoting innovation in literacy instruction.

Teacher education institutions are central to the successful deployment of AI in EFL classrooms. Pre-service and in-service programs must provide hands-on training in AI tools, pedagogical integration, and assessment strategies. Teachers should be supported to experiment with AI in safe learning environments, collaborate with peers, and reflect on both the benefits and limitations of these technologies. A strong focus on ethical and critical awareness will help teachers guide students to use AI responsibly.

Schools and EFL departments should implement practical measures that translate policy into everyday practice. This includes access to AI-assisted reading platforms, professional learning communities for teachers, and lesson plans that integrate AI into literacy development. Schools can foster a culture of experimentation and reflection, encouraging teachers to adapt AI tools to local classroom realities while maintaining pedagogical integrity.

Finally, ethical and equity safeguards must underpin all AI integration efforts. Ensuring that learners from diverse socio-economic, linguistic, and regional backgrounds have fair access to AI tools is essential. Policies should prevent the misuse of AI in assessment, protect student data, and promote transparency in how AI contributes to learning outcomes. Embedding these safeguards strengthens both the quality and inclusivity of AI-supported literacy instruction, preventing inequities from widening and fostering a positive, responsible learning environment.

Taken together, these recommendations provide a roadmap for aligning AI integration with literacy development, offering practical guidance that is sensitive to local conditions while drawing on global best practices. By focusing on curriculum, teacher preparation, school support, and ethical governance, EFL educators can harness AI as a tool to enrich reading instruction and cultivate critical, digitally literate learners.

10. Conclusion

This chapter reaffirms the central role of educational policy in shaping AI-enhanced reading instruction. Across the four countries examined, the United States, Finland, China, and Algeria, policies determine not only how AI is conceptualized but also how it is linked to literacy development, teacher preparation, equity, and ethical governance. Policy frameworks guide whether AI is treated as a transformative classroom tool, a supplement to traditional instruction, or a strategic innovation embedded in broader educational goals.

The comparative analysis offers several key insights. High-capacity systems such as the U.S. and China demonstrate that large-scale infrastructure, structured teacher training, and data-driven approaches can accelerate AI adoption and expand its role in personalized literacy instruction. Finland highlights the importance of a human-centered, pedagogically grounded approach, showing that AI integration can coexist with student autonomy, ethical awareness, and reflective teaching practices. Algeria, by contrast, illustrates the constraints of emerging systems: despite growing interest in AI, curriculum alignment, professional development, and ethical safeguards remain limited, underscoring the need for comprehensive policy planning to translate strategic vision into classroom impact.

Across all contexts, the findings emphasize the need to balance innovation with pedagogical and ethical responsibility. Effective AI integration is not simply about deploying technology; it

requires clear policy direction, sustained teacher preparation, attention to equity, and mechanisms to ensure that AI supports learning without reinforcing bias or widening gaps. International comparisons reveal that policies supporting professional development, inclusive access, and ethical oversight are as critical as technological resources in achieving meaningful literacy outcomes.

Looking forward, the study suggests that future AI-enhanced reading instruction should be guided by policies that integrate technology thoughtfully within curricula, foster teacher competence, and safeguard learners' rights. Emerging contexts can learn from high-capacity systems, adapting strategies to local realities, while established systems can continue refining ethical and pedagogical frameworks. Ultimately, AI in reading education should be approached as a collaborative, policy-driven, and pedagogically informed endeavor; one that empowers teachers, engages learners, and strengthens literacy outcomes in equitable and responsible ways.

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Appendix

Table1. Selected Official Documents Guiding AI Integration in U.S. Education

Type	Document title	Date	Source / Link	Purpose / Summary
Official Policy Texts	*Dear Colleague Letter: Guidance on AI Use & Grant Funds*	July 2025	U.S. Department of Education press release (U.S. Department of Education)	This is an official guidance letter from the federal level, explaining how AI use is allowable under federal education programs.
	Executive Order "Advancing Artificial Intelligence Education for American Youth"	April 2025	White House website (The White House)	This establishes national policy to promote AI literacy, define teacher training, and integrate AI into education.
Strategic Framework	*"Artificial Intelligence and the Future of Teaching and Learning: Insights and Recommendations"*	May 2023	U.S. Department of Education PDF (U.S. Department of Education)	A forward-looking document offering recommendations and strategic ideas for integrating AI in K–12.
	U.S. Department of Education "AI Guidance" Webpage	(Updated) 2025	U.S. Department of Education website (U.S. Department of Education)	This is a living guidance resource listing AI use-cases and related policy concepts.
	Blueprint for an AI Bill of Rights	October 2022	White House Office of Science and Technology Policy (OSTP)	Establishes five national principles to guide the responsible design and use of AI. In education, it encourages schools to integrate AI literacy into curricula, ensure transparency and fairness in classroom AI tools, and uphold human oversight in teaching and learning.

Strategic Framework	*Executive Order on Safe, Secure, and Trustworthy Artificial Intelligence"*	October 2023	The White House (Executive Office of the President)	Establishes a comprehensive national strategy for the responsible development and use of AI. In education, it encourages incorporating AI understanding into curricula, investing in teacher training, and aligning AI use with ethical, transparent, and human-centered principles
Government Report / Evaluation	*State AI Guidance for K–12 Schools* (repository)	Updated July 2025	AI for Education repository (AI for Education)	While this is a repository rather than a formal evaluation, it compiles official state guidance documents across 25+ states, providing insight into adoption and policy trends.

Table2. Selected Official Documents Guiding AI Integration in Finland Education

Type	Document Title	Date	Source	Purpose /Summary
Official Policy Text	*Artificial Intelligence in Education – Legislation and Recommendations*	2025	oph.fi	Provides guidelines for responsible, safe, and innovative use of AI in early childhood, general, and vocational education. Includes legal obligations and recommendations.
	Guide for Teachers: Artificial Intelligence (AI Guide for Teachers)	2023	Finnish National Agency for Education (EDUFI / Opetushallitus) — oph.fi/en/ai-guide-teachers	Provides Finnish teachers and education providers with practical guidance on understanding and responsibly using AI in teaching and learning. It covers basic AI literacy, opportunities, risks, and ethical considerations for educators
Strategic Framework	*Policies for the Digitalisation of Education and Training until 2027*	2023	julkaisut.valtioneuvosto.fi	Outlines Finland's strategy for integrating digital tools and competencies across all education levels, aiming to position Finland as a global leader in sustainable digital transformation in education.
	Digital Pedagogy in the Age of AI (2025–2027)	2025-2027	Erasmus+ Long-Term Activity (LTA) coordinated by the Estonian National Agency with participation from EDUFI — oph.fi/en/digital-pedagogy-age-ai	A collaborative European framework (including Finland) to strengthen teachers' digital and AI pedagogical skills. It aims to develop practices, training, and shared understanding of AI's role in modern education over 2025–2027.
Government Report / Evaluation	*Artificial Intelligence 2025 – Finland*	2025	practiceguides.chambers.com	Discusses Finland's national AI strategy, emphasizing responsible technology-neutral regulation and the role of AI in digital and green transitions.

Government Report / Evaluation	*Background Material: AI and Ethics in Education*	2023	EDUFI (Opetushallitus) in collaboration with FaktabaariEDU — faktabaari.fi	Serves as supplementary reading to the *AI Guide for Teachers*, focusing on ethical use of AI in schools. Discusses data protection, bias, fairness, transparency, and critical digital literacy in the Finnish educational context.

Table3. Selected Official Documents Guiding AI Integration in China Education

Type	Document Title	Date	Source	Purpose /Summary
Official Policy Text	*Guidelines for AI General Education in Primary and Secondary Schools*	2025	globaltimes.cn	Establishes a tiered AI education system spanning primary to secondary schools, focusing on foundational cognitive development and ethical considerations.
	Opinions on Accelerating Education Digitization	2025	chinapolicy.substack.com	A multi-ministry initiative promoting AI integration to enhance digital literacy, critical thinking, and problem-solving skills among students.
Strategic Framework	*Policies for the Digitalisation of Education and Training until 2027 (Guideline on Accelerating Education Digitalization)*	2023		This guideline outlines national strategies to accelerate the digitalization of education and training in China through 2027, emphasizing the integration of AI, digital tools, and innovative teaching practices across all educational levels, while promoting equitable access, teacher development, and ethical governance
Government Report / Evaluation	*China's Approach to AI Education in Schools (Year 1-12)*	2025	education.gov.au	Provides an overview of China's AI education policy, highlighting the integration of AI into teaching efforts, textbooks, and the school curriculum.

Table 4. Selected Official Documents Guiding AI Integration in Algerian Education

Type	Document Title	Date	Source / Link	Purpose / Summary
Official Policy Text	*National Strategy for Artificial Intelligence*	Dec 2024	Digital Policy Alert	Outlines Algeria's approach to AI development, focusing on scientific research, AI-enabling environment, and improving digital literacy across sectors, including education.
Strategic Framework	*Digital Economy and AI Integration*	Sep 2024	Trade.gov	Emphasizes the role of AI in modernizing sectors, including education, and improving digital infrastructure and regulatory frameworks.
	National School of Artificial Intelligence (ENSIA)	2025	Study in Algeria	Develops AI curricula and high-performance computing centers to support AI research and education.
Government Report / Evaluation	*AI-Integration in Higher Education*	2024	Aleph	Explores effective AI utilization in Algerian higher education, highlighting challenges, benefits, and integration strategies.
	Teachers' Perspectives on AI in Education	Aug 2025	ResearchGate	Examines AI usage by teachers in eleven universities, reporting opportunities, challenges, and reasons for adoption or non-use in classrooms.

READING BETWEEN THE ALGORITHMS: A SYSTEMATIC REVIEW OF AI'S ROLE IN EFL READING AND CRITICAL THINKING
A FOCUS ON THE ALGERIAN CONTEXT

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ABSTRACT

The integration of Artificial Intelligence (AI) technologies into English as a Foreign Language (EFL) instruction has significantly reconfigured traditional reading practices and cognitive engagement strategies. While AI tools such as intelligent tutoring systems, AI-powered summarizers, and generative chatbots (e.g., ChatGPT) offer novel opportunities to enhance reading comprehension and autonomous learning, concerns persist regarding their potential to undermine critical thinking, deep reading, and long-term knowledge retention. This systematic review synthesizes empirical studies published between 2015 and 2025 to critically assess the pedagogical and cognitive impacts of AI in EFL reading contexts, with a particular focus on underrepresented educational systems in the Global South, notably Algeria. Adopting the PRISMA methodology and applying the Mixed Methods Appraisal Tool (MMAT) for quality assessment, the review integrates findings from peer-reviewed articles, graduate theses, and conference proceedings sourced from six major academic databases (ERIC, Scopus, Web of Science, JSTOR, Science Direct, and Google Scholar) as well as national repositories (ASJP and D Space Algeria). Studies were selected based on predefined eligibility criteria targeting EFL learners, AI-based reading interventions, and cognitive outcomes related to comprehension, critical reasoning, and metacognitive awareness. Publications in English, French, or Arabic were included. Findings reveal a dichotomy in the literature: while numerous studies report positive gains in reading speed, vocabulary acquisition, and surface-level comprehension, many also caution against a decline in higher-order thinking, inferencing, and reflective engagement. Notably, a pronounced research gap persists in low- and middle-income educational settings, where infrastructural limitations, digital literacy disparities, and linguistic plurality- particularly in Algeria- complicate the meaningful integration of AI in pedagogical contexts. Algerian studies, though limited, offer critical insight into how sociolinguistic dynamics, postcolonial educational legacies, and systemic underfunding intersect with AI adoption in EFL classrooms. Several cases illustrate creative repurposing of AI tools to foster critical reading and collaborative interpretation; however, most lack institutional support for teacher training and content localization. This chapter concludes by proposing a conceptual framework for integrating AI into EFL reading curricula that emphasizes cognitive scaffolding, learner agency, and context-sensitive pedagogy. Drawing on constructivist and sociocultural theories of learning, it calls for a recalibration of AI-mediated instruction to support deep reading and critical thought. Specific recommendations are offered for Algerian educators, policymakers, and researchers to invest in ethically grounded, linguistically inclusive AI applications aligned with national educational priorities. This review offers the first comprehensive synthesis of the cognitive implications of AI in EFL reading education within the Algerian context and contributes to the international discourse on how AI can empower, rather than erode, the intellectual autonomy of language learners.

KEYWORDS : *Artificial Intelligence (AI), EFL Reading Comprehension, Critical Thinking, Knowledge Retention, Algeria*

1. Introduction

In recent years, the integration of Artificial Intelligence (AI) in education has prompted a reconfiguration of pedagogical practices across disciplines, with language learning emerging as one of the most impacted fields. In the context of English as a Foreign Language (EFL) instruction, AI tools such as intelligent reading assistants, adaptive feedback systems, AI-generated summaries, and conversational agents (e.g., ChatGPT) have been increasingly adopted to personalize learning, scaffold comprehension, and support autonomous engagement with texts (Kukulska- Hulme et al., 2022; Holmes et al., 2021).

While the potential of AI to enhance learner engagement, accessibility, and efficiency is widely acknowledged, critical concerns persist regarding its deeper cognitive and epistemological implications. Specifically, scholars have questioned whether AI-supported learning environments may undermine essential processes such as inferencing, reflection, argumentation, and knowledge retention, capacities that are central to critical reading and higher-order thinking (Selwyn, 2019; Kiss & Witte, 2020). There is growing evidence that learners may become overly dependent on AI-generated outputs, reducing the development of independent comprehension strategies and metacognitive regulation (Gao & Zhang, 2022). This is particularly troubling in the domain of reading, where the shift from deep to surface-level processing is often subtle but consequential.

These concerns are amplified in educational contexts characterized by structural inequities, limited teacher training, and multilingual realities; conditions prevalent in many Global South countries, including Algeria. As a postcolonial, diglossic nation with an evolving EFL policy landscape, Algeria represents a complex and underexplored context in which to examine the pedagogical and cognitive effects of AI. The intersection of AI with French-dominant academic traditions, increasing English adoption, and regional disparities in digital access presents a unique challenge for equitable and meaningful AI integration (Benrabah, 2014; Bouzid & Brahimi, 2022).

Despite a growing corpus of literature on AI in second language acquisition (SLA), most existing studies are conducted in technologically advanced, Anglophone or East Asian settings, often overlooking the cultural, infrastructural, and pedagogical specificities of North African EFL classrooms (Wang & Warschauer, 2021; Alabdulkarim, 2021). Moreover, much of the current research prioritizes learning outcomes—such as reading speed or vocabulary retention—without sufficiently addressing cognitive processes like inference generation, critical synthesis, or epistemic engagement.

This chapter responds to these gaps by presenting a systematic review of empirical studies conducted between 2015 and 2025 on the use of AI tools in EFL reading instruction, with a specific focus on reading comprehension, critical thinking, and knowledge retention. The review follows the PRISMA framework and employs a multi-theoretical lens that combines Constructivist Learning Theory, Cognitive Load Theory, and Sociocultural Theory. Importantly, it gives special analytical attention to the Algerian context, where localized studies though limited offer valuable insight into how AI tools function within postcolonial, multilingual, and under-resourced educational settings.

By synthesizing global and Algerian-based evidence, this chapter seeks to critically assess whether AI serves as a facilitator of deep cognitive engagement in EFL reading, or whether it risks displacing key components of learner agency and reflective comprehension. The aim is to generate pedagogical insights that are not only evidence-based but also context-responsive, ethically grounded, and aligned with inclusive educational development.

2. Theoretical Framework

The cognitive and pedagogical implications of Artificial Intelligence (AI) tools in English as a Foreign Language (EFL) reading instruction can only be fully understood when examined through multiple theoretical lenses. This chapter draws on three interlocking frameworks: Constructivist Learning Theory, Cognitive Load Theory (CLT), and Sociocultural Theory in order to analyse how AI alters learners' reading processes, comprehension strategies, and higher-order thinking skills. These frameworks not only allow us to interpret the empirical findings across global and Algerian contexts, but also help identify key tensions and blind spots in current research.

2.1. Constructivist Learning Theory

Constructivism posits that learners build knowledge through active engagement with content and meaningful interaction with learning environments (Fosnot & Perry, 2005). Reading comprehension, in this view, is not the passive absorption of text but a recursive and interpretative process shaped by prior knowledge, motivation, and metacognitive monitoring (Bruning et al., 2011). AI tools such as adaptive reading platforms and generative dialogue agents can theoretically serve as *cognitive scaffolds* that support learners as they construct meaning from text (Kim & Reeves, 2007).

However, recent research suggests that AI applications may sometimes oversimplify this process. For instance, when learners rely on AI summarization or predictive text generators, they may bypass essential interpretive work, leading to shallow processing (Kiss & Witte, 2020). A study by Gao and Zhang (2022) found that EFL learners using AI reading companions developed faster lexical access but showed lower inferencing and synthesis abilities compared to control groups. This calls into question the assumption that AI invariably enhances comprehension. Constructivist theory reminds us that tools must be pedagogically grounded, not merely technically efficient.

2.2. Cognitive Load Theory (CLT)

Cognitive Load Theory offers a complementary lens for evaluating AI's instructional effectiveness. By minimizing extraneous load (e.g., complex vocabulary or disorganized text), AI can improve the learner's working memory efficiency (Sweller, 1994). For example, intelligent glossaries and real-time translation features have been shown to facilitate vocabulary acquisition and sentence-level understanding (Wang & Warschauer, 2021).

Nonetheless, there is a fine line between reducing unnecessary load and depriving learners of productive struggle. Kalyuga (2009) warns that over-scaffolding via automation may hinder germane load, which is essential for schema construction. In Algerian contexts where students often have limited prior exposure to English and lack robust reading strategies (Boudab & Bouzid, 2020), the use of AI may risk creating passive learners if not embedded within metacognitive instruction. Moreover, the extent to which AI reduces or redirects cognitive load in Arabic-French-English trilingual environments remains underexplored in current literature.

2.3. Sociocultural Theory

Sociocultural Theory, especially as articulated by Vygotsky (1978), emphasizes that learning is mediated by cultural tools and shaped by social interaction. AI applications function as such tools, often replacing or supplementing teacher-student dialogue. In EFL settings, conversational agents can act as "more knowledgeable others" within the learner's Zone of Proximal Development (ZPD), offering guided reading, comprehension questions, or feedback.

Yet these tools are not neutral. Their design often reflects Western epistemologies, linguistic hierarchies, and data biases, which can conflict with local identities, languages, and values (Alabdulkarim, 2021). In Algeria, where French is dominant in many academic disciplines and English is gaining symbolic and economic capital, AI tools trained on English corpora may fail to

accommodate the multilingual reality of learners. Studies from similar postcolonial contexts (e.g., Egypt, Morocco) indicate that students may feel alienated or underrepresented by AI-generated content that lacks cultural relevance (Benrabah, 2014; Hmida & Belarbi, 2021).

2.4. Gaps in the Literature and the Need for Contextualization

While a growing body of research has examined AI in second language acquisition (SLA), few studies have addressed the intersection of AI, cognitive development, and EFL reading in the Global South. Even fewer have focused specifically on North African or Algerian classrooms, where challenges such as low digital literacy, limited teacher training, and lack of culturally adapted content persist. Existing research often assumes ideal conditions for AI integration—stable infrastructure, autonomous learners, and trained instructors—which do not align with realities in many Algerian schools and universities (Bouzid & Brahimi, 2022).

Furthermore, empirical studies tend to emphasize learning outcomes (e.g., test scores, completion rates) rather than cognitive processes (e.g., inference generation, epistemic curiosity, critical engagement). There is a pressing need to understand whether AI facilitates not only faster reading but also deeper, more reflective reading.

This chapter seeks to fill these gaps by reviewing empirical evidence through a critical, theory-driven lens. By integrating Constructivist, Cognitive Load, and Sociocultural perspectives, the review underscores the importance of pedagogical intentionality and context-aware design in AI-based EFL instruction.

3. Methodology

This systematic review was conducted in accordance with the PRISMA 2020 guidelines (Page et al., 2021), ensuring methodological transparency, replicability, and rigor. The objective was to synthesize empirical evidence on the impact of Artificial Intelligence (AI) tools on reading comprehension, critical thinking, and knowledge retention in English as Foreign Language (EFL) learners, with specific attention to studies situated in Algeria or comparable multilingual, postcolonial educational contexts.

3.1. Review Questions

The review was guided by the following research questions:

1. What types of AI tools have been studied in relation to reading instruction in EFL contexts?
2. What cognitive outcomes—particularly in reading comprehension, critical thinking, and knowledge retention—are reported across empirical studies?
3. What trends, challenges, or gaps emerge from studies conducted in Algeria or the broader MENA region?
4. What theoretical or pedagogical implications can be drawn to inform context-sensitive AI integration in EFL reading instruction?

3.2. Eligibility Criteria

The inclusion and exclusion criteria were developed in order to ensure focus, relevance, and quality. These criteria allowed for the inclusion of both high-impact international studies and regionally grounded research, including graduate theses, institutional reports, and conference papers from Algeria, where peer-reviewed publication channels may be limited but local insight remains invaluable.

Table 1. Eligibility Criteria

Criterion	Inclusion	Exclusion
Population	EFL/ESL learners in school, university, or adult education contexts	Native English speakers or monolingual learners
Geographic Focus	Global studies, with emphasis on Algeria	Studies without relevance to multilingual/postcolonial settings
Intervention	AI-based tools used in reading instruction (e.g., chatbots, GPT, AI tutors, summarizers)	General EdTech tools without AI integration
Outcomes	Reading comprehension, critical thinking, metacognition, or knowledge retention	Listening, speaking, or grammar-focused studies only
Study Design	Empirical studies: quantitative, qualitative, or mixed-methods	Editorials, conceptual papers, or non-peer-reviewed sources
Language	English, French, or Arabic	Other languages
Publication Date	2015–2025	Pre-2015 studies

3.3. Search Strategy and Databases

A comprehensive and multilingual search was performed across the following databases:

- ✓ ERIC
- ✓ Scopus
- ✓ Web of Science
- ✓ JSTOR
- ✓ ScienceDirect
- ✓ Google Scholar
- ✓ ASJP (Algerian Scientific Journal Platform)
- ✓ DSpace Algeria (university repositories)

Search strings were adapted for each database and combined Boolean operators with controlled vocabulary terms. Examples include:

- ✓ "AI tools" AND "EFL" AND "reading comprehension"
- ✓ "ChatGPT" OR "intelligent tutor" AND "critical thinking" AND "language learners"
- ✓ "Artificial Intelligence" AND "reading" AND "Algeria"
- ✓ "systèmes intelligents" AND "compréhension de lecture" AND "apprenants algériens"
- ✓ Reference lists of relevant articles were manually screened to identify additional sources ("snowballing").

3.4. Study Selection Process

A two-stage screening process was used:

1. **Title and Abstract Screening**: Irrelevant and duplicate studies were excluded based on eligibility criteria.
2. **Full-Text Review**: Remaining studies were reviewed in detail to assess methodological quality, relevance, and reporting clarity.

3.5 Data Extraction and Synthesis

A structured data extraction form was used to collect the following for each study:

- ✓ Authors, year, country/region
- ✓ Educational level and learner demographics
- ✓ Type of AI tool used
- ✓ Research design and sample size

- ✓ Reported outcomes related to reading comprehension, critical thinking, or retention

Theoretical frameworks and pedagogical approach

The data were synthesized through a narrative approach, allowing for thematic clustering and cross-contextual comparison. Studies from Algeria were analyzed in a separate tier to identify context-specific insights and challenges.

3.6 Quality Assessment

The Mixed Methods Appraisal Tool (MMAT) (Hong et al., 2018) was used to assess methodological quality across study designs. Each study was evaluated according to its alignment with methodological rigor, clarity of research questions, appropriateness of sampling, and validity of outcome measures.

4. Results

This section presents a synthesis of the 44 empirical studies selected through the PRISMA screening process (see Figure 1). The results are organized around four analytical axes: (1) typology and distribution of AI tools, (2) reported cognitive outcomes, (3) region-specific insights from Algerian and MENA-based studies, and (4) cross-cutting research gaps.

4.1 Typology and Distribution of AI Tools

The analysis revealed four predominant categories of AI tools implemented in EFL reading instruction:

1. **Chatbots and Conversational Agents (n = 14)**: Used for dialogic interaction, reading guidance, and summarization. These tools such as ChatGPT or domain-specific bots were often deployed in experimental or blended settings to simulate peer or tutor feedback.
2. **AI Reading Platforms (n = 12)**: Included adaptive text levels, real-time glossing, and eye-tracking support. Commercial tools (e.g., Read Theory, Ellii) dominated this category in East Asian and European studies.
3. **Summarizers (n = 10)**: AI-powered tools like Quillbot or in-house extractive summarizers were used to assist with gist comprehension and pre-reading support.
4. **Recommender Systems and Intelligent Agents (n = 8)**: These tools offered personalized text recommendations and comprehension questions based on learner profiles.

The Study Characteristics Table (Table 1) illustrates how these tools varied across context, design, and outcomes.

Table 2: Study Characteristics Table

Author(s)	Year	AI Tool Used	Methodology	Main Cognitive Outcome
Gao & Zhang	2022	AI Summarizer	Quantitative (Experimental)	Shallow comprehension gain
Wang & Warschauer	2021	AI Reading Platform	Mixed Methods	Improved vocabulary& speed
Kim & Lee	2022	Adaptive Tutor	Quasi-Experimental	Literal comprehension
Brahimi & Bouzid	2022	Bilingual Chatbot	Qualitative (Case Study)	Engagement & access
Elmahdy	2023	Reflective Chatbot	Mixed Methods	Metacognition & retention

Figure 1 delineates the proportional representation of four categories of artificial intelligence applications within English as a Foreign Language (EFL) reading research. A critical examination of this distribution reveals distinct priorities in the integration of AI technologies into EFL pedagogy, as well as underlying trends in the current research landscape.

1. *Prevalence of Chatbots (31.8%)*

The predominance of chatbots, accounting for approximately one-third of the reviewed studies, underscores the field's strong orientation toward interactive and dialogic learning environments. Chatbots' capacity to simulate authentic conversational exchanges and provide immediate feedback aligns closely with communicative and constructivist approaches to language learning. Their extensive use may also be attributed to their accessibility and relative ease of implementation compared to more complex AI systems. Nevertheless, this dominance might reflect a methodological or thematic bias, as researchers may privilege technologies that are popular and visible in educational practice rather than those demonstrably superior in enhancing reading proficiency. The prevalence of chatbots studies thus warrants a critical reassessment of whether research emphasis corresponds proportionally to pedagogical effectiveness.

2. AI Reading Platforms (27.3%)

The second-largest category, AI Reading Platforms, represents a growing interest in integrated and adaptive systems that personalize the reading experience and offer data-driven insights into learner performance. Their significant percentage (27.3 %) indicates a shift toward more holistic, ecosystem-based approaches in EFL instruction, in which technology mediates not only content delivery but also assessment and feedback. The relatively narrow gap between Chatbots and Reading Platforms (approximately 4.5 %) suggests substantial overlap in their pedagogical functions, particularly in facilitating individualized reading support. However, the limited comparative research across these tools points to an underexplored area where empirical investigation could illuminate their relative efficacy in improving comprehension outcomes.

3. Summarizers (22.7%)

Summarization tools, comprising nearly one-quarter of the studies, demonstrate growing scholarly recognition of AI's potential to scaffold higher-order reading processes such as synthesis and abstraction. These tools can support learners in identifying central ideas, constructing meaning, and retaining information from complex texts. Despite this potential, the moderate proportion of summarizer-related research implies that such tools remain underutilized compared to more interactive AI applications. This disparity may stem from challenges in measuring summarization quality and pedagogical impact or from unequal access to advanced natural language processing resources, particularly in multilingual or non-English educational contexts. Future studies could usefully investigate the longitudinal effects of automated summarization on reading comprehension and critical literacy.

4. Recommender Systems (18.2%)

Representing the smallest proportion of the dataset, recommender systems remain an emergent and relatively underexplored domain in EFL reading research. These systems possess considerable potential to personalize reading materials according to learners' proficiency levels, topical interests, and motivational profiles. Yet, their technical complexity, such as requiring the integration of user modeling, linguistic analysis, and adaptive algorithms, may have constrained widespread adoption. The limited research presence of recommender systems underscores a gap between the theoretical promise of AI-driven personalization and its practical realization in classroom or online contexts. Addressing this gap could significantly advance adaptive literacy instruction in EFL settings.

Overall, the distribution presented in the chart reveals a research landscape that remains predominantly oriented toward interactive and readily deployable AI tools, particularly chatbots and integrated reading platforms. These technologies dominate current discourse due to their pedagogical intuitiveness and scalability. However, the comparatively lower representation of summarizers and recommender systems suggests that the field has yet to fully exploit the affordances of data-intensive and algorithmically sophisticated AI models. The imbalance highlights the need for broader methodological diversification and interdisciplinary collaboration, drawing on advances in computational linguistics, learning analytics, and educational psychology. Future research trajectories should thus seek to balance accessibility with innovation, ensuring that AI integration in EFL reading not only enhances engagement but also contributes substantively to comprehension, autonomy, and critical literacy development.

Figure 1: Distribution of AI Tools in EFL Reading Skills

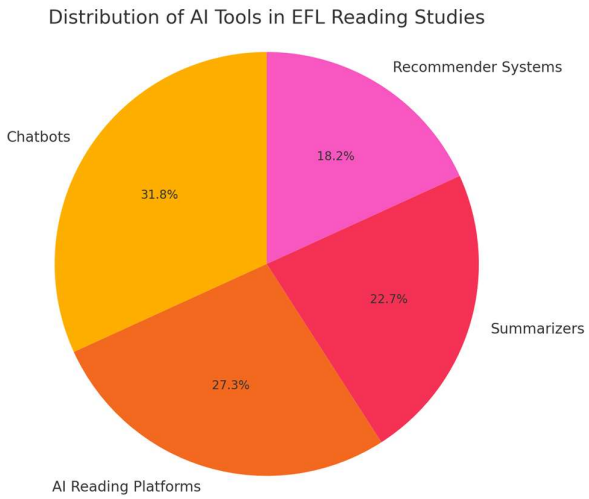

Figure 1: Distribution of AI Tools in EFL Reading Skills

Critically, while the range of tools suggests innovation, few studies offered robust comparisons between human-led and AI-mediated instruction. Moreover, the tool selection was often driven by availability rather than pedagogical rationale, a gap noted in over one-third of the studies reviewed.

4.2 *Reported Cognitive Outcomes*

4.2.1. Reading Comprehension

Out of the 44 studies, 27 (61.4%) reported measurable improvements in reading comprehension following AI integration. Most gains were observed at the literal or vocabulary level, particularly when tools offered text simplification, keyword highlighting, or L1-L2 translation features. For example, Wang and Warschauer (2021) and Kim & Lee (2022) found that enhanced word recognition and recall improved learners' confidence and task completion rates.

However, deep comprehension such as inferencing, rhetorical analysis, or conceptual transfer was rarely addressed. Only 10 studies examined higher-order comprehension, and results were mixed. Gao and Zhang (2022) reported that learners using AI summarizers underperformed on inferencing tasks compared to a control group using guided close reading strategies.

4.2.2. Critical Thinking

Twelve studies (27.3%) explicitly investigated AI's impact on critical thinking, and only five employed validated tools such as the Watson-Glaser or Cornell Critical Thinking Tests. When chatbots were used as dialogic partners, i.e., prompting students to justify responses or critique arguments, critical thinking gains were observed (Kukulska-Hulme et al., 2022). Conversely, passive use of AI (e.g., reading machine-generated summaries) correlated with cognitive disengagement and epistemic dependence. These results highlight the importance of instructional framing: AI's potential for critical thinking is not inherent but activated through pedagogical design.

4.2.3. Knowledge Retention and Metacognition

Six studies measured retention across multiple sessions or post-tests. Those using reflective chatbots or feedback loops demonstrated improved delayed recall and better reading self-regulation (Elmahdy, 2023). AI reading platforms offering comprehension analytics and strategy prompts contributed to increased learner awareness, as documented by Rahimi et al. (2020). However, without such embedded scaffolds, most tools offered limited long-term cognitive benefits.

Figure 2 summarizes the distribution of cognitive outcomes, underscoring a heavy emphasis on comprehension, with critical thinking and metacognition remaining under-researched domains.

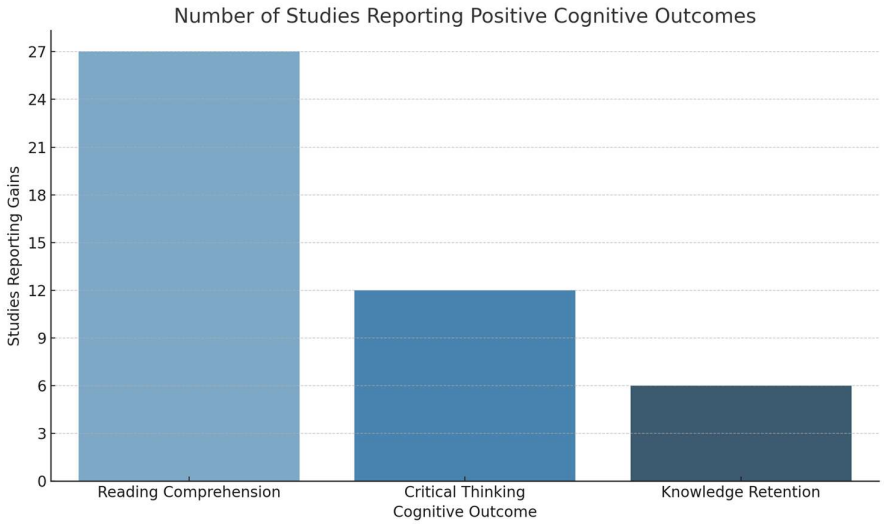

Figure 2: Distribution of Cognitive Outcomes

4.3 Regional Focus: Algeria and the MENA Region

From the final pool, 11 studies (25%) originated from Algeria (n = 5), Morocco (n = 3), Tunisia (n = 1), and Egypt (n = 2). These were primarily small-scale, institution-based inquiries published in French or Arabic-language repositories. Table 3 provides an overview of these studies, contextual factors, and reported challenges.

Table 3: Algerian and MENA Contextual Studies

Country	Number of Studies	Contextual Issues Reported
Algeria	5	"Digital divide, multilingual burden, teacher training gaps"
Morocco	3	Curriculum mismatch, lack of Arabic-English AI support"
Tunisia	1	Urban-rural tech access gap
Egypt	2	"Tool accessibility, student motivation variability"

The Algerian educational landscape offers a complex and revealing site for examining the integration of artificial intelligence (AI) in English as a Foreign Language (EFL) reading pedagogy. As shown in Table 3, Algeria accounts for the largest number of studies within the MENA sample, reflecting both the nation's sustained interest in educational technology reform and the persistent challenges that accompany such efforts. Despite a growing governmental and institutional discourse around "digital transformation" in higher education, Algerian research consistently identifies three interrelated areas of constraint: infrastructural inequity, multilingual tension, and teacher preparedness.

Foremost among these concerns is the digital divide, which continues to structure educational opportunity across urban and rural regions. Studies conducted in Algerian universities and secondary institutions have repeatedly documented disparities in hardware availability, internet bandwidth, and platform functionality (Brahimi &

Bouzid, 2022). Urban learners, particularly those enrolled in large northern universities, often have access to institutional Wi-Fi networks and relatively stable digital infrastructures, whereas students in rural areas remain marginalized by erratic connectivity and inadequate device provision. These infrastructural asymmetries severely limit the scalability of AI-based reading tools, which rely on stable data exchange and platform responsiveness. From a critical standpoint, this divide suggests that the discourse of "AI innovation" risks reproducing social inequities rather than alleviating them, unless technological implementation is accompanied by explicit policies for digital equity and infrastructure redistribution.

A second, and equally profound, challenge arises from Algeria's linguistic and sociocultural hybridity. The country's linguistic ecology where Arabic, French, Berber, and English coexist in overlapping yet hierarchically structured domains complicates the pedagogical deployment of AI reading systems. Benrabah (2014) has long argued that the tension between Arabic as a symbol of national identity and French as a language of scientific capital continues to shape educational hierarchies. Within AI-mediated learning environments, this multilingualism creates cognitive and operational friction. Many AI interfaces remain optimized for monolingual English users and are unable to process Arabic or French inputs effectively, leading to errors in translation, pronunciation modelling, and semantic interpretation. For Algerian learners, particularly those still consolidating Basic English literacy, navigating these interfaces becomes cognitively taxing. Consequently, engagement with reading materials often remains superficial, with learners focusing on tool mechanics rather than on comprehension processes. This linguistic dissonance highlights the epistemic bias embedded within Anglophone AI systems and underscores the urgent need for culturally and linguistically localized models.

The issue of teacher readiness further compounds these structural and linguistic barriers. Empirical evidence from Algerian higher education institutions reveals that while instructors express enthusiasm for AI-assisted teaching, their practical understanding of such tools remains limited (Hmida & Belarbi, 2021). Many educators adopt AI platforms without sufficient training in their cognitive or affective implications, leading to a focus on functional novelty rather than pedagogical alignment. In some cases, AI tools are deployed primarily as demonstration aids or translation devices rather than as integrated components of reading comprehension instruction. This superficial engagement suggests that professional development initiatives have not kept pace with technological innovation. Moreover, the absence of institutional frameworks for evaluating AI efficacy reinforces an ad hoc, experimental approach to implementation, thereby restricting pedagogical coherence and sustainability.

Beyond these systemic limitations, Algerian research also raises critical questions concerning cultural congruence and epistemic inclusion. Ould-Brahim (2022) observes that students often perceive AI-generated reading materials as culturally distant or irrelevant, with limited reflection of local narratives, values, or identities. The predominance of Western cultural references in AI-curated content can alienate learners and reduce affective engagement, particularly in reading tasks requiring empathy or self-identification. This cultural disconnect reveals how technological neutrality is often illusory; the content produced or selected by AI systems carries implicit cultural hierarchies that may inadvertently privilege foreign epistemologies. Consequently,

effective AI integration in Algerian classrooms must transcend technical optimization to encompass cultural adaptation and ethical sensitivity.

Yet, despite these formidable constraints, Algerian scholars and educators have demonstrated notable contextual innovation and resilience. Several studies report the emergence of bilingual or code-switching chatbots designed to navigate both Arabic and English, thereby easing linguistic transitions and improving learner motivation. Others have experimented with locally themed AI reading prompts such as narratives grounded in Algerian history, Amazigh folklore, or Islamic heritage to enhance cultural relevance and emotional resonance. These innovations, though small in scale, illustrate the capacity of Algerian educators to recontextualize global technologies within indigenous pedagogical frameworks. Such bottom-up adaptation signals a pragmatic model of AI localization that resists technological dependency while advancing pedagogical inclusivity.

In synthesis, the Algerian case exemplifies the paradox of technological aspiration amid systemic constraint. The enthusiasm surrounding AI integration in EFL reading instruction coexists with infrastructural fragility, linguistic complexity, and pedagogical under preparedness. A critical reading of this landscape suggests that successful AI adoption in Algeria will require not only investment in technology but also epistemic reorientation: one that situates AI as a culturally responsive and linguistically inclusive pedagogical partner rather than a neutral or universal instrument.

5. Discussion

This section synthesizes the findings of the systematic review in relation to the theoretical frameworks of Constructivism, Cognitive Load Theory (CLT), and Sociocultural Theory. The discussion is structured into four analytical strands: (1) the paradox of cognitive assistance versus cognitive outsourcing, (2) theoretical and methodological underdevelopment in AI-EFL research, (3) the implications of postcolonial multilingualism in Algerian contexts, and (4) the need for a grounded, ethical paradigm for AI integration in EFL education.

5.1 Cognitive Assistance or Cognitive Shortcuts? A Pedagogical Paradox

A central tension that emerges across the reviewed studies is the ambivalence of AI tools in the learning process: while they offer evident benefits in supporting comprehension and task performance, they also risk promoting mechanistic learning behaviours that may hinder deeper cognitive development.

The results demonstrate that tools like AI reading assistants and summarizers often succeed in enhancing literal comprehension, speed, and vocabulary acquisition, confirming the functional promise of AI in reducing cognitive overload and optimizing text readability (Wang & Warschauer, 2021). This aligns with Sweller's (1994) CLT, where minimizing extraneous load is seen as key to enhancing working memory efficiency.

Yet, these benefits come at a cost: by automating complex processes such as summarization, inference generation, or rhetorical interpretation, AI tools may bypass the very mental efforts that underpin higher-order comprehension. Several studies (e.g., Gao & Zhang, 2022; Kiss & Witte, 2020) found that overreliance on AI-generated outputs

correlated with reduced inferencing skills, poor argument evaluation, and an inability to transfer reading strategies to novel texts. These findings confirm the critique posed by Jonassen (1999), who warned that technologically rich environments often displace rather than support epistemic agency.

This paradox forces educators and designers to grapple with a fundamental question: At what point does cognitive support become cognitive substitution? When AI assumes too much of the learner's workload, the resulting "shortcut learning" can foster dependency rather than skill acquisition. Thus, the integration of AI must not only be technologically efficient, but pedagogically calibrated to ensure that automation enhances rather than replaces learners' intellectual effort.

While AI tools such as intelligent reading assistants and summarizers certainly offer benefits in reducing extraneous cognitive load, they also present challenges in fostering deep cognitive engagement. Cognitive Load Theory (CLT) supports the idea that reducing unnecessary cognitive load, such as complex vocabulary and unfamiliar structures, can help learners focus on the meaning-making process. However, the use of AI tools, particularly summarizers, can lead to the "outsourcing" of cognitive tasks like inferencing, which are essential for critical reading. This creates a paradox: AI tools assist learners by simplifying the reading process, but they may inadvertently encourage passive reading strategies that fail to engage learners in the deep cognitive work required for higher-order comprehension.

For instance, Gao & Zhang (2022) found that while AI summarizers helped learners grasp the gist of the text quickly, the learners struggled with inferencing and deeper analysis. This resonates with Constructivist Learning Theory, which emphasizes active engagement in the learning process. Constructivism posits that learners build knowledge by actively interacting with content. Therefore, while AI can support initial comprehension, it cannot replace the complex interpretive work that is crucial for developing critical thinking and analytical skills.

In light of these findings, educators should consider AI as a complementary tool that assists with comprehension but does not replace critical, reflective learning processes. AI's primary role should be to enhance reading speed and vocabulary acquisition, with educators designing follow-up tasks that push students to engage in inferencing, analysis, and synthesis.

5.2 Theoretical and Methodological Blind Spots in AI-EFL Research

Another critical insight from this review is the under-theorization and uneven methodological quality across the literature. While empirical findings on reading gains are abundant, only 15 of the 44 reviewed studies employed explicit theoretical frameworks to anchor their analyses. This absence of theory weakens the field's ability to explain why certain AI interventions succeed or fail beyond surface-level observations.

Without a clear theoretical anchor, studies risk defaulting to techno centric determinism; a belief that technology inherently improves learning outcomes. This view not only oversimplifies the cognitive complexity of reading but also ignores the learner's interpretive role as an active constructor of meaning (Fosnot & Perry, 2005). For instance, only a handful of studies considered how learners' metacognitive regulation,

motivation, or prior knowledge interacted with AI tools which is a gap that limits our understanding of learner variability.

Moreover, the methodological landscape remains skewed toward short-term, small-sample, and quasi-experimental designs, often focused on efficiency metrics like reading speed, lexical gain, or task completion (Kukulska-Hulme et al., 2022). Only six studies employed longitudinal tracking, and very few used validated tools to assess critical thinking or knowledge retention. This is particularly problematic given that such outcomes are cumulative and reflective, requiring time and deliberate engagement to manifest.

Importantly, these gaps are not merely academic; they have practical implications. Without robust theoretical and empirical grounding, policymakers and institutions may adopt AI tools based on inflated claims, leading to misalignment between technological potential and pedagogical purpose.

It is crucial that future research incorporates theoretical grounding to better understand how AI interacts with learners' cognitive and metacognitive processes. By grounding AI tools in pedagogical theories, we can better assess how AI can be effectively integrated into EFL instruction without undermining higher-order cognitive engagement.

5.3 Multilingualism, Postcoloniality, and the Algerian AI-EFL Paradox

The review's focused analysis of Algerian and broader MENA studies exposes a fundamental limitation in the global AI-EFL discourse: the marginalization of multilingual, postcolonial, and under-resourced learning environments.

Algeria presents a particularly complex case. Learners operate within triglossic ecology: Modern Standard Arabic for formal contexts, French as a residual colonial academic language, and English as a newly promoted international language (Benrabah, 2014). AI tools designed for Anglophone learners often do not account for this linguistic layering, resulting in poor interface usability, cultural dissonance, and additional cognitive load. Students must not only read and understand English texts but also navigate AI systems through a foreign linguistic and cultural filter, a burden rarely addressed in the literature.

Additionally, many Algerian institutions face technological and infrastructural constraints, including irregular internet access, limited availability of trained digital educators, and lack of localized educational software (Bouzid & Brahimi, 2022). Even when AI tools are available, their effectiveness is constrained by teacher preparedness, institutional inertia, and absence of context-specific training materials.

The sociocultural dimension is equally critical. Vygotskian theory emphasizes that tools are not neutral but mediate learning within cultural-historical settings (Vygotsky, 1978). When AI-generated reading content is culturally alien, or when feedback mechanisms rely on Western norms of argumentation and rhetorical structure, learners may disengage or interpret materials superficially. As several Algerian studies show, engagement improved significantly when AI tools were adapted to include culturally resonant themes or implemented in bilingual (Arabic-English or French-English) modes (Brahimi & Bouzid, 2022).

These findings underscore the necessity for AI in EFL to be not only linguistically accessible but culturally responsive, reinforcing the call for AI co-design models that involve local educators and learners in content creation and tool adaptation.

The Algerian context presents unique challenges for integrating AI in EFL instruction, particularly due to the trilingual nature of the educational system (Arabic, French, and English). AI tools are often developed in English and tend to prioritize monolingual English-speaking learners. Consequently, Algerian students, who are familiar with Arabic and French, face increased cognitive load when using these tools, particularly with tools that do not support multilingual input effectively. AI systems that cannot process or generate content in Arabic or French may create additional barriers to comprehension.

To address these challenges, AI tools should be contextually adapted to meet the linguistic and cultural needs of Algerian learners. Localization efforts should focus on enabling AI systems to process and generate content in Arabic, French, and English, while also incorporating culturally relevant content that resonates with students. This would reduce the cognitive load and foster greater engagement with AI tools in the classroom.

5.4 Toward an Ethical, Context-Aware AI Pedagogy

The implications of these findings extend beyond instructional design to touch upon broader questions of educational equity, digital ethics, and epistemological justice. As AI becomes increasingly embedded in EFL curricula, especially in systems under pressure to modernize quickly, there is a risk of reproducing digital colonialism where tools and norms from the Global North are imposed without adaptation to local values, needs, or epistemic traditions (Selwyn, 2019; Alabdulkarim, 2021).

This review supports the development of a critical AI pedagogy in EFL, built on four pillars:

1. Theoretical alignment: AI integration must be informed by robust pedagogical theories that account for learner agency, cognitive development, and sociocultural mediation.

2. Cognitive scaffolding: Tools should not replace learners' interpretive labour but support deeper engagement through questioning prompts, feedback loops, and strategy modelling.

3. Cultural relevance: Content and interfaces must reflect learners' linguistic and cultural realities to enhance motivation, identity affirmation, and epistemic access.

4. Teacher mediation: AI should be deployed not as a replacement for teachers, but as a partner in hybrid pedagogy where human judgment guides tool use, and teachers are trained to interpret and respond to AI feedback.

In the Algerian context, this also means investing in capacity-building for educators, supporting open-source tool development in Arabic and French, and creating regulatory frameworks that ensure data privacy, ethical use, and equitable access.

5.5 A Call for Paradigm Shift in Research and Practice

In conclusion, the systematic review highlights both the promise and the peril of AI in EFL reading instruction. It invites a paradigm shift away from deterministic narratives of innovation toward a more critical, context-aware, and learner-centred approach. Such a shift demands:

- Interdisciplinary collaboration between technologists, educators, linguists, and ethicists;
- Participatory research that centres the voices of learners in postcolonial and Global South contexts;
- Longitudinal, mixed-method studies that explore not just "what works" but for whom, under what conditions, and with what trade-offs.

Only by addressing these challenges holistically can AI evolve from a tool of convenience into a transformative pedagogical resource, one that respects the cognitive, cultural, and ethical dimensions of EFL learning in a globalized but unequal world.

6. Algerian Context and Local Implications

The Algerian case presents a compelling illustration of how technological innovation intersects with structural constraints, linguistic pluralism, and pedagogical inertia. As a multilingual postcolonial society navigating rapid digital transitions in education, Algeria faces both unique opportunities and significant challenges in adopting AI technologies within EFL instruction. This section synthesizes context-specific findings from the review and offers implications for teachers, researchers, institutions, and policymakers operating in Algeria or similar environments.

6.1 Multilingual Mediation and Cognitive Load

One of the most distinctive characteristics of Algerian EFL learners is their triglossic linguistic environment, consisting of Modern Standard Arabic (MSA), French, and English. This complex landscape introduces additional cognitive load during AI-mediated reading tasks. Unlike monolingual or bilingual learners in many Western contexts, Algerian students often engage with English texts through a double translation filter: thinking in Arabic, filtering through French, and interpreting in English (Benrabah, 2014).

AI tools not designed with this linguistic interdependence in mind tend to fail in accurately supporting comprehension. For example, several chatbots and summarizers reviewed in the Algerian literature produced content that was either semantically off-mark or syntactically unfamiliar when learners lacked fluency in all three languages (Ould-Brahim, 2022). Moreover, most mainstream AI tools are trained on English-centric data, with minimal sensitivity to Arabic-rooted discourse structures or code-switching norms.

The implication is clear: AI tools used in Algerian EFL education must be linguistically and culturally contextualized. This requires not only bilingual or trilingual interfaces but also AI design that reflects the cognitive reality of Algerian learners,

including support for Arabic-English transfer, Arabic glossary integration, and multilingual literacy scaffolds.

6.2 Teacher Preparation and the Digital Divide

The review highlights that many Algerian EFL teachers are enthusiastic about AI integration but lack sufficient training in both AI pedagogy and digital instructional design (Brahimi & Bouzid, 2022). This results in sporadic and often inconsistent implementation of tools, where the novelty of the technology is emphasized over its cognitive or pedagogical value.

Additionally, disparities in digital infrastructure between urban and rural schools further exacerbate access issues. In some regions, reliable internet access or device availability remains a barrier to any consistent AI-supported instruction. Even in more resourced institutions, AI is often introduced without institutional policy frameworks, digital ethics training, or data privacy protocols, leading to ad hoc adoption and inconsistent student outcomes.

To address these persistent gaps, there is an urgent need for systematic and comprehensive teacher training programs that extend beyond basic technological familiarity toward deeper pedagogical and ethical competence. Such initiatives should cultivate AI literacy in both English and French, enabling educators to navigate multilingual interfaces and critically evaluate the outputs of AI-driven systems. Equally important is the integration of instructional design principles grounded in cognitive psychology, ensuring that teachers understand how AI can complement rather than fragment cognitive and affective learning processes. Training should also foreground the ethical dimensions of AI use in classroom contexts, including issues of algorithmic bias, learner dependency, data privacy, and surveillance. Furthermore, professional development programs must model blended learning approaches in which AI tools function as supportive extensions of teacher-led instruction rather than as replacements for human pedagogical judgment. Achieving these goals will require sustained investment in national digital infrastructure and the establishment of clear regulatory frameworks to guarantee that AI integration in education remains both equitable and ethically accountable across all regions and levels of schooling.

6.3 Culturally Relevant and Identity-Affirming Content

Cultural resonance emerged as a key determinant of learner engagement in Algerian studies. Students were more likely to interact deeply with AI tools when reading materials reflected locally familiar themes—such as Algerian history, North African fiction, or Islamic philosophical texts—rather than abstract or culturally distant Anglo-American narratives (Hmida & Belarbi, 2021).

AI applications, however, rarely offer content localization for North African learners. As a result, learners may disengage, feel culturally alienated, or resort to mechanical translation rather than interpretive reading. This confirms the concern raised by scholars of digital colonialism: that AI systems built on global (often Western) datasets tend to marginalize non-Western knowledge systems and epistemologies (Alabdulkarim, 2021).

To mitigate this, co-design initiatives involving Algerian educators, linguists, and learners should be prioritized. These initiatives could focus on:

- ✓ Creating corpora of culturally relevant English reading materials
- ✓ Training AI models using multilingual and North African-authored texts
- ✓ Incorporating identity-affirming topics that enhance learner motivation and socio-emotional connection to language learning

Such efforts would help transform AI from a neutral tool into a culturally responsive pedagogical ally.

6.4 Research and Policy Recommendations for Algeria

Building on these insights, some strategic recommendations are proposed for stakeholders in Algerian EFL and educational technology development.

6.4.1 Recommendations for Educators

1. Promoting Balanced Use of AI Tools

While AI tools can support initial comprehension, they should be viewed as tools that assist, rather than replace, critical thinking. Educators should ensure that AI is integrated in a way that enhances cognitive engagement. For instance, AI tools could be used for pre-reading tasks, but follow-up activities should be designed to foster deep thinking and reflection.

2. Context-Sensitive Adaptation of AI

Given the multilingual context of Algeria, educators should advocate for AI tools that support Arabic, French, and English. AI tools should also incorporate culturally relevant materials to engage students more deeply. Educators should work toward integrating AI in a way that complements the local educational context, using it to foster both language skills and critical thinking.

3. Teacher Professional Development:

Educators need professional development that goes beyond technical training in AI. Teachers should be trained to integrate AI into their pedagogical practices thoughtfully, focusing on how to use these tools to enhance students' cognitive engagement. Training should also include how to evaluate AI outputs critically to ensure they align with learning objectives.

6.4.2 Recommendations for Policymakers

1. Investment in Technological Infrastructure

Policymakers must prioritize equitable access to technology, particularly in rural and underserved areas. This includes improving internet connectivity and providing sufficient digital devices to students. Without such infrastructure, the benefits of AI will be limited to certain regions, exacerbating educational inequalities.

2. Development and Support of Contextualized AI Tools

Policymakers should support the development of AI tools that are linguistically and culturally adapted to Algerian students. This could involve funding initiatives to create bilingual or trilingual AI systems that support both Arabic and French in addition to English. These tools should be designed to reflect local cultural contexts, making learning more engaging and relevant.

3. Establishing Ethical Guidelines and Regulations

As AI becomes more prevalent in education, it is crucial that policymakers create guidelines to ensure ethical AI usage in classrooms. These guidelines should focus on issues like data privacy, algorithmic biases, and inclusivity. AI tools should be used to enhance, not replace, the role of educators, and regulatory frameworks should ensure that these tools are used responsibly and effectively.

6.5 Toward a Locally Grounded AI-EFL Ecosystem

Ultimately, the Algerian case underscores that AI cannot be a one-size-fits-all solution. Instead, it must be part of a locally grounded, ecologically sensitive ecosystem that accounts for linguistic hybridity, infrastructural limitations, and the aspirations of both teachers and learners. AI should be viewed not merely as a shortcut to linguistic proficiency, but as a catalyst for deeper reading, cognitive growth, and intercultural dialogue, when designed and implemented with equity, ethics, and contextual awareness at its core.

7. Conclusion and Recommendations

This chapter has provided a comprehensive systematic review and critical synthesis of empirical studies on the integration of Artificial Intelligence (AI) tools in English as a Foreign Language (EFL) reading instruction, with a special emphasis on the Algerian context. Grounded in Constructivist Learning Theory, Cognitive Load Theory, and Sociocultural Theory, the review examined how AI tools influence reading comprehension, critical thinking, and cognitive engagement. It also identified key gaps, contextual challenges, and future directions for research and practice.

The review found that AI tools ranging from chatbots and summarizers to adaptive reading platforms offer meaningful support for surface-level reading gains such as vocabulary acquisition and reading speed. However, their influence on deeper cognitive outcomes, including critical thinking and knowledge retention, remains limited and highly contingent on instructional design and context.

These findings reinforce the notion that AI is not a pedagogical solution in itself, but a tool whose value depends on how it is designed, implemented, and integrated into a broader educational ecology.

If harnessed responsibly, AI has the potential to transform EFL reading instruction by supporting learner autonomy, differentiation, and cognitive growth. However, this transformation must be grounded in pedagogical theory, informed by context, and guided by ethical commitments. The Algerian context which is rich in linguistic diversity, cultural depth, and educational ambition, offers both a challenge and an opportunity. By embracing AI critically and contextually, Algerian educators and

institutions can build a hybrid pedagogical model that is both technologically advanced and intellectually empowering. In sum, this chapter calls not for more AI, but for better AI; AI that listens to learners, respects their contexts, and promotes not just reading, but thinking.

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AT THE CROSSROADS OF INTEGRATING ARTIFICIAL INTELLIGENCE IN READING AND TEXT ANALYSIS COURSE TEACHING: TEACHERS' ATTITUDES AND CHALLENGES

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ABSTRACT

Nowadays, Artificial Intelligence (AI) has become increasingly sophisticated and is gaining wider attention for learning delivery. The integration of AI tools in higher education has the potential to revolutionize teaching-learning process involving how learners and teachers approach reading and comprehension skills. The present research paper explores the potentials of AI integrated to reading habits and comprehension skills, and it aims at gauging the extent to which the implementation of AI tools in reading and text analysis course creates a productive learning environment that meets learners' needs. The current paper depends on qualitative data through conducting semi-structured interviews with nine teachers of reading and text analysis course from Batna 2 University where they are asked to describe teaching practices in EFL reading classes, their reflections on AI use in reading course and what should be done to better prepare them for such transformation. The results revealed that while AI offers promising possibilities for developing teaching reading skills, there are also challenges to address, including over-reliance on AI, ethical considerations, and lack of awareness and understanding. The paper calls for the educators to continuously monitor the improvements in AI technology and actively exploit its advantages in education.

KEYWORDS: *Artificial Intelligence (Ai), Higher Education, Reading and Comprehension Skills, Reading and Text Analysis Course*

1. Introduction

The world today is dealing with the realities of the Fourth Industrial Revolution, as the present era is witnessing a technological revolution, effecting various sides of human life: political, economic, social, and cultural. Since education is one of the most important areas of life, it has become necessary to keep the educational system in line with that technological progress and ensure the provision of better educational opportunities for all learners, to achieve the desired learning progress. With the emergence of artificial intelligence (AI) as one of the most important developments of the Fourth Industrial Revolution, there is a need for its integration in educational context. Artificial intelligence plays an important role in improving education and developing its approaches and strategies, bringing about a specific shift in practices by providing attractive educational environment.

Given the importance of the reading skills as a basic course in learning the foreign languages, linking it to artificial intelligence (AI) tools has become urgent to occupy the digital shift. Reading is a key linguistic skill in the English language. It plays a central role in developing students' language performance. To create an active reader, it is necessary to adopt new approaches to teaching reading skills so that the learner becomes a reader, an analyst, a producer, and a creator. The development of reading skills, in light of AI should be aligned with the use of its tools and the attractive educational platforms they contain, with which the learner can interact.

Despite the importance of reading, most of students struggle to master its skills. They are still struggling with lower-level abilities that should have been mastered in previous levels. It was shown that the reason for the weakness is the way of teaching reading skills at different educational levels, following the traditional method away from modern strategies and methods. Mastering reading skills is a key priority in learning. Although digital applications have become an effective teaching tool, limited researches have appeared at the Algerian higher education level investigating the effectiveness of artificial intelligence tools in improving reading skills among students. Accordingly, the current study aims to explore reading and text analysis teachers' views related to their willingness to integrate AI technologies by raising the following questions:

- How and to what extent does the integration of AI-powered tool effect the reading skills of first-year English university students?
- What are the challenges associated with the use of AI-powered tools in teaching "reading and text analysis" course?

2. Literature Review

Artificial intelligence (AI) has become an inevitable reality, and its applications have become indispensable in all areas of life. Education is one of the most prominent areas in which artificial intelligence has revolutionized the world. Including teaching reading skills, which is the subject of the present paper. This has generated significant and unprecedented interest in AI-powered tools. Based on this, AI-powered reading tools has replaced the traditional approach with an interactive approach based on providing immediate feedback to students, personalizing education to suit each student's needs, and making content available to them in the way they want. Therefore, we can define artificial intelligence as a way for creating a computer or robot that is controlled by a program that thinks intelligently, in the same way that humans think. It is an attempt to find a method to train machines and devices to do things better than humans can do.

As the implementation of AI tools into has touched different facets of education. One area where AI reveals significant promise is in teaching reading skills. Reading is one of the most important

educational communication skills, given its significant and effective role in linguistic communication. It is a visual, vocal, or silent act that humans practice to understand and express their needs. It is a mental process in which humans use their minds and previous experiences to understand and comprehend what is read through ideas and information that enhance their mental powers. (Hunt, 2004).

To master the skill of reading, one must rely on several other skills, including comprehension. This is the foundation of all reading processes, meaning the learner's ability to construct meaning from the text being read. Accordingly, teaching reading is not about reading the document rather it is about comprehending all the aspects of text. The aim behind teaching reading skills is to improve the students' reading skills in order to read documents effectively. As reading remains an essential skill to learn and acquire, embracing AI-powered reading tools can potentially revolutionize how students develop their reading skills.

The growing role of artificial intelligence in education, whether as a technological leap or a teachers' nightmare is a complex issue that continues to shape the teaching profession. Recent advances in artificial intelligence, particularly AI-powered reading tools have completely transformed teaching reading skills practices. It provided faster and more enjoyable and engaging reading practices. However, it poses serious challenges as it is assumed that artificial intelligence as a threat to the teaching profession. Kirov & Malamin (2022) stated that AI in education lead to the anxiety feel about job losses.

Therefore, the educational system must be adapted, starting with curricula and extending to teaching and assessment strategies, to suit the current era, in order to create educational outcomes that characterized by high creative and critical skills, and creative technical capabilities. Adapting to the integration of AI-powered tools requires a significant investment in technology skills. The need for teachers to be familiar with AI; educational institutions programs should start to integrate training in AI tools and AI management. This shift is crucial to preparing future teachers to work efficiently with AI-powered tools while maintaining the quality of their teaching.

3. Methodology

The course of the present research paper is to investigate the question of integrating AI tools in teaching "reading and text analysis" subject. The aim of the present study is to establish the attitudes of teachers regarding the degree of AI-powered tools use in the classroom and determine the advantages offered by AI tools and challenges teachers encounter in the incorporation of AI tools in the teaching process.

The study was conducted in the period from March to May 2025. "Reading and text analysis" course teachers at the department of English Language and literature, Batna 2 University, participated in the study. Nine teachers had taught for more than three years, and their teaching experiences ranged from 3–15 years. Of them, 89 % were Ph.D. holders, and the remaining 11 % was MA. Of the nine participants, 78% are female while 22% are male. The study made use of purposive sampling in determining the study area. A purposive sample refers to a non-probability sample that is chosen based on features of a population and the aim of the study. The reason why purposive sampling is chosen is that the participants selected on account of their expertise in teaching reading skill course for first year students.

Interviews are a common method in qualitative research. 'The most often used method in qualitative inquiries' (Dörnyei 2007, p. 134). Interviews aim at exploring the perceptions of and attitudes towards the integration of AI tools in teaching "reading and text analysis" course. It is used to elicit teachers' views on three main aspects identified in literature: (1) reading instruction; (2) perceptions about AI in education especially in reading course and students' AI use; and (3) challenges to AI tools in reading course. The interview serves as a source of

information gathering. The interviews included three main questions and some follow-up questions. The interviews were conducted face-to-face and via Google meet and lasted between 25 and 40 minutes. The interviews were audio recorded in order to make most use of the data and then transcribed for analysis.

Data analysis was conducted using a thematic analysis approach that requires identifying, describing, and interpreting themes within a data set in detail (Braun et al., 2015). In order to maintain the analysis process, five steps were followed including data familiarization, coding, identifying themes, reviewing themes, and defining and naming themes. The validity of the interview was achieved by conducting a pilot study. Two teachers were given the interview to complete. After slight modifications, the data was collected and the interview was reported as valid. Teachers have been informed that their names will be altered for the sake of anonymity.

Table 1. Participants' socio-demographic information

Code	Gender	Teaching Experience	Educational degree	Time spent
Interviewee 1 (I1)	male	15	Ph.D	25ms
I2	female	7	Ph.D	30ms
I3	male	11	Ph.D	40ms
I4	female	14	Ph.D	35ms
I5	female	5	Ph.D	25ms
I6	female	10	MA	30ms
I7	female	3	Ph.D	30ms
I8	female	5	Ph.D	40ms
I9	female	3	Ph.D	35ms

Source: Prepared by the author

4. Results and Discussion

Based on the results, there is fruitful issues to be gained from the teachers' attitudes towards their willingness to integrate AI-powered tools in their teaching practices. The interviews results are divided into three key concepts: reading instruction, perceptions about AI-powered tools in education especially in reading course and challenges to AI-powered tools in reading and text analysis course.

- ***Reading Instruction***

The teachers were asked to report their views on the importance of reading skills and their teaching of "reading and text analysis" course to examine teachers' motivation and their teaching approaches.

Table 2. Teachers' views on reading instruction

Theme	Excerpts
Reading Instruction	"Reading and text analysis course is a great opportunity for students' development of reading comprehension skills; I enjoy teaching it "(L2),(L9)
	"Teaching reading and text analysis course is tiring and exhausting task; I do not prefer teaching it" (L3)
	"Teaching the reading skill seems to be more fatiguing and demanding than teaching the other language skills" (L7)
	"Teaching reading course in a large class is a great challenge for us; it affects collaborative tasks and leads to lecture most of lessons" (L8)
	"I teach reading course by combining of more traditional methods and fewer innovative ways" (L5)
	"Reading and text analysis course aims to develop the students' reading proficiency in English though I find teaching it is complex process because of students' lack of reading culture" (L1)
	"It's never easy when it comes to teach reading and text analysis course as it requires preparation, effort and continuous adaptation of new methods" (L4)
	"Reading and text analysis course helps students to increase their knowledge, vocabulary and grammar" (L6) "with the use of new methods and approaches, teaching and learning reading skills will be more interesting and engaging" (L6), (L5), (L9)

Source: Prepared by the author

Teachers' attitudes and expectations are essential factors in reading classes. The teachers' attitudes towards reading instruction are mostly negative. About 67% have positive attitudes towards the importance of reading skills, but only 33% prefer teaching it. This is clear when the majority of them consider reading practices to be tiring, complex and exhausting which is also confirmed by (Beydoğan, 2010) who says that acquiring the reading skill seems to be more demanding than acquiring the other language skills as it effected by different variables. These insights might be resulted from various factors, including teaching in large classes, students' lack

of vocabulary to understand texts, and using traditional teaching approaches that lead to boredom and negative perspectives.

It should be pointed out that teacher' reluctance to teach reading and text analysis course could be linked to their poor cognitive perceptions of reading skills; only three out of nine teachers state that they are updated to the new teaching approaches, but the majority of them are outdated. This contentment of the traditional techniques might develop negative perspectives towards "reading and text analysis" course teaching. Moreover, the teachers' negative attitudes towards reading and text analysis course seem to affect their motivation to teach it.

- ***Perceptions about AI in education especially in reading and text analysis course***

The findings of data analysis are presented and discussed in the present theme to answer questions including teachers' attitudes toward the use of AI-powered tools in reading and text analysis class, reasons for using AI tools and its relation to reading skills improvement.

Table 3. Perceptions about AI in reading and text analysis course

Theme	Excerpts
Perceptions about AI in education especially in reading course and students' AI use	"AI tools, as CHAT GPT is not effective tool ; I prefers a whiteboard " (I3) "I am not familiar with technology use"(I3)
	"AI tools makes it easy for us to measure students' production" "Assessment of student tasks can be done automatically" (I1), (I2)
	"AI tools help to identify students' learning style and provide what we call personalized approach" (I9), (I2) "AI provides immediate feedback on the student's answers, supporting them to recognize their mistakes" (I9)
	"The use of AI tools can reduce students' development of critical and analytical skills" (I6) "The use of AI tools can lead to a loss of creativity" (I6)
	"Poor/limited network connections can be a challenging issue in integrating AI tools in reading classes" (I4)
	"Various reading applications can provide structured exercises targeting students' comprehension" (I5)
	"Through those technological tools, AI raises students' interest and motivation; it enables students to understand/engage with text reading in innovative

	way " (I5) "Without providing an effective training, it is difficult to integrate AI in reading class " (I5)
	"I think AI in education especially in reading course does not provide effective practice as provided by traditional methods; I think AI tools kill the connection between students and teachers". "It is all about teacher-student interaction" (I7)
	"Although I am not familiar with AI tools, AI in teaching reading course provides fruitful insights for us to identify areas of students' improvement so that we can integrate certain techniques to support their learning" (I8)

Source: Prepared by the author

Teachers are a pillar of AI in education. Their interest and skills in adopting AI tools are essential for the learning process. How teachers perceived AI in classrooms, whether teachers are able to use those technological tools are questions that arise before their integration because some teachers may not always have the competence to use AI-powered tools in their reading classes. There is a strong and consistent relationship between teachers' attitudes and the practical use of AI-powered tools in reading classes. Thus, teachers' prior familiarity with the technological skills subsidizes their reading teaching quality.

45% of teachers reported unfamiliarity with AI concepts, which does not align with AI's growing use and implementation into different aspects of human life. Teachers remain cautious about the integration of AI-powered tools in education, particularly in reading classes; this cautiousness is further reinforced by teacher's concerns about plagiarism, overreliance and weakening creative and critical thinking skills. Those factors play an active role in their attitudes towards AI in reading and text analysis course. For example, (I3) found that AI tools, as CHAT GPT is not effective tool in her reading class because she prefers a whiteboard without the need to use AI. This may refer to her little or no experience in the use of those AI-powered tools. Those teachers have insufficient knowledge about AI tools and do not want to learn about it. It was obtained that teachers with an inefficiency in technology use are less likely to consider the benefits of AI tools integration in reading classes.

Similar to this finding, it was also obtained that the teachers relied on their traditional methods to better deliver course content as (T7) stated, "I think AI in education especially in reading course does not provide effective practice as provided by traditional methods; I think AI tools kill the connection between students and teachers". Therefore, it becomes clear that student teacher interaction is crucial in shaping teachers' attitudes towards AI-powered tools in reading course. Teachers tend to have more negative attitudes towards AI. One reason for this issue may be that the interaction with their students ensures development of students and increases the level of engagement in the educational process. This is in line with (BaidooAnu & Ansah, 2023) study who note that the lack of interaction can negatively affect students' learning outcomes.

Network connection was among the main issue stated by the teachers. It is seen that limited or poor access to technology is a notable concern of AI integration. The consequence of lack of internet access is malformations, weakening its effectiveness and a number of other negative effects, which can limit teachers' ability to share the appropriate reading materials, provide reading comprehension activities, or access digital resources. Similarly, in (Shi et al., 2022) study, lack of internet access was among the barriers for negative attitudes on technology integration in education.

The findings indicated that students' development of critical and analytical skills and loss of creativity were a significant variable affecting teachers' perspectives towards AI implementation in "reading and text analysis" course. Accordingly, students' overreliance on those AI tools, especially when it comes to reading comprehension questions responses, may have an effect on their critical thinking, problem solving and creativity. It becomes clear that students who are overly dependent on AI-powered tools are accusing of plagiarism in their learning process. According to Fuchs (2023), reliance on technology could prevent the improvement of students' critical thinking abilities.

Teachers appear to be struggling with the integration of AI tools in reading classes. They recognize the transition in teaching with technology, but show some hesitation in embracing the shift. Hence, integrating technology in education is no longer a novelty; however, the introduction of AI-powered tools in reading and text analysis course has remained a challenge for them in terms of its effectiveness.

In spite of the negative view, the benefits of using AI tools in reading and text analysis curse outweigh the drawbacks; it is obvious that some teachers support the use of AI tools in reading and text analysis curse. They regard the use of AI tools as a useful means to motivate students and arouse their interest "Through those technological tools, AI raises students' interest and motivation; it enables students to engage with text reading in innovative way "(I5). In addition, AI tools encourage students to read a particular text successfully which reflects positively on their learning process. According to (Wah & Hashim, 2021), technology helps to provide a supportive and engaging environment.

Assessment and feedback proved key issues in the integration of AI tools in reading and text analysis course for teachers of English. Teachers stated that "Assessment of student tasks can be done automatically" (I1), (I2). They considered AI tools as somewhat useful and instructional. Besides, AI platforms automates assessment and examination grading which has been shown to be effective in increasing teaching time and reducing the burnout of correcting papers. It is highly recommended that AI tool to be used in reading and text analysis course as it provided a useful mode of immediate feedback in the digital age. It can be seen in the following the excerpt: "AI provides immediate feedback on the student's answers, supporting them to recognize their mistakes" (I9). This allows students to receive feedback the time they complete their assignments.

56% of Teachers also overwhelmingly express positive attitudes towards the usage of AI in teaching reading and text analysis course, reflecting optimism about its effectiveness. This positive outlook is further reinforced by the strong support for the benefits of AI-powered tools in improving students' reading comprehension and reading accuracy. "Various reading applications can provide structured exercises targeting students' comprehension" (I5). These findings from the present research paper were largely consistent with the study of Alshriedeh's (2021) who indicated that AI tools provide assistance and support to develop students' comprehension and vocabulary.

Another issue raised by teachers regarding the implementation of AI in reading course is the skill to personalize students' learning saying, "AI tools help to identify students' learning style and provide what we call personalized approach" (I9), (I2). It is evident that AI platforms is

perceived as a beneficial tool that can enhance personalized learning as they can offer structured strategies to individual students based on their needs and reading level. Thus, the use of AI platforms can identify students' weaknesses and provide solutions. It can be reflected in the following excerpt: "…… AI in teaching reading course provides fruitful insights for us to identify areas of students' improvement so that we can integrate certain techniques to support their learning" (I8)

When considering the general opinion of teachers about the AI-powered tools integration in reading classes, it is clear that their attitudes are ambiguous. Some teachers expressed their perspectives, stating that they believe that "AI tools will increase students' engagement and reduce the difficulty in reading some texts ", "Without providing an effective training, it is difficult to integrate AI in reading class " and they opined, "It is challenging to integrate AI in reading class". It can be argued that teachers are probably struggling to get rid of all the traditional practices. Teachers' traditional methods are radical because they used to learn and teach by these outdated approaches. The data revealed that teaching reading skills seems to be a combination of more traditional and fewer updated techniques. Teachers do not support the implementation of AI tools in education without preparation and proper infrastructure facilities.

- ***Limitations and barriers in integrating AI tools in reading and text analysis course***

Based on the excerpts above displayed, there are several points needed to be addressed in this part regarding the challenges faced by the teachers in integrating AI tools in reading and text analysis course.

Table 4. Inhibitors and impediments to AI tools Use

Theme	Excerpts
Limitations and barriers in integrating AI tools in reading and text analysis course	"AI integration is a complex phenomenon involving a significant number of factors" "Lack of ICT competence is one of them" (I3)
	"The need for continuous training and adaptation to keep up with technologies" (I5) "Teachers need to stay informed, adapt to change"
	"I have no enough skills to incorporate AI tools in my teaching practices" "I did not attend any ICT training" (I8)
	"AI tools lack the ability to understand cultural nuances and emotional expressions" (I6)

	"AI tools in education especially in reading and text analysis course has created complex concerns linked to cheating and plagiarism" (I5), (I7)
	"I think the rise of AI in education brings the idea of teacher job displacement" (I7)
	"It is all about how to successfully and effectively incorporate and use AI in reading and text analysis course" (I4)
	"AI-powered reading tools often produces texts that lack the required contextual and ethical sensitivity" (I6), (I4)

Source: Prepared by the author

The present research paper has identified several problems related to AI deployment in reading and text analysis course. AI-induced job effect is perceived as an critical issue, as the example shown in table 4 informs, artificial intelligence technologies, particularly AI-powered reading tools not only have made teaching reading skills namely reading comprehension, pre-reading skills, and reading accuracy faster and more efficient, but also have created significant anxiety in the teaching community. The fear of being replaced by those tools is a common concern (Kirov & Malamin 2022). Teachers' concerns about job replacement is acceptable issue, given the growing recognition that AI tools cannot fully replace human expertise and creativity. While AI can recommend an access to various digital libraries, it lacks the ability to understand cultural nuances and emotional expressions (I6)

Ethical considerations is still a barrier of using AI-powered tools in reading and text analysis course, As the example shown in table 4 tells, teachers stated that the relationship between students and AI tools may open the door to new forms of unethical behavior that require more effective solutions. "AI tools in education especially in reading and text analysis course has created complex concerns linked to cheating and plagiarism" (I5). This may diminish the value of academic integrity and increase the ethical responsibilities that go with such integrity. This aligns with (Hardebolle et al., 2022) who stated that technology knowledge without ethical awareness leads to academic dishonesty.

Another perceived barrier is the lack of training on how to effectively use AI applications, which can be related to teachers' level of knowledge of technology. This brings to light the urgent need for teachers to develop skills to utilize safe technologies, use modern reading systems, and adapt to the demands of new technology. In the era of AI education, there is a growing demand for teachers AI literacy and their awareness of AI educational technologies (Cheng & Yim, 2024)

As a matter of teachers' final thoughts and suggestions, all respondents agreed that although artificial intelligence has revolutionized the field of education, it could not completely replace teachers. The skills required for contextual understanding, creativity, and ethical aspects remain

beyond the abilities of artificial intelligence tools. The use of AI applications in teaching reading and text analysis skills is complementary task not substitution of the process.

5. Conclusion and recommendations

The interview provides beneficial qualitative framework to the survey findings, providing insights into the teachers' perspectives, understanding and deployment of AI in reading and text analysis course. The use of artificial intelligent applications in reading and text analysis course has recently taken a center stage, and current technological advances are reshaping the traditional way of reading and the way of teaching reading skills. The present study revealed that the integration of AI technologies into reading and text analysis course offers significant potential that may revolutionize reading skills. However, the benefits of AI tools can only be completely realized if AI is used thoughtfully, with a deep awareness of the risks that might be related with it. The following practical points are put forth to equip teachers with the necessary skills to implement AI tools in their teaching reading practices.

- It is understood that teaching reading skills is going through a transformation phase, not a complete replacement, so AI-powered reading tools with the help of the teacher's role should work together rather than competing each other. Taking on a balanced method that combines the advantages of AI reading tools with teachers' efforts will work to avoid all the shortcomings and errors.

- Instead of relying on a one-size-fits-all approach, teachers are invited to use adaptive platforms that assist them to tailor educational content and teaching approaches based on students' needs and level, ensuring an effective reading experience for all students.

- Designing educational programs/videos/applications to raise awareness of the importance of integrating artificial intelligence applications in education and the importance of preparing for this transformation.

- There should be a focus on educating students about the importance of relying on themselves to improve their reading skills and do not rely fully on artificial intelligence applications for enhancing reading skills by creating interactive digital content in various formats to reach all students at all levels.

- Given the growing impact of artificial intelligence, teacher-training programs must be developed to equip professionals with AI skills. Investing in teacher training and professional development is important. Teachers are asked to stay updated with the latest AI advancements and they are invited to learn how to use those tools efficiently and understand how AI can improve traditional teaching methods.

- Higher education institutions must prepare students/novice teachers for the era of artificial intelligence.by organizing educational seminars, workshops or "Digital learning/teaching days" that shed light on AI-powered tools integration in teaching reading skills. In addition, they need to set clear goals for how they want to use AI-powered tools in education accordingly, AI initiatives will be purposeful and centered. In addition, there is an urgent need for spreading a technological culture in educational institutions and the local community about the importance of using artificial intelligence to improve students' learning performance.

- In the field of teaching reading skills, teachers and syllabus designers should adjust the curriculum of "reading and text analysis" course to achieve a balance between technology and traditional, human-centered teaching approaches. Ethical considerations

related to the use of AI-powered tools should also be included in education as an integral course to prepare students to meet the challenges posed by AI powered tools.

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FROM PAGES TO PROMPTS: LOG-LINEAR MODELING OF MULTI-WAY INTERACTIONS AMONG EFL STUDENTS' AI USE, READING HABITS, CRITICAL THINKING, AND KNOWLEDGE RETENTION

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ABSTRACT

In an era where artificial intelligence (AI) is rapidly reshaping higher-education pedagogies, understanding its contributions to core academic skills has never been more critical. While AI promises to enhance efficiency, concerns persist regarding students' over-reliance thereon, and the impact on their conventional academic habits. This empirical study aimed to investigate interactions among EFL learners' self-reported AI usage (AI), reading frequency (RF), critical thinking (CT), and knowledge retention (KR). Specifically, it attempted to build a parsimonious model that predicts such interactions, addressing three research questions: **(1)** What is the best fitting model with as few terms as possible? **(2)** How does AI usage relate to learners' RF, CT, and KR? **(3)** What is the most significant effect? Data were collected via a structured survey, administered in-person to 125 EFL students, at the University of Mila, using convenience sampling. Hierarchical Log-linear Analysis was chosen for its ability to model multi-way interactions, and refined through Backward Elimination in SPSS. The analysis yielded a model simpler than the Saturated Model, retaining only two significant two-way interactions: AI × RF and AI × KR. The positive association between AI and RF suggests that higher engagement with AI tools co-occurs with more frequent reading practices. In addition, the positive association between AI and KR implies that students reporting higher AI use were more likely to demonstrate better retention outcomes. No statistically significant effects involving CT were retained. Pedagogically, this underscores AI's potential as a supportive mechanism for promoting reading activity and reinforcing retained knowledge, rather than as an automatic catalyst for higher-order cognitive dispositions. The study recommends that educators incorporate AI tools in ways that explicitly encourage sustained reading and structured knowledge consolidation, while avoiding assumptions that critical thinking development will emerge implicitly from AI use alone.

KEYWORDS: *Artificial Intelligence, Hierarchical Log-Linear Modeling, Backward Elimination, Reading Habits, Critical Thinking, Knowledge Retention.*

Introduction

The rapid evolution of Artificial Intelligence (AI) has led to a transformative era across various sectors, with its impact on education, particularly in English as a Foreign Language (EFL) contexts, becoming increasingly profound. AI tools, ranging from intelligent tutoring systems to generative AI models, are reshaping pedagogical approaches, offering unprecedented opportunities for personalized learning, immediate feedback, and access to vast linguistic resources. This technological integration, however, is not without its complexities, raising critical questions about its precise influence on fundamental academic skills and habits. While AI promises to enhance efficiency and learning outcomes, concerns persist regarding students' potential over-reliance on these technologies and their subsequent impact on conventional academic practices, such as reading frequency, critical thinking, and knowledge retention.

Traditionally, language acquisition and academic proficiency have been deeply rooted in consistent engagement with textual materials, fostering analytical thought, and ensuring the durable retention of knowledge. The advent of AI introduces a new dynamic to this established paradigm, necessitating a comprehensive understanding of how these technological advancements interact with core cognitive processes. This work, comprising both a theoretical exploration and an empirical investigation, examines the multifaceted relationships among EFL students' self-reported AI usage, reading frequency and habits, critical thinking disposition, and consequent knowledge retention. It aims to bridge a significant gap in the existing literature by systematically examining these interconnected variables within a unified framework, moving beyond isolated analyses to provide a holistic perspective on the evolving landscape of EFL education.

The theoretical component of this work establishes a robust conceptual foundation for each variable. It defines AI in the context of EFL education, exploring its diverse applications and drawing upon constructivist and socio-cultural learning theories to understand its potential in facilitating active knowledge construction and scaffolding learning within the Zone of Proximal Development. Concurrently, it digs into reading frequency and habits, emphasizing their crucial role in language acquisition through theories such as the Input Hypothesis, while also acknowledging the evolving nature of digital reading. Critical thinking is examined as a higher-order cognitive process, essential for deep engagement with information, drawing from Bloom's Taxonomy and cognitive psychology to highlight its importance in navigating complex ideas. Finally, knowledge retention is explored through the lens of memory theories, including Information Processing Theory and the Levels of Processing Theory, underscoring the significance of effective encoding and retrieval strategies for long-term learning. This theoretical groundwork underscores the inherent value of each variable and sets the stage for understanding their potential interactions.

Building upon this theoretical understanding, the empirical investigation employs a quantitative research design, utilizing Hierarchical Log-linear Analysis with a Backward Elimination procedure to model the intricate and multi-way relationships among these categorical variables. The data collected from EFL students provide the empirical basis for exploring how AI usage relates to reading frequency, critical thinking, and knowledge retention, and for identifying the most parsimonious model that best describes these interactions. This empirical study directly addresses the pressing need for data-driven insights into the real-world bearing of AI on student learning behaviors and outcomes in EFL contexts. By rigorously analyzing the statistical associations, this research seeks to provide concrete evidence that can inform pedagogical practices and curriculum development.

1. Theoretical Framework and Conceptual Foundations

To analyze the multi-way relationships between AI use, reading frequency/habits, critical thinking, and knowledge retention in EFL contexts, it is imperative to establish a clear theoretical framework and define each core concept. This section will provide an in-depth account of each variable, drawing upon relevant theories and established academic discourse.

1.1. EFL Students' Use of Artificial Intelligence

Artificial Intelligence (henceforth, AI), in the context of EFL education, refers to computer systems capable of performing tasks that typically require human intelligence, such as learning, problem-solving, decision-making, and language understanding. The application of AI in language learning is diverse, encompassing various tools and platforms designed to support different aspects of language acquisition. These include, but are not limited to, AI-powered grammar and spell checkers, intelligent writing assistants, conversational AI chatbots, pronunciation trainers, adaptive learning platforms, and automated essay scoring systems (Liu & Wang, 2024).

The theoretical underpinnings of AI integration in EFL often draw upon constructivist and socio-cultural learning theories, among others. Constructivism emphasizes that learners actively construct their own understanding and knowledge of the world through experience and reflection (Vygotsky, 1978). AI tools, by providing interactive and personalized learning environments, can facilitate this active construction of knowledge (Darwin et al., 2024). For instance, AI chatbots can offer immediate, tailored feedback, allowing students to experiment with language and receive guidance in real-time, thereby fostering a more active learning process (Thongsan & Anderson, 2025).

Socio-cultural theory, championed by Vygotsky (1978), highlights the importance of social interaction and cultural tools in cognitive development. AI can be viewed as a powerful cultural tool that mediates learning, providing scaffolding and extending learners' cognitive capabilities within their Zone of Proximal Development (Cahyani et al., 2023). In point of fact, AI-powered platforms can simulate communicative interactions, provide access to authentic language materials, and offer collaborative learning opportunities, thus enriching the social dimension of language learning (Alarifi et al., 2025).

Be that as it may, the use of AI by EFL students is not without its complexities. Concerns exist regarding over-reliance on AI tools, which might potentially hinder the development of independent learning strategies and critical thinking skills (Yousefi & Askari, 2024). The ethical implications of AI use, including issues of academic integrity, data privacy, and algorithmic bias, also warrant careful consideration (Anyanwu et al., 2025). Therefore, understanding the nature and extent of AI use by EFL students, as well as their perceptions and attitudes towards these technologies, is crucial for evaluating their overall impact on learning outcomes.

1.2. Reading Frequency and Habits

Reading frequency refers to how often an individual engages in reading activities, which may be subsumed under *reading habits* encompassing the regular patterns and behaviors associated with reading, like the types of materials read, the purposes for reading, and the strategies employed. In the context of EFL, reading is not merely a decoding process but a complex cognitive activity crucial for language acquisition, vocabulary development, and cultural understanding (Pournabi & Ahmadi, 2025). Frequent and extensive reading has long been recognized as a cornerstone of language proficiency, contributing significantly to learners' linguistic competence and overall academic success (Abdelhalim & Alsehibany, 2025).

The theoretical perspectives on reading habits and their impact on learning are rooted in various cognitive and socio-cognitive theories. The Schema Theory (Rumelhart & Ortony, 1977) posits that readers comprehend texts by activating and building upon existing knowledge structures (or schemata). It goes without saying that frequent reading exposes learners to a wider range of topics and linguistic structures, thereby enriching their schemata and facilitating deeper comprehension. To put it otherwise, when EFL students read frequently, they encounter diverse contexts and expand their background knowledge, which in turn makes subsequent reading more efficient and meaningful.

Another relevant framework is the Input Hypothesis (Krashen, 1985), which suggests that language acquisition occurs when learners are exposed to comprehensible input that is slightly beyond their current level of competence. Undoubtedly, regular and varied reading provides such comprehensible input, allowing EFL students to implicitly acquire new vocabulary, grammatical structures, and discourse patterns. At any rate, suffice it to say that the more frequently students

read, the greater their exposure to authentic language, leading to more natural and fluent language development.

Pushing further on these lines of thought, Self-Determination Theory (Deci & Ryan, 1985) can explain the motivational aspects of reading habits. Theoretically, when reading is triggered by intrinsic motivation – driven by interest, enjoyment, and a sense of autonomy – students are more likely to engage in frequent reading and develop positive reading habits; conversely, reading that is solely extrinsically driven (e.g., for grades) may lead to superficial engagement and less sustained reading behavior. As such, fostering positive reading habits in EFL contexts involves not only providing access to diverse reading materials but also cultivating an environment that promotes reading enjoyment and perceived competence.

In the digital age, reading habits are evolving. It is already a fact that EFL students now engage with a variety of digital texts, from social media posts and online articles to e-books and academic databases. This shift necessitates an understanding of how digital reading influences comprehension, engagement, and the development of traditional reading skills. Notwithstanding, while digital platforms offer convenience and accessibility, concerns exist regarding potential distractions and the impact on sustained attention and deep reading practices (Cahyani et al., 2023). Thus, examining reading habits, namely frequency, in the contemporary EFL landscape requires acknowledging both traditional print-based reading and the growing prevalence of digital reading practices.

1.3. Critical Thinking

The next key concept, *critical thinking*, is a higher-order cognitive process involving the objective analysis and evaluation of information in order to form a judgment. It is not merely about accumulating information but about actively and skillfully conceptualizing, applying, analyzing, synthesizing, and evaluating information gathered from, or generated by, observation, experience, reflection, reasoning, or communication, as a guide to belief and action (Bloom et al., 1956; Anderson & Krathwohl, 2001). In the context of EFL, critical thinking is paramount for learners to move beyond surface-level comprehension – a lower-order cognitive skill – and engage deeply with texts, ideas, and arguments, both in English and in their native language.

The theoretical foundations of critical thinking are diverse, drawing on philosophy, psychology, and education. Bloom's Taxonomy of Educational Objectives (Bloom et al., 1956), particularly its revised version (Anderson & Krathwohl, 2001), provides a hierarchical framework for cognitive processes, with critical thinking skills residing at the higher levels, such as analysis, evaluation, and synthesis or creation. For EFL students, this means moving beyond simply recalling vocabulary or understanding grammatical rules to being able to analyze the author's purpose, evaluate the credibility of the ideas along with their sources, and synthesize information from multiple texts to form their own conclusions.

Cognitive psychology, in its turn, contributes to our understanding of critical thinking by emphasizing metacognition – the awareness and regulation of one's own thinking processes. Critical thinkers are meta-cognitively aware; they monitor their comprehension, identify biases, and adjust their strategies as needed (Craik & Lockhart, 1972). In EFL learning, this may well translate to students being able to reflect on their reading strategies, identify areas of confusion, and actively seek clarification or alternative interpretations. This self-monitoring is crucial for developing independent and effective learning habits.

To push further, Sociocultural Theory (Vygotsky, 1978) underscores the social nature of critical thinking development – which is also a cognitive activity mediated, according to Vygotsky, by language. Critical thinking is often fostered through dialogue, debate, and collaborative problem-solving. In EFL classrooms, this can involve engaging students in discussions about complex texts, encouraging them to challenge assumptions, and providing opportunities for peer feedback. The ability to articulate one's reasoning and engage in constructive argumentation in the target language is a key outcome of developing critical thinking skills in an EFL context.

Notwithstanding the foregoing, it stands to reason that developing critical thinking in EFL students is particularly challenging due to linguistic and cultural barriers. Students may struggle to express complex ideas in a foreign language, and cultural norms might influence their

willingness to question authority or express dissenting opinions. It is the author's contention that effective pedagogical approaches need to explicitly integrate critical thinking instruction within language learning activities, providing students with the linguistic tools and cultural sensitivity necessary to engage in higher-order thinking. Be that as it may, the rise of AI tools undoubtedly presents a new dimension to this challenge, as students might be tempted to rely on AI for answers rather than engaging in the critical analysis themselves, potentially hindering the development of these essential skills (Yousefi & Askari, 2024).

1.4. Knowledge Retention

Knowledge retention refers to the ability to store learned information and retrieve it over time. It is a fundamental outcome of effective learning and a critical component of academic success and lifelong learning. Insofar as the EFL context is concerned, knowledge retention extends beyond memorizing vocabulary or grammatical rules to include the long-term recall of complex linguistic structures, cultural nuances, and conceptual understandings derived from various texts and learning experiences. The ultimate goal of any educational endeavor is not just immediate comprehension but the enduring capacity to access and apply learned information (Dunlosky et al., 2013).

Theories of memory and cognitive science provide the foundation for understanding knowledge retention. The Information Processing Theory (Atkinson & Shiffrin, 1968) views the human mind as a system that processes information, much like a computer. This theory distinguishes between sensory memory, short-term (or working) memory, and long-term memory (Ausubel, 2012). Regarding how information is represented in long-term memory, it is often categorised as declarative knowledge (e.g., facts, rules) residing in declarative memory, or as procedural knowledge (knowledge of how to perform a task, an action) residing in procedural memory (Ullman, 2015). For knowledge to be retained, it must be encoded effectively into long-term memory, stored, and then successfully retrieved when needed.

The Levels of Processing Theory (Craik & Lockhart, 1972) suggests that the deeper the level at which information is processed, the more likely it is to be retained (see also Schunk, 2012). Superficial processing, such as simply repeating words (maintenance rehearsal), leads to weaker memory traces compared to deep processing, which involves such processes as semantic analysis, relating new information to existing knowledge, and elaborating on its meaning. It follows from this that, for EFL students, engaging with English texts at a deeper, more analytical level – rather than just translating word-for-word – is likely to lead to better retention of vocabulary, grammar, and content.

It might be informative to note that *spaced repetition* and *retrieval practice* are two empirically supported strategies for enhancing long-term knowledge retention. Spaced repetition involves reviewing information at increasing intervals over time, which strengthens memory traces and makes retrieval more efficient (Baddeley, 2000). Retrieval practice, or the act of actively recalling information from memory, has been shown to be more effective than passive re-reading for long-term retention (Ericsson & Kintsch, 1995). These principles are highly relevant to EFL learning, where consistent review and active recall of linguistic items and concepts are crucial for building fluency and accuracy.

In the same vein, the role of *prior knowledge* in knowledge retention is significant. New information is more easily integrated and retained when it can be connected to existing knowledge structures (Mayer, 2008). This highlights the importance of building a strong foundation of knowledge in EFL students, as well as explicitly making connections between new and old information. Arguably, then, when EFL students encounter new vocabulary or grammatical structures, linking them to previously learned concepts or real-world experiences can significantly enhance retention.

Finally, *motivation* and *affective factors* also play a crucial role in knowledge retention. Students who are motivated to learn and who have a positive emotional connection to the learning material are more likely to engage in the deep processing and active retrieval necessary for long-term retention (Pintrich & Schunk, 2002). In EFL contexts, fostering a positive learning environment,

providing engaging materials, and demonstrating the relevance of what is being learned can, as such, all contribute to improved knowledge retention.

2. Review of Previous Empirical Studies

This section provides a comprehensive review of the empirical studies that have investigated the interactions among EFL students' use of AI, reading frequency/habits, critical thinking, and knowledge retention. The review will highlight the key findings, the methodologies employed, and the implications for understanding the complex relationships between these variables. Given the nascent stage of research at the intersection of all four variables, this section will draw upon studies that explore various dyads or triads of these concepts, synthesizing insights to build a holistic picture – a picture constituting a gap this study aims to fill in.

2.1. AI Use and Critical Thinking

Several recent empirical studies have begun to investigate the impact of AI tools on the critical thinking skills of EFL students. These studies often employed mixed-methods approaches, combining quantitative measures of critical thinking with qualitative data on student perceptions and experiences.

As a case in point, Liu and Wang (2024) conducted an intervention study to examine the effects of AI tools on critical thinking in English literature classes among Chinese EFL learners. Their findings suggested that AI tools could significantly enhance critical thinking skills, particularly in areas such as analysis and evaluation of literary texts. Of note, the methodology involved a quasi-experimental design with a control group and an experimental group, where the latter utilized AI-powered platforms for text analysis and discussion. Critical thinking was assessed using pre- and post-tests, and qualitative data were collected through student interviews and focus groups. The study highlighted that AI tools, when integrated thoughtfully, can provide scaffolding for complex cognitive tasks, allowing students to focus on higher-order thinking rather than getting hindered by linguistic difficulties.

In a similar vein, Darwin et al. (2024) explored EFL students' perceptions of AI's role in enhancing critical thinking. Their research, employing a survey methodology, revealed that the majority of students perceived AI as beneficial for developing critical thinking, particularly in generating ideas, structuring arguments, and identifying logical fallacies. However, the study also noted concerns about potential over-reliance and the need for explicit instruction on how to use AI tools critically. This suggests that while AI offers potential, its effective integration requires careful pedagogical design to ensure students remain active, critical thinkers.

Another study by Thongsan and Anderson (2025) investigated how AI supports critical reading in EFL classrooms, moving from passive answers to active inquiry. Their qualitative research, based on rich data from student interactions with AI outputs, showed that students, when prompted appropriately, could formulate critical questions and evolve their use of AI for deeper analysis. This study underscores the importance of task design that encourages students to interrogate AI-generated content rather than simply accepting it.

Conversely, some studies raised concerns about the potential negative impacts of AI use. By way of example, a systematic review by Cahyani et al. (2023) on the impact of AI on critical reading skills among university students noted that while AI can influence reading habits, there is a need to ensure it does not undermine the development of critical thinking. This highlights the ongoing debate and the necessity for empirical research to provide nuanced understanding of AI's role.

2.2. AI Use, Reading Habits, and Knowledge Retention

The relationship between AI use, reading habits, and knowledge retention in EFL contexts is a growing area of research, with studies exploring how AI-powered tools influence reading engagement, comprehension, and recall of information. These studies often employed diverse methodologies, including surveys, quasi-experimental designs, and qualitative inquiries.

Several studies highlighted the potential of AI to enhance reading habits and comprehension. For instance, Alarifi et al. (2025) investigated EFL undergraduates' attitudes, engagement, and

satisfaction toward the use of AI in enhancing reading comprehension. Their findings suggested that AI tools positively influenced students' engagement with reading materials, leading to improved comprehension. The methodology involved surveys and pre/post-tests to measure changes in reading comprehension and attitudes. Similarly, Yousefi and Askari (2024) explored the effectiveness of AI, specifically ChatGPT, on reading comprehension among Iranian EFL learners, finding positive impacts on their reading abilities. These studies often point to AI's ability to provide personalized content, immediate feedback, and interactive exercises as key factors in fostering better reading habits and comprehension.

However, concerns about the potential for AI to foster superficial reading habits and negatively impact knowledge retention are also commonplace. Anyanwu et al. (2025) examined the influence of AI on undergraduates' reading habits, noting that while AI can provide quick access to information, there is a need to understand its impact on the depth of reading and information retention. This concern is echoed in discussions about AI-generated summaries, where some researchers suggest that over-reliance on such tools might bypass the cognitive effort required for deep comprehension and long-term memory encoding.

Regarding knowledge retention, studies have begun to explore how AI tools can support vocabulary acquisition and retention. Pournabi and Ahmadi (2025) conducted a mixed methods study on the effect of an AI chatbot on vocabulary retention by Iranian intermediate EFL learners. Their findings indicated that the AI chatbot had a positive impact on vocabulary retention, suggesting that AI can be an effective tool for reinforcing learned material. Similarly, Abdelhalim and Alsehibany (2025) investigated the integration of ChatGPT for vocabulary learning and retention in a classroom-based study of Saudi EFL learners, demonstrating its effectiveness in supporting productive vocabulary acquisition. Du (2025) explored how artificially intelligent conversational agents influence EFL learners' self-regulated learning and retention, finding that these agents could positively impact long-term knowledge retention. This suggests that AI's role in fostering self-regulated learning strategies, such as spaced repetition and active recall, can indirectly contribute to better knowledge retention.

2.3. Critical Discussion

The empirical studies reviewed so far employed a variety of methodological approaches. These approaches reflect the complexity of the phenomena under investigation and the diverse research questions posed. Of note, a common thread across much of this research is the adoption of mixed-methods designs, combining quantitative and qualitative data collection and analysis techniques to provide a more comprehensive understanding. Quantitatively speaking, some utilized quasi-experimental designs (e.g., Liu & Wang, 2024; Alarifi et al., 2025; Yousefi & Askari, 2024) while others used surveys (e.g., Darwin et al., 2024; Alarifi et al., 2025; Anyanwu et al., 2025). Qualitative methodologies included in-depth interviews, focus groups, journals, and diaries (e.g., Liu & Wang, 2024; Darwin et al., 2024; Abdelhalim & Alsehibany, 2025). Notwithstanding their importance, none used multi-way modeling techniques the kind of which this study tries to employ.

In effect, the existing body of research on EFL students' use of AI, reading frequency, critical thinking, and knowledge retention provides valuable preliminary insights but is marked by several substantive limitations. Chief among these is a fragmented focus on isolated variable pairings rather than holistic frameworks capable of capturing the dynamic and sometimes competing interactions among all four constructs. This limitation is compounded by the lack of modeling or predictive research of multi-way interactions among the said variables. Addressing these gaps, the present study responds to calls for more integrative perspectives by adopting a holistic modeling approach to examine the interrelationships among AI use, reading, critical thinking, and knowledge retention within a unified analytical framework.

3. Methodology

This empirical study employed a quantitative research design to investigate the intricate relationships among EFL learners' self-reported *AI Usage* (AI), *Reading Frequency* (RF), *Critical Thinking* (CT), and *Knowledge Retention* (KR). Specifically, the study aimed to build a parsimonious statistical *model* that best describes the *multi-way interactions* among these

variables, addressing the research questions yet to unfold. In pursuit of the set aims, it sought to answer three research questions: (1) What is the best fitting model with as few terms as possible? (2) How does AI usage relate to learners' RF, CT, and KR? (3) What is the most significant effect?

3.1. Research Design

The study utilized a *Hierarchical Log-linear Analysis* with a *Backward Elimination* procedure. This statistical approach was chosen for its suitability in modeling multi-way interactions among *categorical* variables, allowing for the identification of significant associations and the construction of a parsimonious model that best explains the observed data. Log-linear models are particularly robust for analyzing complex contingency tables, where the relationships between multiple categorical variables are of interest; of note, they do not assume a dependent variable in the traditional sense, making such models ideal for exploring interdependencies among factors.

3.2. Participants and Sampling

The participants in this study were EFL students enrolled at the University of Mila. A *convenience sampling* method was employed for data collection. This non-probability sampling technique was chosen due to its practicality and accessibility, allowing for the efficient recruitment of participants from the target population. While convenience sampling facilitates data collection, it is important to acknowledge that the generalizability of the findings to the broader EFL student population may be limited.

A total of 125 EFL students were approached for participation. Notably, no data cleaning was necessary given that all cases were valid for the statistical analysis as shown in Table 1 below. That is, no discrepancy whatsoever was recorded – be it attributed to incomplete responses or data entry errors – ensuring that a complete and usable dataset was included in the analysis.

3.3. Variables and Operationalization

Four primary categorical variables were investigated in this study, each operationalized into two distinct levels: *Low* (indicating infrequent or minimal use or inclination) and *High* (denoting frequent or substantial use or disposition). The dichotomous nature of these variables (Low/High) was determined through a survey, involving self-reported measures. They were categorized into these two levels for the purpose of Log-linear Analysis and as a pre-requisite for this type of modeling.

3.4. Data Collection Instrument

Data were collected using a structured survey instrument. The survey was administered in-person to the EFL students volunteering to take part in the study. This method allowed for direct interaction with the participants, enabling clarification of questions and ensuring a high response rate for the survey items. The structured nature of the survey ensured consistency in data collection across all participants, facilitating quantitative analysis. It also ensured high participation rates, knowing that data collection is indeed a daunting task for researchers. The specific items within the survey designed to measure each variable (AI, RF, CT, and KR) were developed to align with the operational definitions of their respective low/high categories.

3.5. Data Analysis

Statistical analysis was performed using *Hierarchical Log-linear Analysis* in *SPSS* (Statistical Package for the Social Sciences). The primary objective of this analysis was to identify the most parsimonious model that adequately fits the observed data, representing the significant putative interactions among the four categorical variables. Of note, the analysis followed a *Backward Elimination* procedure, which is a common method for model selection in Log-linear Analysis.

4. Results

This section presents the results of the Hierarchical Log-linear Analysis generated by SPSS. For reminder purposes, the analysis aimed to identify the most parsimonious model that best

describes the interactions among EFL students' AI usage, reading frequency, critical thinking disposition, and knowledge retention.

To start with, Table 1 below, labeled *Data Information*, provides crucial details regarding the dataset used for the Log-linear analysis. It indicates that out of the collected data, 125 valid cases were included in the analysis. This confirms that all the participants had complete data for the variables under investigation, as there were no 'Out of Range' or 'Missing' cases among the valid entries. The 'Weighted Valid' count also being 125 suggests that no weighting was applied to the cases, meaning each participant contributed equally to the analysis. This is an important detail, as there were no incomplete responses or data cleaning processes, ensuring the integrity of the statistical analysis.

To push further, the table clearly lists the four categorical variables included in the model: AI, RF, CT, and KR. For each of these variables, the 'Categories' column shows a value of 2, confirming that each variable was indeed dichotomous, as specified in the methodology (i.e. Low/High for AI, RF, CT, and KR). No doubt, the clear definition of the number of categories/levels for each variable is essential for validating the model's setup and ensuring that the analysis aligns with the research design. The absence of 'Out of Range' values further confirms that all data points for these categories fell within the expected binary classification, indicating clean data for the analysis. This table serves as a foundational check, ensuring that the data fed into the Log-linear Model adheres to the intended structure and quantity of observations.

Table 1. Data Information

		N
Cases	Valid	125
	Out of Range[a]	0
	Missing	0
	Weighted Valid	125
Categories	AI Use	2
	Reading Frequency	2
	Critical Thinking	2
	Knowledge Retention	2

a. Cases rejected because of out of range factor values.

Table 2 provides a summary of observed (derived from the data) and expected counts (based on the model being tested) for each category combination, offering insight into model performance. Notably, large residuals indicate potential issues with the model fit. The table provides information on the fit of the Log-linear Model to categorical data with interaction effects between variables. It can be seen that for some rows, the expected frequency was equal to the observed count, indicating that no residual was present. The residuals were typically small or zero, indicating a good fit between the observed and expected counts.

Table 2. Cell Counts and Residuals

				Observed		Expected			
AI Use	Reading Frequency	Critical Thinking	Knowledge Retention	Count[a]	%	Count	%	Residuals	Std. Residuals
Low	Low	Low	Low	2,500	2,0%	2,500	2,0%	,000	,000
			High	2,500	2,0%	2,500	2,0%	,000	,000
		High	Low	1,500	1,2%	1,500	1,2%	,000	,000
			High	1,500	1,2%	1,500	1,2%	,000	,000
	High	Low	Low	1,500	1,2%	1,500	1,2%	,000	,000
			High	2,500	2,0%	2,500	2,0%	,000	,000
		High	Low	1,500	1,2%	1,500	1,2%	,000	,000
			High	2,500	2,0%	2,500	2,0%	,000	,000
High	Low	Low	Low	1,500	1,2%	1,500	1,2%	,000	,000
			High	10,500	8,4%	10,500	8,4%	,000	,000
		High	Low	1,500	1,2%	1,500	1,2%	,000	,000
			High	14,500	11,6%	14,500	11,6%	,000	,000
	High	Low	Low	12,500	10,0%	12,500	10,0%	,000	,000
			High	40,500	32,4%	40,500	32,4%	,000	,000
		High	Low	5,500	4,4%	5,500	4,4%	,000	,000
			High	30,500	24,4%	30,500	24,4%	,000	,000

a. For saturated models, ,500 has been added to all observed cells.

To evaluate the fit of the Log-linear Model to the data, two key statistics were employed (see Table 3): Pearson's Chi-square and the Likelihood Ratio statistic. These metrics assess whether the observed frequencies in the data differed significantly from the expected frequencies predicted by the model. In essence, a good model should have little to no difference between the observed and expected frequencies. Stated differently, if the model were a close fit, it would imply that both the observed and expected counts were similar, suggesting no significant differences; conversely, if there were a notable disparity, it would indicate that the model deviated significantly from the data, signifying a poor fit. In this case, the statistical analysis aimed to determine which terms in the Saturated Model could be removed without compromising the overall fit.

By definition, a saturated model perfectly fits the observed data, meaning it accounts for all the variance in the cell counts. Insofar as the present Saturated Model is concerned, the observed results show both Pearson's Chi-square and the Likelihood Ratio statistics were equal to 0, which means that the probability of computing the test statistic could not be determined as the model perfectly fitted the data. This is because the saturated model was reached, implying that all possible terms were included in the model. At this stage, the analysis would shift from evaluating the fit of the entire model to examining individual terms within it. The question becomes: which term or set of terms could be removed without significantly compromising the overall fit? This would allow for a more concise and interpretable representation of the relationships between variables.

While this table does not provide insights into the relationships between variables, it is a necessary diagnostic step, confirming that the most complex and Saturated Model perfectly reproduced the observed cell frequencies. The purpose of the subsequent Backward Elimination process was to simplify this Saturated Model by removing non-significant interaction terms, thereby seeking a more parsimonious model that still adequately fits the data.

Table 3. Goodness-of-Fit Tests (Saturated Model)

	Chi-Square	df	Sig.
Likelihood Ratio	,000	0	.
Pearson	,000	0	.

Table 4, *K-Way and Higher-Order Effects*, is a critical output in Hierarchical Log-linear Analysis, providing insights into the overall significance of effects at different orders (e.g., main effects, two-way interactions, three-way interactions, and the four-way interaction). It is instrumental in guiding the Backward Elimination process by indicating which orders of effects were contributing significantly to the model. The table is divided into two main sections: *K-way and Higher Order Effects* and *K-way Effects*.

- K-way and Higher Order Effects: This section tested the significance of all effects of a given order (K) and all higher-order effects. For example, the row for K=1 tested the significance of all main effects, two-way interactions, three-way interactions, and the four-way interaction. The row for K=2 tested the significance of all two-way, three-way, and four-way interactions, and so on. These tests determined whether all effects at a certain order and above (i.e. when K = 1, 2, 3, and 4) were equal to zero. Put otherwise, for every variable, there was a main effect as well as interactions between variables. The task of Log-linear Analysis was to evaluate all of these effects hierarchically to determine the best predictors.

• *K=1 (All effects from 1-way up to 4-way):* The first row in the table below indicates whether removing the one-way effects (i.e. the main effects of AI, RF, CT, and KR) and any higher-order effects (i.e. all two-way interactions, three-way interactions, and the four-way AI × RF × CT × KR interaction) would result in significantly affecting the fit of the model. Stated another way, this tested whether deleting all interactions would result in a significant effect on the fit of the model. The *Likelihood Ratio Chi-Square* was 192.019 with 15 degrees of freedom, and a significance of .000; the *Pearson Chi-Square* was 257.336 with 15 degrees of freedom, and a significance of .000 (see Table 4 below). This indicates that, collectively, there were highly significant relationships

among the variables, confirming that a model including at least some of these effects was necessary to explain the data.

• *K=2 (All effects from 2-way up to 4-way):* The second row tested whether the removal of the two-way interactions (i.e. AI × RF, AI × CT, AI × KR, RF × CT, RF × KR, and CT × KR) and higher-order effects (namely, all three-way interactions and the four-way interaction) would significantly affect the model fit. The *Likelihood Ratio Chi-Square* was 13.890 with 11 degrees of freedom, and a significance of .239. The *Pearson Chi-Square* was 18.424 with 11 degrees of freedom, and a significance of .072. Since both p-values (i.e. Sig.) were greater than .05, this suggests that, jointly, the two-way, three-way, and four-way interactions were not statistically significant. This is a crucial finding for the Backward Elimination process, as it implies that higher-order interactions (three-way and four-way) were unlikely to be significant and would likely be removed early in the process.

• *K=3 (All effects from 3-way up to 4-way):* Row 3 tested whether removing the three-way effect (i.e. AI × RF × CT, AI × RF × KR, AI × CT × KR, and RF × CT × KR) and higher-order effects (i.e. the four-way interaction) would significantly affect the fit of the model. A glance at the table below shows that the *Likelihood Ratio Chi-Square* was 2.803 with 5 degrees of freedom, and a significance of .730; the *Pearson Chi-Square* was 2.641 with 5 degrees of freedom, and a significance of .755. Unsurprisingly, both p-values were well above .05, strongly indicating that the three-way and four-way interactions were not significant.

• *K=4 (4-way interaction only):* This tested whether removing the AI × RF × CT × KR interaction would significant affect the fit of the model. Given the *Likelihood Ratio Chi-Square* (.007) and the *Pearson Chi-Square* (.007) small values, the four-way interaction was highly non-significant i.e. the test indicates that there was no such effect (p > .05).

- K-way Effects: This is the lower part of Table 4 below; this section tested the significance of effects at a specific order, after accounting for and to the exclusion of all higher-order effects. This is particularly useful for understanding the *unique* contribution of effects at each level.

• *K=1 (Main Effects):* This tested whether the removal of the main or one-way effects had a significant negative effect on the fit of the model. The *Likelihood Ratio Chi-Square* was 178.128 with 4 degrees of freedom, and a significance of .000; the *Pearson Chi-Square* was 238.912 with 4 degrees of freedom, and a p-value less than .05. This indicates that, individually, the main effects (AI, RF, CT, KR, respectively) were highly significant, suggesting that each variable had a substantial independent influence.

• *K=2 (Two-way Effects):* This tested whether removing the two-way interactions from the model (in this case, the AI × RF, AI × CT, AI × KR, RF × CT, RF × KR, and CT × KR interactions) would have a significant negative effect on the fit thereof. Clearly, the *Likelihood Ratio Chi-Square* test was 11.088 with 6 degrees of freedom, and a significance of .086. The *Pearson Chi-Square* test was 15.783 with 6 degrees of freedom, and a significance of .015. Here, the Likelihood Ratio p-value (.086) was slightly above the .05 threshold, while the Pearson p-value (.015) was below. This mixed result suggests that some two-way interactions might be significant, while others might not. This is where the 'Partial Associations' table (see Table 5 below) becomes crucial for identifying which specific two-way interactions were significant.

• K=3 (Three-way Effects): This tested whether removing the three-way (i.e. AI × RF × CT, AI × RF × KR, AI × CT × KR, and RF × CT × KR) interactions would have a significant negative effect on the fit of the model. The *Likelihood Ratio Chi-Square* which equaled 2.795 with 4 degrees of freedom, and a significance of .593; as for the *Pearson Chi-Square* test, it was equal to 2.634 with 4 degrees of freedom, and a significance of .621. Clearly, both p-values were non-significant (p > .05), reinforcing the earlier indication that three-way interactions were not contributing significantly to the model.

• K=4 (Four-way Effect): Last but not least, the last row indicates that the *Likelihood Ratio Chi-Square* was .007 with 1 degree of freedom, and a significance of .931. Likewise, the *Pearson Chi-Square* was .007 with 1 degree of freedom, and a significance of .931. This again confirms the non-significance (p > .05) of the four-way (AI × RF × CT × KR) interaction.

What are the implications for model selection? Based on the *K-Way and Higher-Order Effects* table above, the Backward Elimination process is expected to proceed as follows: **1.** The four-way

interaction would be the first to be considered for removal, as its p-value (.931) was highly non-significant. **2.** Subsequently, the three-way interactions would likely be removed, as the collective test for K=3 effects was non-significant. **3.** The Backward Elimination would then focus on the *two-way* interactions. Given that the collective test for K=2 effects yielded *mixed* results (Likelihood Ratio p=.086, Pearson p=.015), it suggests that some two-way interactions might be significant and would be retained, while others would be removed. The 'Partial Associations' Table below would provide the definitive answer for individual two-way interactions. **4.** The main effects (K=1) were highly significant and are expected to be retained in the final model. In summary, then, Table 4 provides a roadmap for the model simplification process, indicating that a parsimonious model would likely consist of main effects and potentially a subset of two-way interactions, with higher-order interactions being non-contributory to the overall model fit. This aligns with the research aim of building a parsimonious model.

Table 4. K-Way and Higher-Order Effects

			Likelihood Ratio		Pearson		Number of Iterations
	K	df	Chi-Square	Sig.	Chi-Square	Sig.	
K-way and Higher Order Effects[a]	1	15	192,019	,000	257,336	,000	0
	2	11	13,890	,239	18,424	,072	2
	3	5	2,803	,730	2,641	,755	3
	4	1	,007	,931	,007	,931	2
K-way Effects[b]	1	4	178,128	,000	238,912	,000	0
	2	6	11,088	,086	15,783	,015	0
	3	4	2,795	,593	2,634	,621	0
	4	1	,007	,931	,007	,931	0

a. Tests that k-way and higher order effects are zero.

b. Tests that k-way effects are zero.

Table 5 below, *Partial Associations*, breaks down the preceding table into its components. It is crucial for understanding the individual contribution of each effect to the overall model, particularly within the context of the Backward Elimination procedure. That is, even though there is evidence for some lower-order interactions to significantly affect the model, it is not that clear which interaction precisely had the effect. This being said, the 'Partial Associations' process generated partial chi-square values for each effect in the saturated and most complex model. Table 5 displays the *Likelihood Ratio Chi-Square* statistic and its significance for each effect when all higher-order effects were included in the model. In Backward Elimination, effects with a significance (Sig.) value greater than the predetermined alpha level (typically .05) are candidates for removal, as their removal does not significantly affect the model's fit. An analysis of the effects from highest to lowest order is now very much warranted:

Three-Way Interactions:
All of the four *three-way* interaction terms had p-values greater than .05 (AI × RF × CT, Sig. = .300; AI × RF × KR, Sig. = .234; AI × CT × KR, Sig. = .731; and RF × CT × KR, Sig. = .894), indicating that none of them contributed significantly to the model when higher-order effects were considered. This aligns with the 'K-Way and Higher-Order Effects' table, which showed that the collective three-way effects were non-significant. Therefore, these three-way interactions are strong candidates for removal during the Backward Elimination process.

Two-Way Interactions:
• AI × RF (Sig. = .036): This interaction was statistically significant ($p < .05$). This suggests a significant association between *AI Use* and *Reading Frequency*.
• AI × CT (Sig. = .857): Not significant ($p > .05$).
• RF × CT (Sig. = .246): Not significant ($p > .05$).
• AI × KR (Sig. = .041): This interaction was statistically significant ($p < .05$), indicating a significant association between *AI Use* and *Knowledge Retention*.
• RF × KR (Sig. = .364): Not significant ($p > .05$).
• CT × KR (Sig. = .285): Not significant ($p > .05$).

In light of the foregoing, and among the two-way interactions, only AI × RF and AI × KR were statistically significant ($p < .05$). This means that the relationship between *AI Use* and *Reading Frequency*, and the one between *AI Use* and *Knowledge Retention*, were important and should be retained in the model. The other two-way interactions (namely, AI × CT, RF × CT, RF × KR, CT × KR) were not significant ($p > .05$) and should be considered for removal.

Main Effects (One-Way Effects):
• AI (Sig. = .000): Highly significant ($p < .05$).
• RF (Sig. = .000): Highly significant ($p < .05$).
• CT (Sig. = .179): Not significant ($p > .05$).
• KR (Sig. = .000): Highly significant ($p < .05$).
All main effects, except for Critical Thinking (CT), were highly significant ($p < .05$). This implies that *AI Use*, *Reading Frequency*, and *Knowledge Retention* each had a significant independent effect on the overall cell counts. The non-significance of the main effect for Critical Thinking (CT) suggests that, on its own, the overall distribution of *low* vs. *high* critical thinking across the entire sample did not significantly contribute to the model's fit, once interactions were considered. Nevertheless, it is important to note that a non-significant main effect does not necessarily mean the variable is unimportant, especially if it participates in significant interaction terms. Be that as it may, in the built parsimonious model, CT did not participate in any significant two-way or higher-order interactions that were retained.
Based on the Partial Associations table, the Backward Elimination process would systematically remove the non-significant effects, starting from the highest order. The Backward Elimination Statistics table will detail the actual steps taken by SPSS to arrive at the final model, confirming this expected sequence of removals.

Table 5. Partial Associations

Effect	df	Partial Chi-Square	Sig.	Number of Iterations
AI*RF*CT	1	1,074	,300	2
AI*RF*KR	1	1,417	,234	3
AI*CT*KR	1	,118	,731	2
RF*CT*KR	1	,018	,894	3
AI*RF	1	4,389	,036	3
AI*CT	1	,033	,857	3
RF*CT	1	1,345	,246	3
AI*KR	1	4,175	,041	3
RF*KR	1	,823	,364	2
CT*KR	1	1,142	,285	3
AI	1	94,236	,000	2
RF	1	31,079	,000	2
CT	1	1,804	,179	2
KR	1	51,009	,000	2

Table 6, *Parameter Estimates*, provides the estimated coefficients for each effect in the Saturated Log-linear Model, with *z*-scores and confidence intervals instead of chi-square statistics. *Z*-scores make it possible to compare between effects i.e. the bigger the *z* value, the more significant the effect is (Field, 2013). As such, this helps the researcher answer research question 3: what is the most significant effect? Insofar as the significant effects are concerned, the main effect of AI was, clearly, the most significant in the model ($z = -4.824$, Sig. = .000) – obviously while ignoring the positive/negative score directions. This negative and highly significant *z* score (see also its corresponding parameter estimate) for the main effect of AI suggests that, overall, there is a tendency for students to be in the 'Low' AI Use category; however, in Log-linear models, main effects are interpreted in the context of the highest-order interactions in which they are involved. Given the significant AI × RF and AI × KR interactions, the main effect of AI should be interpreted with caution, as its influence was modulated by its interaction with Reading Frequency and Knowledge Retention.

In the same vein, the negative and significant *z* score (see the resultant parameter estimate) for the main effect of RF (*z* = -2.235, Sig. = .025) suggests an overall tendency towards 'Low' Reading Frequency. Similar to the AI main effect, this should be interpreted in light of the significant AI × RF interaction, which indicates that the relationship between AI and RF was not uniform across all levels but depended on their combined presence.

Likewise, the negative and highly significant *z* score (and parameter estimate) for the main effect of KR (*z* = -3.294, Sig. = .001) suggests an overall tendency towards 'Low'' Knowledge Retention. Again, the significant AI × KR interaction indicates that the relationship between AI and KR was not simply a main effect but was influenced by their interaction.

As regards the other effects, it is also important to note the non-significant parameter estimates for the effects that were removed during Backward Elimination. These are, namely, the three-way interactions (e.g., AI × RF × CT, AI × RF × KR, AI × CT × KR, RF × CT × KR), other two-way interactions (e.g., AI × CT, RF × CT, RF × KR, CT × KR), and the main effect of CT. Their non-significance (p > .05) confirms that these effects did not contribute meaningfully to explaining the relationships among the variables in the most parsimonious model. The non-significant main effect of CT (Sig. = .465) is particularly noteworthy, suggesting that Critical Thinking, as an isolated factor, did not have a significant overall association with the other variables in the final model. Its absence from the final model indicates that its direct influence, independent of other interactions, was not statistically supported by the data. This could imply that critical thinking might be a prerequisite or an outcome influenced by other factors, rather than an independent predictor in this specific model. The focus of the significant findings was on the interplay between AI usage, reading frequency, and knowledge retention.

Table 6. Parameter Estimates

Effect	Parameter	Estimate	Std. Error	Z	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
AI*RF*CT*KR	1	,013	,154	,087	,931	-,289	,316
AI*RF*CT	1	,153	,154	,993	,321	-,149	,455
AI*RF*KR	1	,147	,154	,952	,341	-,155	,449
AI*CT*KR	1	-,054	,154	-,349	,727	-,356	,248
RF*CT*KR	1	-,013	,154	-,087	,931	-,316	,289
AI*RF	1	,345	,154	2,235	,025	,042	,647
AI*CT	1	,015	,154	,097	,923	-,287	,317
RF*CT	1	-,025	,154	-,164	,869	-,327	,277
AI*KR	1	,380	,154	2,466	,014	,078	,682
RF*KR	1	-,019	,154	-,123	,902	-,321	,283
CT*KR	1	,054	,154	,349	,727	-,248	,356
AI	1	-,744	,154	-4,824	,000	-1,046	-,442
RF	1	-,345	,154	-2,235	,025	-,647	-,042
CT	1	,113	,154	,731	,465	-,189	,415
KR	1	-,508	,154	-3,294	,001	-,810	-,206

Table 7, *Backward Elimination Statistics*, meticulously details the step-by-step process of model selection in the Hierarchical Log-linear Analysis. This procedure, which started with the Saturated Model, systematically removed non-significant effects therefrom until only statistically significant effects remained, resulting in the most parsimonious model that adequately fitted the data. Of note, the decision to delete an effect is based on its *Likelihood Ratio Chi-Square* change and its significance (Sig. or *p*) – if *p* > .05, the effect was removed. To state it differently, at each step of the Backward Elimination process, the effect with the largest significance level was deleted – given its non-significance – in search of the best model. Notably, after deleting an effect from the model, a change in the *Chi-square* statistic would take place.

Step 0: The process began by generating the Saturated Model, which included the four-way interaction (AI × RF × CT × KR). The first deleted effect was the four-way interaction with a *Chi-Square* change of .007 and a significance of .931. Since .931 > .05, this highest-order interaction was removed, confirming its non-significance.

Step 1: The generating class now included all three-way interactions. The table then lists the individual three-way interactions and their significance levels from the Partial Associations table. All three-way interactions (i.e. AI × RF × CT, AI × RF × KR, AI × CT × KR, RF × CT × KR) had *p*-values

greater than .05 (.300, .234, .731, and .894, respectively); therefore, SPSS removed them one by one, starting with the one with the highest *p*-value. The table shows these removals, confirming that all three-way interactions were non-significant and were thus removed from the model.

Steps 2-7: These steps continued the process of removing non-significant two-way interactions and main effects, in addition to the remaining three-way interactions. The table shows that various two-way interactions (AI × CT, RF × CT, RF × KR, CT × KR) were successively removed because their significance levels were consistently above the threshold i.e. $p > .05$; as a case in point, in *Step 5*, AI × CT (.689) and RF × CT (.209) were removed. In Step 7, the main effect of CT (.179) was removed, indicating that Critical Thinking, as a standalone factor, did not significantly contribute to the model's fit once other interactions were accounted for.

Step 8: At this step, the generating class included one main effect and two-way interactions. The effects after deletion were CT (.179), AI × RF (.037), AI × KR (.038), and RF × KR (.305). This is a *critical* point: while CT and RF × KR were clearly non-significant ($p > .05$), both AI × RF and AI × KR were significant ($p < .05$). At this stage, SPSS generates a note at the bottom of the table (see Table 7), which is crucial here; clearly, it means that if an effect had a *p*-value less than or equal to .05, it would not be deleted for its significant effect.

Step 9: The generating class was now CT, AI × RF, and AI × KR. CT (.179) was listed as a deleted effect. AI × RF (.055) and AI × KR (.057) were very slightly above the .05 threshold. This suggests that, at this point, these effects were still considered for removal given the p-value. The process continues until no more effects could be removed without significantly worsening the model.

Step 10: The final generating class was AI × RF and AI × KR. This indicates that the model converged, and these were the only remaining effects that were statistically significant at the .05 level. The *Chi-Square* for this model was 8.408 with a significance of .589. This significance value is crucial; it indicates that the retained model (AI × RF, AI × KR) provided a good fit to the observed data ($p > .05$) i.e. the model adequately represented the relationships among the variables.

Table 7. Backward Elimination Statistics

Step[a]			Effects	Chi-Square[c]	df	Sig.	Number of Iterations
0	Generating Class[b]		AI*RF*CT*KR	,000	0	.	
	Deleted Effect	1	AI*RF*CT*KR	,007	1	,931	2
1	Generating Class[b]		AI*RF*CT, AI*RF*KR, AI*CT*KR, RF*CT*KR	,007	1	,931	
	Deleted Effect	1	AI*RF*CT	1,074	1	,300	2
		2	AI*RF*KR	1,417	1	,234	3
		3	AI*CT*KR	,118	1	,731	2
		4	RF*CT*KR	,018	1	,894	3
2	Generating Class[b]		AI*RF*CT, AI*RF*KR, AI*CT*KR	,025	2	,988	
	Deleted Effect	1	AI*RF*CT	1,098	1	,295	3
		2	AI*RF*KR	1,407	1	,235	3
		3	AI*CT*KR	,171	1	,679	3
3	Generating Class[b]		AI*RF*CT, AI*RF*KR, CT*KR	,196	3	,978	
	Deleted Effect	1	AI*RF*CT	1,007	1	,316	3
		2	AI*RF*KR	1,319	1	,251	3
		3	CT*KR	,916	1	,339	2
4	Generating Class[b]		AI*RF*CT, AI*RF*KR	1,112	4	,892	
	Deleted Effect	1	AI*RF*CT	1,231	1	,267	3
		2	AI*RF*KR	1,602	1	,206	3
5	Generating Class[b]		AI*RF*KR, AI*CT, RF*CT	2,343	5	,800	
	Deleted Effect	1	AI*RF*KR	1,602	1	,206	3
		2	AI*CT	,160	1	,689	2
		3	RF*CT	1,576	1	,209	2
6	Generating Class[b]		AI*RF*KR, RF*CT	2,503	6	,868	
	Deleted Effect	1	AI*RF*KR	1,602	1	,206	3
		2	RF*CT	1,446	1	,229	2
7	Generating Class[b]		AI*RF*KR, CT	3,948	7	,786	
	Deleted Effect	1	AI*RF*KR	1,602	1	,206	3
		2	CT	1,804	1	,179	2
8	Generating Class[b]		CT, AI*RF, AI*KR, RF*KR	5,550	8	,698	
	Deleted Effect	1	CT	1,804	1	,179	3
		2	AI*RF	4,358	1	,037	2
		3	AI*KR	4,302	1	,038	2
		4	RF*KR	1,053	1	,305	2
9	Generating Class[b]		CT, AI*RF, AI*KR	6,603	9	,678	
	Deleted Effect	1	CT	1,804	1	,179	2
		2	AI*RF	3,672	1	,055	2
		3	AI*KR	3,615	1	,057	2
10	Generating Class[b]		AI*RF, AI*KR	8,408	10	,589	

a. At each step, the effect with the largest significance level for the Likelihood Ratio Change is deleted, provided the significance level is larger than ,050.
b. Statistics are displayed for the best model at each step after step 0.
c. For 'Deleted Effect', this is the change in the Chi-Square after the effect is deleted from the model.

In summary, the Backward Elimination process successfully identified a parsimonious model that included only the *two-way interactions* between *AI Use* and *Reading Frequency* (AI × RF), and between *AI Use* and *Knowledge Retention* (AI × KR). All higher-order interactions and other two-way interactions, as well as the main effect of Critical Thinking, were found to be non-significant and were removed from the model. This iterative process systematically refined the model, moving from a complex Saturated Model to a simpler, more interpretable one that still accurately reflected the underlying data structure.

5. Discussion

This study aimed to investigate the intricate relationships among EFL learners' self-reported AI, RF, CT, and consequent KR, with a particular focus on building a parsimonious model that predicts such interactions. The Hierarchical Log-linear Analysis with Backward Elimination yielded a final model, shedding light on the significant associations within this complex interplay. The research questions can now be addressed through the lens of the retained significant effects.

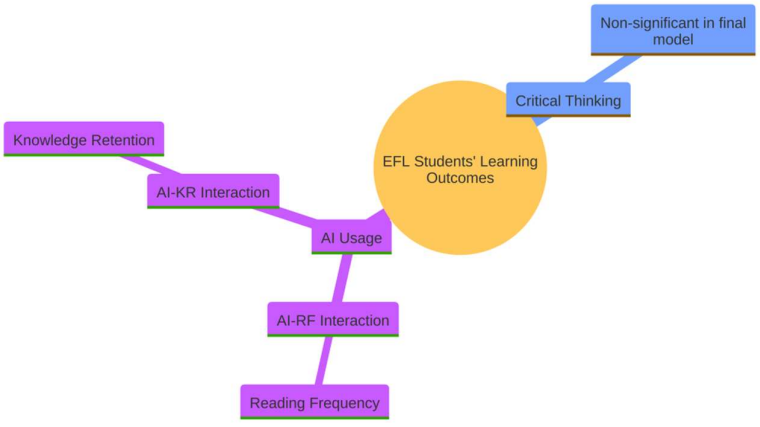
In answer to research question one, the final Log-linear Model retained two significant two-way interaction terms: AI × RF and AI × KR. This means that, after testing possible combinations, the model showed that these two interactions were statistically important for explaining the data, while other potential terms were unnecessary. In relation to the research question, the result demonstrates that the *simplest adequate model* is one that includes just these two interactions, thus balancing *parsimony* (fewest terms) with *good fit* (significant explanatory power).

The foregoing shows that the most important relationships revolve around *AI* and its direct links to RF and KR. Stated otherwise, AI use interacts significantly with both RF and KR. However, interactions involving CT – whether two-way (AI × CT, RF × CT, CT × KR) or higher-order (three-way and four-way) – as well as the main effect of CT itself, were not statistically significant and were therefore excluded from the model. These findings indicate that AI usage is meaningfully connected to how often learners read and how well they retain knowledge, but not to their critical thinking disposition.

As regards research question three, in this model, the main effect of *AI Use* was the most significant ($z = -4.824$, Sig. = .000). This indicates an overall tendency for students to fall into the 'Low AI Use' category. However, as aforementioned, because Log-linear models interpret main effects in light of higher-order interactions, this result must be considered alongside the significant AI × RF and AI × KR interactions, which show that AI's influence is shaped by its relationship with *Reading Frequency* and *Knowledge Retention*. This means that the strongest effect is AI use, but its interpretation depends on how it connects with these two variables.

Figure 1, generated using Mermaid platform coding, presents a conceptual mind map illustrating the key relationships identified in the final parsimonious Log-linear Model. The mind map visually emphasizes that AI is a central factor, showing significant two-way interactions with RF and KR. This visual representation directly reflects the findings from the 'Parameter Estimates' and 'Backward Elimination Statistics' tables (Table 6 and Table 7).

Figure 1. Conceptual Mind Map of Significant Relationships in the Final Log-Linear Model



To push further on these lines of thought, the significant AI × RF interaction (Parameter Estimate = .345, p = .025) indicates a positive association between *AI Use* and *Reading Frequency*. This suggests that EFL students who reported higher AI usage also tend to engage in more frequent reading, and vice versa. This finding aligns with the theoretical perspective that AI tools, particularly those designed for language learning, can provide accessible and engaging content, thereby encouraging more reading (Alarifi et al., 2025). For instance, AI-powered reading platforms, personalized content recommendations, or AI-assisted translation tools might lower the barrier to entry for complex texts, making reading more approachable and frequent for EFL learners. This interaction challenges the simplistic notion that AI might universally deter traditional reading; instead, it suggests a potential relationship where AI can serve as a catalyst for increased reading engagement. It stands to reason that this could be particularly true if AI tools were used to provide scaffolding for comprehension, such as simplifying complex sentences, defining unfamiliar vocabulary, or offering contextual explanations, thereby making reading less daunting and more rewarding.

The significant AI × KR interaction (*Parameter Estimate* = .380, *p* = .014) reveals a positive association between *AI Use* and *Knowledge Retention*. This implies that EFL students who frequently use AI tools tend to exhibit better knowledge retention. This finding supports the growing body of literature suggesting that AI can enhance learning outcomes by facilitating more effective memory processes (Du, 2025). AI tools often incorporate principles of cognitive science, such as spaced repetition and adaptive learning algorithms, which are known to improve long-term memory and retention (Dunlosky et al., 2013). For example, it can be conjectured that AI-driven flashcard systems, intelligent tutoring systems that adapt to a learner's forgetting curve, or AI-powered practice exercises that provide immediate, targeted feedback can all contribute to more robust knowledge encoding and retrieval. This interaction suggests that AI is not merely a tool for information access but can also actively contribute to the consolidation of learned material, leading to more durable knowledge.

Conversely, the non-significance of CT as a main effect and its interactions with other variables are a noteworthy finding. This suggests that, within the context of this specific model and dataset, *Critical Thinking* did not emerge as a statistically significant factor influencing or being influenced by AI use, RF, or consequent KR. This outcome might seem counterintuitive given the widespread emphasis on critical thinking in education and the theoretical arguments for its interplay with AI and reading. Be that as it may, several interpretations are possible. It could be that the operationalization of CT into a simple low/high dichotomy did not capture the nuances of this complex construct. Alternatively, the influence of AI on CT might be indirect or mediated by other factors not included in this model. It is also plausible that while AI can support CT, its actual impact depends heavily on pedagogical design and how students are instructed to use these tools, which might not have been uniformly present in the study's context.

5.1. Implications

The findings of this study have several important implications for EFL pedagogy and curriculum design.

5.1.1. Pedagogical Implications

1. *Using AI to Foster Reading Habits:* The positive association between AI usage and reading frequency suggests that educators can strategically integrate AI tools to encourage more reading among EFL students. That is, instead of viewing AI as a distraction, teachers can introduce AI-powered reading platforms, personalized content recommenders, or AI-assisted comprehension tools to make reading more accessible and engaging. For instance, this could involve using AI to generate graded readers, provide instant vocabulary support, create interactive reading exercises, and the like. The key is to guide students in using these tools as supplements and scaffolds for deeper engagement with texts, rather than as replacements for reading itself.
2. *Using AI for Enhanced Knowledge Retention:* The positive link between AI usage and knowledge retention highlights the potential of AI to support more effective learning. Educators may explore and incorporate AI tools that are grounded in cognitive science principles, such as

spaced repetition and *adaptive learning*. This could involve, for example, using AI-powered flashcard apps, intelligent tutoring systems, or personalized review schedules to help students consolidate their learning and improve long-term memory. By discharging some of the rote memorization and review tasks to AI, teachers can free up class time for more communicative and higher-order thinking activities.

3. *Re-evaluating the Role of Critical Thinking in AI-Enhanced Learning:* The non-significance of CT in the final model does not diminish its importance but rather calls for a more nuanced pedagogical approach. It suggests that the development of critical thinking skills in AI-enhanced learning environments may not be an automatic outcome of AI use. As such, educators need to explicitly design tasks and activities that require students to engage in critical analysis of AI-generated content. This could involve encouraging students to evaluate the accuracy, bias, and completeness of AI-generated summaries, to compare and contrast AI-generated texts with human-written ones, or to use AI as a tool for brainstorming and then critically refining their own ideas. This being said, the focus should be on teaching students to be critical consumers and users of AI, rather than passive recipients of information.

4. *Personalized Learning Pathways:* The findings underscore the potential of AI to support personalized learning pathways. Put in a different way, by understanding the relationships between AI usage, reading habits, and knowledge retention, educators can use AI to tailor learning experiences to individual student needs. To illustrate, AI could be used to recommend specific reading materials based on a student's interests and proficiency level, or to provide targeted practice exercises to address areas of weakness in knowledge retention. Ideally, such personalized approach can lead to more efficient and effective learning for all students.

5.1.2. Implications for Curriculum Design

1. *Integrating AI Literacy into the Curriculum:* The findings highlight the need to integrate AI literacy into the EFL curriculum. This goes beyond simply teaching students how to use AI tools; it involves developing their understanding of how AI works, its potential benefits and limitations, and the ethical considerations surrounding its use. Let it be stressed that a curriculum that includes AI literacy will better prepare students to navigate the complexities of an AI-driven world.

2. *Designing AI-Enhanced Learning Materials:* The findings hint to the likelihood for curriculum developers to focus on creating AI-enhanced learning materials that are pedagogically sound and aligned with learning objectives. This could involve developing interactive e-books with embedded AI support, creating AI-powered simulations for language practice, or designing AI-driven assessment tools that provide meaningful feedback. The goal is to create a rich and supportive learning ecosystem where AI is seamlessly integrated to enhance, not replace, traditional learning methods.

3. *Balancing AI with Traditional Skills:* The curriculum needs to strike a balance between fostering the benefits of AI and ensuring the development of foundational skills, such as deep reading, critical thinking, and independent learning. This means that while AI can be used to support learning, there should still be ample opportunities for students to engage in unplugged activities, collaborative projects, and face-to-face discussions that foster these essential skills.

In brief, the implications of this study are far-reaching, suggesting a paradigm shift in how EFL education could be approached in the age of AI. In effect, by embracing a more strategic and critical approach to AI integration, educators and curriculum designers can create more effective, engaging, and personalized learning experiences that empower students to become proficient and lifelong learners.

5.2. Limitations

Despite the valuable insights gained from this study, several limitations warrant acknowledgment. These limitations provide important context for interpreting the findings and highlight areas for future research.

1. *Sampling Method and Generalizability:* The use of convenience sampling at a single university limits the generalizability of the findings. While practical for data collection, this

method does not ensure that the sample is representative of the broader EFL student population. Therefore, the results may not be directly transferable to EFL learners in different geographical locations, educational systems, or socio-economic contexts.

2. *Self-Reported Data:* The study relied on self-reported measures for AI usage, reading frequency, consequent knowledge retention, and critical thinking disposition. Self-reported data can be subject to various biases, including social desirability bias (where participants report what they believe is socially acceptable rather than their true behavior), recall bias (inaccurate memory of past behaviors), and subjective interpretation of survey questions. While efforts were made to structure the survey clearly, objective measures (e.g., tracking AI tool usage logs, direct observation of reading habits, standardized critical thinking assessments) would provide more reliable data.

3. *Nature of AI Use:* The type of AI tool used (e.g., generative AI, intelligent tutoring systems, grammar checkers) and the manner in which it is used (e.g., for content generation, for feedback, for practice) was not covered. Such may significantly influence learning outcomes. As such, a more granular classification of AI usage would provide richer insights into its differential impacts.

These limitations underscore the complexity of researching the interplay between technology and cognitive processes in educational settings. Addressing these areas in future investigations will contribute to a more comprehensive and nuanced understanding of the role of AI in EFL learning.

5.3. Recommendations

Based on the findings and limitations of this study, the following recommendations are put forth for educators, curriculum developers, and future researchers.

5.3.1. For Educators and Practitioners

1. *Strategic and Purposeful AI Integration:* Given the positive associations between AI usage, reading frequency, and knowledge retention, educators should actively explore and integrate AI tools into their EFL teaching practices. However, such integration must be strategic and purposeful, aligning with specific learning objectives. For this to obtain, teachers should be trained on how to effectively use AI to enhance reading engagement (e.g., through personalized content, interactive exercises) and to support knowledge retention (e.g., via spaced repetition tools, adaptive review systems, and the like).

2. *Promotion of AI Literacy:* In the AI turn, it is crucial to educate EFL students on responsible and critical AI usage. This includes teaching them how to evaluate AI-generated content, understand the limitations of AI, and use it as a tool for learning and critical inquiry rather than for shortcuts or plagiarism. Pushing further, workshops and explicit instruction on AI ethics and effective AI prompting are likely to empower students to become discerning users.

3. *Focus on Deep Learning and Critical Engagement:* While AI can facilitate access to information and support retention, it is worthwhile reminding that educators must continue to emphasize deep learning and critical engagement with content. They should design activities that require students to analyze, synthesize, and evaluate information, whether it comes from traditional sources or AI. They should as well encourage students to question, challenge, and refine AI outputs, fostering higher-order thinking skills.

4. *Balancing Technology with Human Interaction:* it is worthwhile underscoring the point that AI should complement, not replace, human interaction in the learning process. This way, teachers remain indispensable for providing feedback, facilitating discussions, fostering collaborative learning, and addressing the affective dimensions of language acquisition. No doubt, a balanced approach that leverages AI's strengths while preserving the irreplaceable role of human educators is essential.

5.3.2. For Curriculum Developers

1. *Development of AI-Integrated Curricula:* Curricula should be updated to reflect the reality of AI in education. This involves designing learning materials and activities that seamlessly integrate AI tools to enhance language skills, reading comprehension, and knowledge retention.

Examples may include AI-powered adaptive assessments, interactive digital textbooks, and AI-assisted writing and speaking practice modules.

2. *Embedding Critical Thinking across the Curriculum:* However paradoxical this may seem and despite its non-significance in this study's model, critical thinking remains a vital skill. Curriculum developers should ensure that critical thinking skills are explicitly embedded and progressively developed across all levels of the EFL curriculum, with specific learning outcomes and assessment criteria related to critical analysis, evaluation, and synthesis.

3. *Provide Professional Development for Teachers:* Effective AI integration requires well-prepared teachers. Curriculum developers should collaborate with teacher training institutions to design and implement comprehensive professional development programs that equip EFL teachers with the pedagogical knowledge and technical skills to leverage AI effectively and ethically in their classrooms.

5.3.3. For Future Research

1. *Conducting Longitudinal Studies:* Future research should employ longitudinal designs to investigate the long-term impacts of AI usage on reading habits, critical thinking development, and knowledge retention. This will provide a more robust understanding of causal relationships and developmental trajectories.

2. *Employing Mixed-Methods Approaches with Objective Measures:* Notwithstanding the predictive power of Log-linear Models, future studies should use mixed-methods designs, but with a greater emphasis on incorporating objective measures alongside self-reported data. This could include AI usage logs, eye-tracking data for reading habits, standardized critical thinking tests, and diverse measures of knowledge retention (e.g., delayed recall, application-based tasks).

3. *Coarse Analysis of AI Usage:* Instead of broad categories, future research should explore the specific types of AI tools used (e.g., generative AI, intelligent tutoring systems, grammar checkers) and the specific ways in which students interact with them. Let it be stressed that understanding these will provide more actionable insights into how different AI applications influence learning outcomes.

4. *Conducting Cross-Cultural and Comparative Studies:* It is also recommended to conduct studies across diverse EFL contexts and cultures to assess the generalizability of findings and to identify context-specific factors that influence the interplay of these variables. This will enrich the global understanding of AI's role in EFL education.

It goes without saying that by addressing these recommendations, future research can contribute to a more comprehensive and actionable understanding of how AI can be optimally integrated into EFL education to foster effective reading habits, critical thinking, and robust knowledge retention in the 21st century.

Conclusion

This comprehensive work embarked on a critical examination of the intricate relationships among EFL students' use of AI, their reading frequency, critical thinking disposition, and knowledge retention. Through a dual approach encompassing a theoretical exploration and an empirical investigation, this study has shed light on the evolving dynamics of learning in an AI-enhanced educational landscape. The theoretical framework meticulously defined each variable, establishing their individual significance and setting the stage for understanding their potential interactions. Then, the empirical study, employing Hierarchical Log-linear Analysis, provided data-driven insights into these complex interactions, culminating in a parsimonious model that offers valuable implications for EFL pedagogy and future research.

The empirical findings underscore the central role of AI usage in shaping EFL students learning behaviors and outcomes. The most salient discovery was the statistically significant positive association between AI Use and Reading Frequency (AI × RF); this finding suggests a relationship where increased engagement with AI tools is associated with more frequent reading. This challenges the often-held apprehension that AI might deter traditional reading habits; instead, it indicates that AI, when integrated into the learning process, can potentially serve as a catalyst for greater reading engagement. This could be attributed to AI's capacity to personalize content,

provide scaffolding for comprehension, or offer immediate linguistic support, thereby making reading more accessible and less daunting for EFL learners. This empirical evidence supports theoretical notions that AI can act as a mediating tool, facilitating exposure to comprehensible input and fostering positive reading habits.

Equally significant was the positive association found between AI Use and Knowledge Retention (AI × KR). This indicates that EFL students who frequently utilize AI tools tend to exhibit better retention of learned information. This finding aligns with cognitive theories emphasizing the importance of effective encoding and retrieval for long-term memory. This is especially true where AI tools, by incorporating principles such as spaced repetition, adaptive learning algorithms, and personalized feedback mechanisms, appear to contribute to more robust knowledge consolidation. This suggests that AI is not merely a passive information source but an active agent in enhancing the durability of learning, transforming how EFL students acquire and retain linguistic and conceptual knowledge.

Conversely, a critical insight from the empirical analysis was the non-significance of Critical Thinking (CT) as a main effect or in any of its interactions within the final parsimonious model. While, theoretically, critical thinking is paramount for deep learning and navigating complex information, its absence from the statistically significant relationships in this study's model is noteworthy. This does not necessarily diminish the importance of critical thinking but rather suggests that its influence might be indirect or contingent upon specific pedagogical interventions not captured by the current operationalization or data. It highlights a potential disconnect between the theoretical emphasis on critical thinking and its observable statistical relationship with AI usage, reading frequency, and knowledge retention in this particular context. This finding encourages further inquiry into how critical thinking is fostered and measured in AI-enhanced learning environments.

In essence, this work is an attempt to understand the evolving educational reality. It demonstrates that AI is not merely a technological add-on but an integral component that can positively influence fundamental learning processes like reading engagement and knowledge retention in EFL contexts. However, it also highlights areas, such as critical thinking, where the relationship with AI may be more complex than initially assumed, necessitating further investigation and careful pedagogical design. The findings collectively advocate for a strategic and informed integration of AI into EFL education, one that leverages its strengths to enhance learning outcomes while remaining cognizant of the need to cultivate essential cognitive skills that may not automatically emerge from AI use alone. This research contributes to a more evidence-based approach to AI integration, paving the way for future studies to build upon these insights and refine our understanding of AI's transformative potential in language education.

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Glossary of Important Concepts

About the book

THE SIGNIFICANCE OF THE BOOK THE IMPACT OF AI ON STUDENTS' READING HABITS, CRITICAL THINKING, AND KNOWLEDGE RETENTION LIES IN ITS TIMELY EXAMINATION OF HOW ARTIFICIAL INTELLIGENCE IS FUNDAMENTALLY ALTERING THE COGNITIVE LANDSCAPE OF HIGHER EDUCATION. BY INVESTIGATING THE TRANSITION FROM TRADITIONAL HUMAN–TEXT INTERACTION TO A COLLABORATIVE HUMAN–AI "CO-READING" DYNAMIC, THE ARTICLES HIGHLIGHT BOTH THE POTENTIAL FOR ENHANCED PERSONALIZED LEARNING AND THE CRITICAL RISK OF "SHALLOW PROCESSING" AND DIMINISHED INTELLECTUAL INDEPENDENCE.

ITS PRIMARY IMPORTANCE STEMS FROM ESTABLISHING AN EVIDENCE-BASED FRAMEWORK FOR "AI LITERACY," ARGUING THAT STUDENTS MUST MOVE BEYOND PASSIVE CONSUMPTION TO ADOPT "EPISTEMIC VIGILANCE," A CRITICAL STANCE INVOLVING THE ACTIVE VERIFICATION AND SYNTHESIS OF AI-GENERATED CONTENT. ULTIMATELY, THE BOOK SERVES AS A VITAL PEDAGOGICAL GUIDE FOR EDUCATORS AND POLICYMAKERS, ADVOCATING FOR AI TO BE USED AS A COGNITIVE "SCAFFOLD" THAT SUPPORTS, RATHER THAN REPLACES, THE DEVELOPMENT OF HIGHER-ORDER THINKING AND DEEP KNOWLEDGE RETENTION.

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